TO ADVANCE AND DIFFUSE THE KNOWLEDGE OF PHYSICS

An account of the one-hundred year history of the American Physical Society

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Harry Lustig, The University of New Mexico [a)]

Abstract: On May 20, 1899, thirty-six physicists founded the American Physical Society. A hundred years later, 11,239 scientists - the Society had by then 41,786 members - gathered to mark both a century of physics and the centennial of the Society. How the APS came about and developed, how it pursued its mission - the advancement and diffusion of the knowledge of physics - through its meetings, journals, and public activities, who its leaders were, and what it looks like today, is the subject of this article.

I. BEGINNINGS

Early America was not a fertile land for physics or a mecca for physicists. In the eighteenth century there was Benjamin Franklin and in the earlier part of the nineteenth there was Joseph Henry [1]. When Henry died in 1878, not more than seventy-five Americans called themselves physicists. They published research at an average rate of about one article per physicist every three years and few members of the group, Henry had lamented, were doing significant work [2]. By the early 1890's the number of Americans who identified themselves as physicists had risen to about 200; perhaps one-fifth of that number were publishing their research results regularly [3]. And although much of the research was pedestrian and inconsequential, three American physicists were gathering worldwide (meaning European) respect and acclaim for their achievements. The three were Henry A. Rowland, Josiah Willard Gibbs, and Albert A. Michelson.

America's "painfully small" contributions to physics annoyed Professor Arthur Gordon Webster (Fig. 1) of Clark University [4]. A Harvard graduate who had attained his Ph.D. 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. He was mentor to twenty-seven doctoral candidates at Clark and was regarded as an outstanding lecturer and textbook author [5]. Disillusioned with the National Academy of Sciences, to which, in his opinion, "few of us can hope to belong and which we might not enjoy if we did" [6], believing that the American Association for the Advancement of Science [1] was no longer sufficient for the needs of the growing number of physicists, and evidently inspired by the recent formation of the American Chemical Society and the American Mathematical Society, he undertook, in 1899, to organize an American Physical Society. He lined up Rowland (Fig. 2) and Michelson [7] to serve as the first president and vice-president [8]. Webster served as the third president of APS, after Michelson, and was in fact elected to the National Academy during his term of office in 1903 [9].

While Webster played an indispensable role in organizing the American Physical Society, other early participants in its affairs, in accounts written years after the formation, maintain that the event was in the air. Michael I. Pupin of Columbia University, one of six prominent cosigners with Webster of the call to create the Society, thought that the great European discoveries of the new physics had inspired the Society's formation: "Needless to say, the physicists in the United States were thrilled by these revelations [the discovery of the electron], and the new views disclosed by them, perhaps even more than by the discoveries of X-rays and of radioactivity. The first visible effect of this thrill was the organization in 1899 of the American Physical Society" [10]. Röntgen discovered X-rays in 1895, Becquerel saw the first radioactive elements in 1896, and J.J. Thomson isolated the electron in 1897. It seems unlikely that these events so impressed themselves on American physicists in so short a time as to have led them to organize the Society in 1899. Indeed, Frederick Bedell, who had joined his Cornell colleagues Edward L. Nichols and Ernest Merritt (Fig. 3) as an editor of *The Physical Review* shortly after its creation in 1893 and who had become a member of the APS right after its formation, had a different view. In a reminiscence "What led to the founding of the American Physical Society", presented as an invited paper at an APS meeting fifty years after the event and published in *The Physical Review* [11], he credits the remarkable technology on display at the Centennial Exhibition of 1876 in Philadelphia and the 1893 International Electrical Congress in Chicago with pointing to a future role of physics in industry and the opportunity for an American physical society to play its part. Although the Electrical Congress was heavily attended by inventors and engineers -Thomas Edison, Alexander Siemens, and Nikola Tesla were among the prominent participants - the aged Helmholtz, Lord Kelvin, and, perhaps more to the point, Rowland, Nichols, and Webster were also there (see Fig.4). They and others present could hardly help but notice the public's awed reaction to what - *they* knew - physics had wrought. The creation of *The Physical Review* in 1893, Bedell allows, also played a part in furthering the recognition that America was ready for a professional association of physicists. And he does not minimize Webster's seminal role.

In any case, whatever may have been the role of the historical events cited by Pupin and Bedell in the formation of the Society, the call to the organizational meeting does not mention them or any other scientific stimuli. Rather it refers to the American Mathematical Society, the (British) Physical Society and the Deutsche Physikalische Gesellschaft as models for what an American Physical Society could accomplish in furthering the "interchange of ideas among American physicists and for learning of one another's work ...Persons who have attended meetings of the American Association for the Advancement of Science must have wished that such opportunities... were more frequent". Webster and his six cosigners therefore proposed that the new society meet "four or more times yearly... for the reading and discussion of papers". And, significantly for the future, the call added that although for "such a society there is small need to speak", nevertheless "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" [12].

The organizational meeting of the American Physical Society was held on May 20, 1899 - a Saturday - thereby establishing the venerable (but no longer universally revered) tradition of weekend meetings. Thirty-six physicists [13] gathered in Fayerweather Hall at Columbia University, in response to Webster's call [14]. All of the participants came from the East and many represented leading universities: there were, among others, Carl Barus of Brown, Pupin and William A. Hallock of Columbia, Merritt and Nichols of Cornell, Benjamin O. Peirce of Harvard (he of the long-lived *Short Table of Integrals*), Joseph S. Ames of Johns Hopkins, William F. Magie of Princeton, and Henry A. Bumstead of Yale. (All but Pupin and Hallock were to become presidents of the Society in the years after Webster, and Hallock served as its first treasurer. The first secretary was Ernest Merritt.) The founding group included two women, Isabella Stone of Vassar, who was the first woman Ph.D. in physics from the University of Chicago, having worked with Michelson, and Marcia Anna Keith, who was head of physics at Mount Holyoke. Not all the founders of APS were academic scientists. Cleveland Abbe, from the U.S. Weather Bureau, was a pioneer weather forecaster and a well known promoter of research in atmospheric physics. He represented the one-sixth of American physicists who were employed by the Government. One of the two industrial scientists present, Elihu Thomson of General Electric, was a famous engineer. Contrary to some present impressions, industrial and government physicists attended meetings and were active in the Society from the start. However, they rarely took prominent parts in the organization's leadership. Thomson was one of the exceptions; he was vice-president for two years, but he did not become president [12].

A representative Council of the four officers (president, vice-president, secretary, and treasurer) and seven elected members (to be increased to eight members at the very next meeting) was established and a draft constitution was put forward. Article 1 stated that: " the society shall be called the American Physical Society". The name has remained unchanged to this date, even 'though the word "physical" has occasionally caused some misunderstanding, having led to impressions that the Society was concerned with combating intestinal disorders or with promoting strenuous exercise [15]. The name may also have been the reason for recent approaches by venture capitalists to buy the Society.

Article 2, which proclaimed, "The objective of the Society shall be the advancement and diffusion of the knowledge of physics", remained unchanged for almost a century, through several revisions of the rest of the constitution. Two aspects of this one sentence definition have led to some soul-searching and controversy. One is the question to what extent the Society should promote the advancement and welfare of physicists, rather than that of physics. In spite of the remark in Webster's call for the formation of the Society, that such an organization "could not fail to have an important influence in all matters affecting the interests of physicists", APS has traditionally - at least until recently - eschewed the orientation of some other professional societies, not to mention that of trade associations or labor unions, to promote the economic welfare of its members. In the words of Amy Halsted, APS has always acted on the belief that "physicists are necessary so that the physics gets done, not that physics is necessary so that physicists will have something to do" [16]. A reason for this outward-looking approach is provided by the historian Daniel J. Kevles in his important book *The Physicists - The History of a Scientific Community in Modern America*: "Although physicists, like other Americans, have embraced political engagement in arenas of technological policy such as arms control, 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" [17]. Kevles's explanation would have been even more on the mark if he had written "themselves" instead of "their science". To be sure, this - to some undoubtedly fine - distinction, has not prevented the Society, in recent years, from promoting the creation of research facilities and the safeguarding of budgets that would provide jobs for its members, or from sponsoring a placement service [18] and, *faute de mieux*, when new jobs for physicists were scarce in the 1990's, organizing retraining programs for young physicists. However even such social outreach programs as those to improve opportunities for and recognition of women and minority physicists have been accommodated under the rationale that this would be good for physics, rather than for the individuals who would benefit.

The second issue, whether or not all uses of physics should be promoted or even tolerated, has been more divisive. In 1971, as one of the efforts 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 add the following to Article 2: "...in order 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" [19]. 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 Council and the membership adopt a change 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 validate the taking of stands on public issues - a dispensation that no longer needed to be made explicit - Article 2 now reads: "In the firm belief that an understanding of the nature of the physical universe will be of benefit to all humanity, the objective of the Society shall be the advancement and diffusion of the knowledge of physics".

The founding assembly created a *Bulletin of the American Physical Society*, to announce and record the proceedings of the meetings. In its original form it lasted only three years. *The Physical Review*, which had been founded at Cornell University in 1893, was "conducted" there (since 1903 "with the cooperation of APS"), published by Macmillan for its first two decades, and taken over by APS in 1913, carried out the functions of the *Bulletin* from 1903 until 1925. The latter's publication was resumed in 1925. Its main purpose was to publish the abstracts of papers to be delivered at meetings, but at various times it also served to circulate news of the APS and its activities. Only in 1992 did the Society create a separate news organ for its membership, *APS News*. For some years before that, *Physics*

Today, founded in 1948 and published by the American Institute of Physics, had disseminated news about APS, both in its regular columns and on special pages paid for by the Society. Members who kept asking why this highly respected and widely read magazine could not serve as APS's membership publication were not aware of the different identities and roles of AIP and APS. To this day much of the physics community, including members of the Society, is only vaguely able to distinguish the two organizations. Many believe, erroneously, that *Physics Today* is published by APS and the *Physical Review* by AIP.

The second meeting of the Society, held on October 28, 1899, was memorable for Henry Rowland's presidential address "The Highest Aim of the Physicist" [20]. It provided a magnificent *tour d'horizon* of the physical world as it had been elucidated by the end of the nineteenth century, as well as of the open questions that were to be confronted during the twentieth. But it also sounded many of the themes that would resonate, albeit sometimes controversially, with physicists and their compatriots to this day: the assertion that there is no such thing as absolute truth, but that we must nevertheless act in this real world on the basis of the knowledge we have attained [21]; 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 (what is now called) curiosity driven research is ultimately more valuable than practical research [22]; and that all scientific research was shamefully underfunded [23].

The themes of "best-science elitism" [24] and the superiority of pure over applied research in this speech echoed Rowland's 1883 address as vice-president for physics of the AAAS, according to which the flaws of American physics also reflected the "pride [taken in] a democratic country...in reducing everything to a level" [25]. Not every physicist agreed with Rowland's attitude to utilitarian research. In 1890 Thomas Corwin Mendenhall (see Fig.4), whose career encompassed the presidencies of two polytechnic institutes and the superintendency of the U.S. 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" [26]. Although T.C. Mendenhall apparently had little use for the American Physical Society or, perhaps, it for him - he never became a member -, his son, C.E. Mendenhall, a professor of physics at the University of Wisconsin, was elected to membership at the second meeting in 1889 and served as the Society's fourteenth president in 1923-24.

II. EVOLUTION

Rowland's theme, that pure research was superior to and more important than applied, is seen by some as having been, for much of the twentieth century, a *Leitmotif* of the American Physical Society. This characterization - some have made it an accusation - of exclusivity, "its strict, rather elitist view of physics" , Phillips calls it [12], is questionable, at least for the first quarter of the century, and even more so for the last quarter. Not only was *The Physical Review* during its early decades heavily devoted to applications, but industrial and government research were well represented at the Society's meetings. Thus at the February 1925 meeting at Columbia University (arbitrarily examined for this analysis) fourteen of the thirty-seven contributed papers came from industrial and government laboratories. These included not only the Bureau of Standards and the American Telephone and Telegraph Company, but also the Westinghouse Lamp Company, the Eastman Kodak Company, Munsell Research Laboratory and Nela Laboratory [27]. Indeed, Kevles characterizes the APS's leadership, even for some years after Planck and Einstein, of living in the nineteenth century and as unwilling and unable to "stimulate young physicists into confronting the increasingly theoretical issues of the twentieth" [28] . The dominance of the Society's affairs 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, the activities of the Society evidently did not meet the needs of all physicists. Whether as a result of dissatisfaction with APS or, more mundanely, simply reflecting a Darwinian evolution of the species, other physics-based associations were established, 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 the same year, 1899, as APS [29].)

"Spinning-off" the three specialized societies did not still the criticism of those who saw APS as being too devoted to fundamental research and particularly to the by then flourishing field of quantum physics, and as of being not representative of physics in its broadest scope. A Committee on Applied Physics, with Paul D. Foote of the Gulf Oil Company as chairman, reported these findings to the APS Council on 28-29 November 1930 [30] and recommended a reorganization of the Physical Society along the lines of the American Chemical Society, in which different interests were represented by separate divisions. As a start, divisions of Applied Physics and Mathematical Physics would be formed. The formation of divisions, in fact, did not happen until 1943 and, ironically, the first division to be formed, "Electron and Ion Physics", now "Atomic Molecular and Optical Physics", has quantum mechanics at the very core of its work (as have most of the others that came later).

Another belief about the exclusivity of the APS, that "from the beginning ... encouragement of research physics...was to be pursued single-mindedly, certainly to the exclusion of problems concerned with teaching" [12] , also needs reexamination. It is true that, notwithstanding efforts by Arthur Gordon Webster, who wrote in 1905, "I have often tried to get the Physical Society to take up pedagogical questions, but without success", it adopted a policy in 1907 that "all pedagogical matters lie outside of the Physical Society" [31]. Webster and his like-minded colleagues must nevertheless have continued to raise these matters, 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" [32]. Of the three recommendations made by the Committee [33], the only one promptly carried out was that calling 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 representative appointed was Homer L. Dodge, who at one time had been an assistant of Webster's. In 1920 an Educational Committee was established to formulate a comprehensive plan "whereby the

Society can give adequate consideration to the teaching of physics" and 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 one on "Physics in Relation to Medicine". These reports were published as pamphlets and some were printed in the *Bulletin* [34]. But apparently not enough came of these initiatives to satisfy the advocates - inside and outside of APS - of vigorous Society involvement in the teaching of physics, for in 1930 the American Association of Physics Teachers (AAPT) was formed for "the advancement of the teaching of physics and the furtherance of appreciation of the role of physics in our culture" [35]. Its first president was Homer Dodge.

In spite of the feeling by some AAPT leaders that APS was (what would now be pejoratively called) elitist - a characterization which at the time many in APS would not have been embarrassed by - the two organizations, beginning in 1931, have held a joint meeting every year. (In 1991 APS abandoned this January meeting as a result of declining participation by its members - the final act in a series of retrenchments of the Society's general meetings caused by the growth in the number and popularity of divisional and other specialized gatherings. The AAPT thereupon joined the APS April meeting, but few of *its* members have been able to participate in that assembly and also in their Association's popular and convenient summer and winter meetings. The joint meeting has thus become endangered.) Furthermore, in 1973, after a hiatus of half a century, the APS again established a committee on education whose four goals included developing an effective partnership with AAPT in matters of common interest [36]. In 1986 the APS added an education officer to its staff [37] and in 1990 it established a Forum on Education. While membership in APS is a requirement for belonging to and being active in the Forum, places on its executive committee are reserved for members who also belong to and are nominated by AAPT. Despite the intrusion, from time to time, of "turf" issues, fueled by the disparity in human and financial resources between the two organizations, they have cooperated on a number of projects. These have included the holding of periodic conferences of physics department heads and outreach programs by research scientists to school teachers. The publicly most impressive instance of this partnership has been a successful $4 million joint fundraising *Campaign for Physics* (education).

In the early thirties, as a result of the depression and other factors, *The Physical Review* (and therefore APS), as well as the journals of other physics related associations, were in severe financial trouble. The Chemical Foundation offered to provide support on the condition that the societies would cooperate to publish and distribute their journals more cost-effectively [38]. This was the primary stimulus that led to the formation of the American Institute of Physics on May 14, 1932, with APS, the Optical Society, the Acoustical Society, the Society of Rheology, and AAPT as founding members. Subsequently five other physics related associations joined AIP. Although organized principally in order to reduce the cost of producing the member societies' journals, the Institute soon began providing other services and, in fact, took on some of the coloration of the trade association that APS had been so reluctant to assume. In the beginning APS leaders played a dominant role in AIP's affairs: Karl T. Compton, who had been APS's President in 1927-1928 and had continued to be an important leader in the Society, John T. Tate, who edited *The Physical Review* from 1926 until 1950, and George B. Pegram, who was the APS treasurer from 1918 until 1957, not only took the lead in the bail-out by the Chemical Foundation, but served the Institute, respectively, as its first and second chairman of the board and as its first secretary. However, later - as the pursuit of science and the ways of the world became more complex - APS lost its dominant influence, even 'though it has remained the largest of the AIP constituents, both in membership and the amount of business transacted. As the producer and distributor of most of APS's journals, AIP is APS's biggest vendor and APS is AIP's biggest customer. Originally each member society had the same number of representatives - three - on the Governing Board of the Institute, but as a result of the adoption of a quasi-logarithmic scheme of representation by society membership, seven of the forty members of the Board are now appointed by APS. AIP has become a major publisher on its own, publishing eight research journals, to a large extent because APS lacked the financial resources or the will to create them when they were proposed, or, in the case of the *Journal of Applied Physics*, when APS ceded its precursor to AIP. The Institute also has been translating and distributing important Russian journals. APS and AIP cooperate in a number of activities, including cohabitation in their headquarters. However, they and other member societies have also sometimes competed with each other, notably in the area of "who speaks for physics". Over the past decade a mutually supportive but occasionally still wary *modus vivendi* has been re-established [39].

As membership in the Society and research in physics grew, especially after World War II, so did the sentiment, among members, for the organization of specialized divisions within the APS. As already noted, the first, then called "Electron and Ion Physics" and now "Atomic, Molecular and Optical Physics", was established in 1943 [40]. There are now fourteen divisions and eight smaller topical groups [41]. At first the divisions had no role in the governance of the Society, their main function being the organization of invited papers in their specialties at APS meetings. Not until 1967, after a revision of the 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 [42]. 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 size and mode of operation of the APS Council have changed over the one hundred years of the APS' existence. At the beginning, the Council although small - eight members at large, in addition to the four officers - constituted more than ten percent of the membership. The Council remained, for many decades, not only the supreme, but also the sole governing body of the Society. It convened at every meeting of the Society. During this period temporary, ad-hoc committees were formed as needed. The increase in the size of the Council, after World War II, took place not only and perhaps not even primarily because of the rapid rise in overall membership, but because of the creation of and demands for representation by the divisions and, later, other "sub-units" with their own concerns and interests. After a period of

struggle and discord, each division was, in the 1966 revision of the constitution, given a voting representative on the Council; a number of councillors - at - large, equal to the total of divisional councillors was to be elected. Then in 1991, when internal divisiveness and the pursuit of parochial and sometimes competitive group interests in the APS had become a serious factor and problem, the number of councillors for each division was changed to be proportional to its membership [43]. The number of at-large councillors, now called "general" councillors, was set so as to be roughly proportional to the number of members who were not affiliated with a division [44].

As the Council grew, it became too unwieldy and costly for it to meet as often as before and the number of meetings per year was reduced to three and then to two. In the 1966 constitution, a smaller Executive Committee (of about the size of the original Council) was created, to act for the Council between meetings. At first most actions of the Committee were reported for ratification to the Council, so that the agendas of the two bodies greatly resembled each other. However after a while, the Executive Committee acquired a life of its own. Its importance became enhanced with the constitution of 1991 when its expanded functions were officially recognized and its name was changed to "Executive Board". In recent years. the "presidential line"- the president, president-elect, vice-president, and immediate past president - in concert with the three operating officers - the executive officer, treasurer, and editor-in-chief - has assumed some of the functions and powers of the Executive Board. Over the past decades a number of standing Committees have been constitutionally established. Most of them make important contributions to the governance and activities of the Society. Some report (from time to time) to the Council, some to the Executive Board, and some work only with the staff. The Council itself, while it still must fulfill a number of constitutional functions, such as the adoption of the budget and the (formal) election of fellows, can, at each meeting, discuss in any depth only one or two of the many issues that face the Society, and must often vote on recommendations from the Executive Board and the officers with only limited understanding and little discussion [45].

III. MEETINGS

The scientific meetings of the Society - originally its chief if not sole *raison d'être* - have indeed played a vital role in the dissemination of physics. The programs of the early scientific sessions already reflect a variety of interests and, as Melba Phillips charitably puts it, "degrees of sophistication" [12]. But in spite of the routine nature of many contributions, even the earliest programs did include great names and important papers. In December of 1901, Ernest Rutherford , then at McGill University, gave two talks on radioactivity, one on "The transmission of excited radioactivity", the other (with S.J. Allen as coauthor) on "Excited radioactivity and the ionization of atmospheric air" [46]. He continued to speak on various aspects of radioactivity at many of the meetings [47]. A paper by him and Cook, entitled "A penetrating radiation from the earth's surface" [48] and another by McLennan and Burton "Some experiments on the electrical conductivity of air" [49], may in effect have reflected the first observation of cosmic rays. A.A. Michelson gave three papers on diffraction gratings at the 28th meeting on April 21 and 22, 1905 [50]. Then at the December 1905 meeting Rutherford announced the determination of e/m of the alpha particle in the paper "Magnetic and electric deflection of the alpha rays from radium" [51] . At the 34th meeting in December 1906 R.A. Millikan and George Winchester weighed in with "Upon the discharge of electrons from ordinary metals under the influence of ultra-violet light" [52]. At the 35th meeting not Michelson, but E.W. Morley and D.C. Miller, gave a "Final report on ether drift experiments" [53].

Invited papers were given occasionally, one by S. Arrhenius on "The electrical charge of the sun" in a joint session with the International Electrical Congress at APS's 25th meeting**;** another, at the 32nd meeting by H.A. Lorentz on "Gibbs statistical mechanics" [54] - the text is not provided; and one by O. Lummer at the 36th meeting on "Theories of the color of the sun" [55] - again no text. A.G. Webster's presidential address - the first in the five years since Rowland's, Michelson having failed to give one - was entitled "Some practical aspects of the relations between physics and mathematics" [4]; Carl Barus gave his presidential address on "Condensation nuclei" at the 30th meeting [56] and E.L. Nichols did his presidential duty at the 40th meeting with "Theories of the color of the sky" [57].

At the very first meeting of the Society it had been voted that " there be four regular meetings annually" and that, "except in special cases, the meetings be held in New York City" [32] (read at Columbia University). This limitation soon fell by the wayside and in 1901 meetings began to be scheduled in other cities and at universities in the East and even as far away as St. Louis and Denver. At first meetings took up only one day (a Friday or Saturday), and at that the secretary often had to scramble to make up a program of respectable size. The first two-day meeting was held on December 31, 1902 and January 1, 1903, in Washington and the first Spring meeting took place there in 1904. The year 1906 saw the inauguration of annual meetings at the Bureau of Standards (on Fridays) and at the elegant Cosmos Club (on Saturdays). From the beginning some meetings were held jointly with section B of the AAAS and with other societies, and these sometimes consumed as many as three or four days [58]. The sessions were all "plenary" and continued to consist mostly of papers contributed by members, with occasional invited papers delivered by distinguished, usually foreign scientists. For the first two decades, the time for the delivery of contributed papers appears to have been largely up to the authors [59] . But in 1912, with the accelerating growth of physics and of papers, the time was set at ten minutes "except by special action of the program committee" and the presiding officer was "directed to enforce the limit". Enforcement actually became a reality in 1921 through the introduction, by APS Secretary D.C. Miller, of "a sensational device", a time clock, to warn speakers and signal the end of the allotted time [12]. But this was not sufficient. An obvious, if imperfect, solution to the ever more crowded meetings, the introduction of multiple parallel sessions, was finally adopted in 1926, over the opposition of important elder statesmen, notably the 1916-17 president, R.A. Millikan [60]. Invited papers, of greater length than the contributed ones, became a regular feature in 1927 [12].

At the 1923 "Thanksgiving" meeting in Chicago, Niels Bohr gave an invited talk on "The quantum theory of atoms with several

electrons". Sampling volume I of the revived *Bulletin* (for 1925-26), we note invited talks by Peter Debye on "The diamagnetism of gases at low pressure" (he was visiting MIT from Zurich at the time of the February 1925 meeting); Manne Siegbahn of Uppsala, entitled "X ray spectra and optical spectra" (at the same meeting)**;** K.T. Compton on "dielectric constants and molecular spectra" (Kansas City, December 1925**)**; Michael Pupin on"Fifty years progress in electrical communication" (at the joint meeting with AAAS in 1926); and W.F.G. Swann on "The new quantum dynamics" .And in a joint session with the American Mathematical Society, G.D. Birkhoff - arguably the greatest American mathematician of the first half of the twentieth century - spoke on "A mathematical critique of some physical theories". We do not know how the physicists present reacted to the critique. The authors of the contributed papers still included some of the established luminaries, but new, subsequently famous names began to make their appearance. Thus in the 1925-25 *Bulletin*, we find Ernest Lawrence (from Yale) speaking on "The photoelectric effect in potassium vapor"; Gregory Breit (from the Carnegie Institution) on "The dependence of radio fading on modulation(!)", and, from Cal Tech, Linus Pauling, Paul Epstein, H. P. Robertson, and Fritz Zwicky. The academic or job titles of authors were never given, except for one select group, the National Research (Council) Fellows [61]. In 1925-26 the following authors of contributed papers were identified as National Research Fellows: Samuel K. Allison, J.W. Beams, R J. Havighurst, W.W. Houston, Frank C. Hoyt, H. Kahler, Otto Laporte, Ernest O. Lawrence, and R.V. Zumstein.

With American physics having become world class, the invited sessions during the 1930's give a good reflection of the important physics of the period. Cosmic rays [62] and astrophysics, including stellar structure end energy, were important, as were x-rays and crystal structure, mass spectroscopy and, increasingly, nuclear structure and accelerators. Work on nuclear magnetic moments was reported in a series of contributed papers authored by I.I. Rabi and members of his group and, in an apparent departure from previous procedure, Rabi got permission to present all of them consecutively to give a coherent account. In 1936, APS along with AIP's four other founder societies, participated in a meeting organized by the Institute to celebrate its fifth anniversary. In keeping with AIP's mission to demonstrate the utility of physics and to encourage the growth of industrial research, the meeting was designed to emphasize "entire new technologies and a reliable promise of more to come". The APS sessions consisted of contributed papers, except for a symposium on the solid state organized by its Metropolitan (New York) Section [12]. At APS's' own meetings, there were some invited sessions on applied physics: the magnetron as a source of high frequency radiation was discussed in 1937. Niels Bohr brought the news of fission to America in January of 1939 and only four months later, at the APS Washington meeting, important experimental papers on the subject were given by Booth, Dunning, and Slack, and by others from Columbia University , and by Bohr and Wheeler (which anticipated their explanation of the mechanism of fission a few months later in *The Physical Review)* [63]. The very next APS meeting, on June 23-24 in Princeton, featured a symposium on fission. It was to be the last session on the subject until after World War II.

Discussions of a possible chain reaction, that had begun in scientific circles two week's after Hahn's announcement of the discovery of fission, continued at some meetings and even in newspapers, but gradually, under informal pressure, voluntary self-censorship became the norm. A policy was finally formalized in June of 1940 when a committee of the National Research Council was set up to screen papers [64]. The effect on APS's meetings was important, but it was even more significant for *The Physical Review*. In November of 1941, the APS Council authorized a committee to make sure that papers possibly injurious to national defense did not appear in print. The annual meeting for 1941, held at Princeton in December jointly with AAAS and AAPT, was arranged before the attack on Pearl Harbor and the only reference to US involvement in the war appears in the printed report of the speech made by A.H. Compton at the ceremonial session. But changes came rapidly in 1942. The "Washington meeting" was moved to Baltimore. At a meeting with AAPT in June at Penn State, K.T. Compton gave an evening lecture on war research. The annual meeting, previously held with AAAS at the end of the year, was canceled by AAAS at the request of the office of Defense Transportation, but only postponed by APS to January 1943, when a joint meeting was held with AAPT [12]. This marked the beginning of annual meetings to be held in January with AAPT, that persisted until 1990. Because of travel restrictions - the Office of Defense Transportation limited the number of people coming from outside the "local commuting zone" to fifty - smaller, more local meetings were substituted for big national ones. But even if papers on fission were banned, there remained plenty of interesting topics, stellar structure, nuclear moments, field theory, the approach to absolute zero, and semi-conductors, among others. And after the war ended in August 1945, recovery was swift. The annual meeting of January 1946 meeting at Columbia University exceeded pre-war size [65] and featured a joint symposium of APS and AAPT on nuclear energy.

In the decades after World War II APS' meetings continued to grow very rapidly and were the venue for the announcements of so many important new discoveries, that the examples on any list of reasonable length would have to be random. But in recent years, with institutions and individuals, as well as their funding agencies, ever more eager to orchestrate and exploit their own public relations scoops, few announcements of new results at APS meetings have come as a surprise.

Although generally staid and low-key, some APS meetings had elements of high (and occasionally low) drama. Following the discovery, in 1986, by Bednorz and Müller, of "high temperature" superconductivity, the New York meeting in March 1987 turned into the "Woodstock of Physics" [66]. So many physicists wanted to report on their high-T_c discoveries and theories, that a session that began in the evening of March 18 did not end until 3:15 the next morning. And that was the official conclusion; some people were still in the meeting room at the New York Hilton talking at 6 AM. Sometimes, APS meetings also have served to expose erroneous claims of new phenomena. This occurred most dramatically at the 1989 meeting in Baltimore, when "Cold Fusion" was mercilessly and convincingly debunked by a score of experimenters who had tried and failed to reproduce, and by theorists who demonstrated

the lack of plausibility, of the results that had been claimed by the "discoverers".

With the very first set of by-laws, papers intended for presentation had to be passed by a Program Committee appointed by the Council and at the second meeting the Council decided that the Committee should consist of the Secretary and two other Council members appointed by the President. In practice the function appears to have been exercised by the Secretary alone and, at that, perfunctorily: we have no evidence of any paper having been refused until the 1940's [67]. With the boom in physics after World War II came, inevitably, an increase in the number of crank abstracts of papers that their authors wanted to present at meetings. A "Committee to judge eccentric papers" was established by the Council in 1951 and the Secretary was given power to refuse acceptance of an abstract, if the Committee so recommended. A list of persons whose abstracts were to be submitted to the Committee was maintained. In April 1952 Secretary K.K. Darrow asked that a member named Bayard L. Peakes be placed on the list (he had earlier submitted an abstract entitled "The electron does not exist"). The minutes of the Council meeting record that "this request had an unexpected kickback: on motion of [Luis] Alvarez [who was to become APS' president in 1969], the Council reversed its policy of several years standing, and proclaimed that henceforth every member of the Society shall have the right to submit abstracts of ten-minute papers which shall not be refused" [32]. This democratic and egalitarian tradition of free speech, which permits every member or anyone introduced by a member to give a ten-minute unvetted paper at an APS meeting, persists to this day [68]. But Peakes could not be mollified. He was not eccentric, he was psychopathic. Even 'though his abstract had been accepted, he entered the office of the APS - then located in the Physics Department of Columbia University - and shot and killed a secretary, Eileen Fahey [69].

The right of every member to give a paper was now established, but the organizational structure and character of the meetings continued to change. Through the 1970's there were six to eight "general" APS meetings per year, and invited as well as contributed papers in all fields of physics were given at most of them. One of them, in January, served as the annual meeting of the Society and provided the venue for the president and other officers to report to the membership. It was held in New York City until 1968, and in various provincial cities afterwards. There was the March meeting, which moved around the country from the beginning; the Washington meeting held in late April or early May (occasionally in Baltimore or other places outside the future Beltway); summer meetings in the East and in the West; the "Thanksgiving" meeting, which was however, beginning in 1963, moved to October, and often held in Chicago; and winter meetings in the West - sometimes as far West as Hawaii - or in the East, between Christmas and New Year. Joint meetings with the Canadian Association of Physicists and with the Mexican Physical Society took place regularly, and from time to time in Canada or Mexico.

The growth in attendance at the meetings inevitably led to the much regretted abandonment of universities and government laboratories as their venue in favor of hotels (and, later, convention centers).This produced some culture shock on the part of physicists and hoteliers alike. The former had to get used to increasingly higher costs [70] and the latter had to confront the fact that physicists tended to behave differently from the conventioneers they were used to [71]. But it was not only hotel and travel expenses that inexorably raised the cost of meetings for the attendees.

Whereas not so long ago the Society's Secretary, with the sometime aid of an assistant in the Columbia University physics department, had made all arrangements for the meetings himself, the increasing complexities of the meetings "business" soon required the creation of a Meetings Department - now grown to five members . This in turn has required large increases in registration fees [72]. However the scientific organization of the meetings - the choice of topics and of invited speakers, and the organization of the contributed papers into sessions - became and has remained resolutely democratic and in the hands of volunteers: before each meeting these "sorters" congregate - by the dozens for the larger meetings - at APS headquarters to do their thankless, but essential job.

As both physicists and specialization in physics continued to proliferate, general meetings gave way to specialized gatherings both under the auspices and outside of the Society [73]. By the end of the eighties, there were only two APS meetings that were not divisional or otherwise specialized, and these were more multi-divisional than general. The March meeting, which is still held in a different city every year, is now organized by the Divisions of Condensed Matter, Material, Chemical, High Polymer, and Biological Physics, and constitutes the largest annual gathering of physicists in the world. The Spring meeting, which has recently alternated between Washington and other locations, brings together Nuclear Physics, Particles and Fields, Astrophysics and, periodically, Physics of Beams, and Atomic, Molecular and Optical Physics. Those divisions that do not participate in one or the other of these two meetings - Plasma, Laser Physics, Computational Physics, and Fluid Dynamics - hold their own separate annual gatherings and some of those who do participate in a general meeting have additional divisional meetings as well. Most meetings take from three to five days and feature as many as thirty parallel sessions. Attempts by the APS leadership to recreate an annual meeting where all fields of physics would be represented, or to serve all the units with two general meetings, have not been successful to-date (except for the 1999 Centennial meeting). Established habits, the attraction of conflicting specialized conferences, and the reluctance by some divisional leaders to relinquish the control afforded by separate meetings have, until now, frustrated the striving fully to regain that aspect of the unity of physics [74].

In addition to organization by field of specialization, the APS has evolved a limited and somewhat accidental geographic structure. Although the invitation list for the 1899 meeting was designed to represent a wide geographical distribution, apparently no one in the far west was invited. The first meeting west of the Rockies was held in 1915 in conjunction with the San Francisco World's Fair. The organization of regional sections had been envisaged in the first APS constitution and from 1917 until 1987 there were regional secretaries for the Pacific Coast (later referred to as the Western States), as well as from 1964 to 1981, for the Central

States, and for shorter intervals, for the Southwestern and Mountain States, and for the Southeast. The principal duty of the regional secretaries was to help organize the general meetings in their areas. However, the first autonomous geographic unit - the New England Section - was not established until 1932. A Metropolitan (New York) Section was organized in 1933, but, operating in a compact area where there was no dearth of physics colloquia, seminars, and conferences, the Section was dissolved in 1952. The Southeastern Section grew out of a regional association of physicists in 1937. The New York State Section dates from 1938 and the Ohio Section from 1939. The next section, Texas, was not founded until forty-three years later, in 1982, and the Four Corners (Southwestern) and Northwestern Sections were organized in 1997 and 1998, respectively. Most sections hold two meetings annually, some of them true "general meetings" in the old style of the APS, others organized around special topics, including education with the participation of the local section of AAPT. College teachers and students, as well as others with small travel budgets, are readily able to join research physicists at these meetings.

IV. JOURNALS

Beginning in 1913 with the takeover - upon invitation - of *The Physical Review* by the Society, the dissemination of research through refereed journals at first supplemented and later even supplanted the holding of meetings as APS' primary tool for diffusing the knowledge of physics. Today the Society's research publications account for about three quarters of its annual budget of $35 million and two- thirds of its paid staff of close to 200. The count of employees engaged in publishing would be even higher, were it not for the contracting out of production and of subscription fulfillment to AIP and other agents. *The Physical Review* had been founded in 1893 - by two faculty members at Cornell University, Edward L. Nichols and Ernest Merritt (see Fig. 3), both of them to become in 1899 founding members of APS - because there was no American journal devoted solely or predominantly to physics. With European journals often beyond their reach, in part because of a high import tariff, American physicists tended to depend on the *American Journal of Science* to keep up with research, but that journal, relying on mediocre or out-of-touch physicists, was unable to set effective standards in physics. Thus, after repeatedly rejecting Rowland's papers, the referees admitted that they just could not understand his mathematics [75].

The founding of *The Physical Review* was a cause for rejoicing and a boon for American physicists. Nevertheless, much of what was published in it during its early years was, in keeping with most of the research being done in the country at the time, not very profound or basic; it was applied, "practical" physics. "Nichols and his editorial colleagues...conducted The *Physical Review* with a seeming Baconian eagerness to publish the report of any experiment ..." [76]. In the decade following the discoveries of X-rays, radioactivity, and the electron, four out of five articles published by American physicists in *The Physical Review* dealt with pre-X-ray physics.

In addition to original research articles (a disproportionally large fraction contributed by the editors - Nichols and Merritt were veritable *stakhanovites* - and other persons at Cornell), *The Physical Review*, in the early decades, published translations of papers from European journals, book reviews [77], obituaries, and advertisements. Advertising was discontinued only in 1933, when AIP - temporarily in complete business control of *The Physical Review* - transferred it to the Institute's *Review of Scientific Instruments*. (Later, AIP also made advertising a feature of the *Journal of Applied Physics.*) Originally published bi-monthly in two volumes per year adding up to about 500 pages, *The Physical Review* soon cost $5.00 for an annual subscription. The balance sheet - consisting of five lines - for the first year shows an annual appropriation of $2400.00 (from Cornell); credits from Macmillan (for advertising) of $420.65; expenditures (not detailed, but presumably including all editorial, production and distribution costs, as well as Macmillan's commission) of $2056.19; and an unexpended balance of $874.46. (As a percentage of revenues, this was the highest profit ever to be achieved in the history of the journal.) By 1910, *The Physical Review* was printing about 1300 pages, with expenses totaling $4000. There were about 300 "regular" subscribers and 600 who, as members of the American Physical Society, received their subscriptions at a reduced price, for a total subscription income of about $3400. Extra reprints and other miscellaneous receipts brought in several hundred dollars; any remaining deficit was presumably still made up by Cornell University.

The scope, range, and quality of the early articles may be inferred from some of the titles: "The transmission spectra of certain substances in the infrared", "Relation between the lengths of the yard and the meter", "Studies of the lime light", "Notes on the theory of oscillating currents". While, in the early decades of the twentieth century, reports of important discoveries by American physicists could increasingly be found in *The Physical Review*, they were often abstracts of papers at APS meetings, rather than articles. Many American physicists (and virtually all physicists who worked abroad) preferred to publish their work in the more prestigious and widely read European journals or, in the case of spectral studies, in the recently founded (American) *Astrophysical Journal*. The significance of the contributed articles therefore at first remained generally low. But there were some notable exceptions, prominently among them R.A. Millikan's 1913 reports on improvements in his oil drop experiments to measure the electron's charge and Avogadro's number [78]; A.H. Compton's 1923 paper on his discovery of the eponymous effect [79]; in 1927, Davisson and Germer's first *detailed* description of their famous experiment on the diffraction of electrons and its results [80]; and, in 1929, J.C. Slater's theory of complex spectra [81]. Noteworthy early *applied* papers included those by G.W. Pierce in 1907 on crystal rectifiers for electric currents and electric oscillations [82]; by W.D. Coolidge (1913) on an improved Röntgen ray tube [83]; and by Irving Langmuir in 1913 on the effect of space charge and residual gases on thermionic currents [84]. Many of the papers published in the journal were first presented at APS meetings.

Beginning in about 1930 a dramatic change in the strength of American physics and with it in the fortunes of *The Physical Review* took place, led by the emergence into prominence and positions of leadership of physicists such as P.W. Bridgman, A.H. and K.T. Compton, L.A. DuBridge. E.U. Condon, J.R. Oppenheimer, I.I. Rabi, and J.H. Van Vleck - all of whom later

served as presidents of the American Physical Society - and many others. The transformation was greatly helped by the influx of European refugees from the Nazis [85]. These new Americans included future APS presidents Enrico Fermi, Hans Bethe, Eugene Wigner, George Uhlenbeck, Victor Weisskopf, Felix Bloch, and Maurice Goldhaber [86]. In 1931 *The Physical Review* was for the first time cited more often in the physics literature than its chief rival , the German *Zeitschrift für Physik* [87].

This ascent to world status occurred under the editorship (1926 to 1950) of University of Minnesota physics professor John T. Tate [88], "the most important Chief Editor of *The Physical Review* in this century" [89]. In 1929 Tate became the founding editor of *The Physical Review*'s first offspring, *Reviews of Modern Physics* (originally *Physical Review Supplements*), meant "to contain résumés, discussions of topics of unusual interest, and, in a broad sense, material that will give valuable aid to productive work in physics and yet cannot appropriately be published in *The Physical Review*" [90]. Beginning with the first issue, which was given over to a compilation and review by R.T. Birge of the "probable values of the physical coupling constants" and articles by A.H. Compton on corpuscular properties of light and by K.K. Darrow on statistics in matter, radiation, and electricity, the quarterly *Reviews of Modern Physics* rapidly became "one of the best sources of broad-ranging review articles in physics" [91]. Thus, a series of articles by Hans Bethe and collaborators in 1936-37 [92] served for many years as the "bible" and textbook for the new field of nuclear physics.

The *Reviews of Modern Physics'* "impact"- the frequency with which a journal's articles are, on the average, cited during a two year period after their publication - has been by far the highest of any physics journal in the world [93] , and the second highest of any scientific review journal (after *Annual Review of Biochemistry* [91]). In a 1988 article [91] celebrating its 60th anniversary, Eugene Garfield lists the 100 articles from *Reviews of Modern Physics* that were cited most often between 1955 (when Garfield's Institute for Scientific Information began to compile its citation index) and 1986. Six papers each had more than 1000 citations, led by S. Chandrasekhar's on stochastic problems in physics and astronomy, and followed by two papers by C.C.J. Roothan on molecular orbital theory and three papers on topics in nuclear physics by A. Bohr, B. Mottelson and their associates, Lane and Thomas, and Kisslinger and Sorenson, respectively [94]. From its inception until 1969, in addition to regular articles, *Reviews of Modern Physics* frequently published special issues. These included *Festschriften* for Bohr's 60th, Einstein's 70th and Millikan's 80th birthdays, a Fermi memorial volume (in 1955) and proceedings of conferences, ranging from one on cosmic rays in 1939 to the Chapel Hill conference on general relativity in 1957. In recent times the journal has regularly published the investiture lectures of the physics Nobel laureates as well as APS studies at the intersection of physics and society, such as the influential report on Directed Energy Weapons [95].

While brilliantly managing the APS journals [96], Tate also served the Society as president in 1939 and the AIP as chairman of the governing board from 1936 to 1939. Tate relinquished the editorship of *Reviews of Modern Physics* from 1941 to 1946, while he was engaged in war work, to his Minnesota colleague, J.W. Buchta, and the latter was again in charge from 1948 to 1951. Upon Tate's death in 1950, *The Physical Review* was edited by another Minnesota faculty member, E.L. Hill. In 1951 Samuel Goudsmit was appointed managing editor of both *The Physical Review* and *Reviews of Modern Physics*. In 1957 the two jobs were split and Edward U. Condon became editor of *Reviews of Modern Physics.* He served until 1968 [97]. Lewis Branscomb edited the journal from 1968 until 1973. David Pines took over in 1973 [98] and served until 1995, longer than any other editor of the journal. George Bertsch succeeded Pines in 1995.

Back to *The Physical Review*: In spite of the diversion of most physicists to war work and the practice of holding back the publication of work that might have jeopardized the atomic bomb and other defense projects (see Section III), *The Physical Review* was published regularly, if on a reduced scale [99]. But with the end of the war, the growth resumed. Whereas in 1939 the pages of the journal had peaked at 2564, by 1949 it published 3950. The number passed 10,000 in 1962, 20,000 only five years later, 40,000 in 1987, and 80,000 in 1998. Any reasonably sized selection of "most important" papers for the period since the end of World War II would be hopelessly idiosyncratic. In lieu of citing here any examples of the multitude of seminal papers published, we refer the reader to Paul Hartman's engaging Memoir on *The Physical Review* [100] for a running narrative, and to the magisterial collection of over 1000 articles (200 in print and over 800 more as a CD ROM) that were selected and annotated for "*The Physical Review* - the First Hundred Years. A Selection of Seminal Papers and Commentaries" [101], for more complete documentation. With the growth and specialization of physics, world-wide, *The Physical Review* was divided, beginning in 1964, into what became, by 1993, five subject matter sections. Each eventually was given its own physicist-editors [102].

In 1958, in what was undoubtedly the most important development in post-war physics journal publishing, *Physical Review Letters* was established. The original motivation was to create a journal for the initial, brief publication "of just those reports that reasonably might be expected to have immediate impact on the research of others", much more quickly than what had by then become the norm for material appearing in *The Physical Review.* Since before the War, short Letters announcing important new discoveries had been published in *The Physical Review* itself , upon acceptance by the editor, with as little delay as a week between receipt and distribution. But by the fifties, although acceptance was still decided by the editor without external refereeing, growing delays in the production and printing of *The Physical Review* had frustrated speedy publication. Goudsmit therefore proposed a new journal which would avoid production delays by introducing a new method of typesetting and printing by offset lithography, while retaining the practice of deciding, in-house, without refereeing, on the acceptance of contributions [103]. In addition to importance and brevity, "general interest" also became a desired characteristic for acceptance in *Physical Review Letters*. In the event, both speedy publication and general interest have been compromised. *Physical Review Letters* rapidly grew in the number of submissions and in size - by a factor of four in its first decade and another factor of seven since then - and soon became and has remained (with the exceptions of *Science* and *Nature*) the most prestigious choice in

the world for the publication of physics research. With this expansion, general interest is no longer a *sine qua non*, but referees and editors still look for significance. Rapid publication has mostly fallen victim to the volume of manuscripts, the decision - inevitable in the face of the mounting submissions of specialized articles - to use external referees, and the care and contention that are associated with an acceptance rate of now less than forty percent. Brevity - four pages per article - however remains a requirement. Like the sections of the parent journal, *Physical Review Letters* has its own editors [104].

Not that the *Physical Review* is not the most prestigious [105] (as well as the most voluminous - see Fig. 5) *archival* physics journal in America and, arguably, the world. With 70% of their authors (Fig. 6 [106]) and more than half their subscribers residing outside the United States, the APS journals are now as important a place for publication for foreign physicists as for Americans. Much of the growth in size and quality of the APS publishing enterprise took place under the managing and then chief editorship (1951-1975) of the redoubtable Samuel Goudsmit. It has continued under managing editor Chalmers Frazer (1975-1981), and editors-in-chief David Lazarus (1981 -199l) and Benjamin Bederson (1992-1996). The present editor-in-chief is Martin Blume.

The last ten years have seen increasing attention to electronic publishing, with *Physical Review Letters* and all of the sections of the *Physical Review* having come "on line" by July 1, 1997, and *Reviews of Modern Physics* on January 1, 1998. A new venture of the *Physical Review,* to be more specialized fields than the existing sections, was inaugurated in 1998 with *Physical Review Special Topics - Accelerators and Beams.* It is being distributed only electronically. Acting on a long standing conviction by some APS leaders that something should be done to make up for the abandonment of *Physical Review Letters*' original role as a publication of important discoveries accessible to most physicists, regardless of their specialties, APS started a new "journal" to do just that, also in 1998. Also being disseminated only on-line, it provides brief exegeses of selected papers from *Physical Review Letters* and sometimes from the *Physical Review.* An earlier suggestion by Treasurer Harry Lustig that this publication should be called "Physical Review Postcards" was not adopted: instead the service is called *Physical Review Focus.* In addition, APS has pioneered, originally in collaboration with Los Alamos National Laboratory, in creating a fully searchable and inter-linked on-line database for the journals, which will eventually date back to the founding of *The Physical Review* in 1893.

Although there has been variation in growth over the more than 100 years of the *Physical Review's* existence, representing the growth by an exponential doubling time of thirteen years is not far off the mark. In 1998 the five sections of the *Physical Review* and its offshoots *Physical Review Letters* and *Reviews of Modern Physics* published 94,008 pages. With revenues, in fiscal year 1998, of $26.06 million and expenses of $23.19 million, the journals of the American Physical Society are a flourishing enterprise. In spite of the healthy - albeit by today's measure tiny - balance sheet at the time of the takeover in 1913, this was not always the case. In 1926, at the end of his first year and as a result of an ever greater spate of papers, Tate had to report sizeable arrears. In spite of a required shortening of papers and the raising of acceptance standards, the financial difficulties multiplied. Voluntary Page Charges were introduced in 1930, at first at $2 per page. They grew rapidly and at one time brought in over 50% of the journals' revenue. For various policy and practical reasons, both their total and their relative dollar values have since sharply diminished [107]

Even after the 1932 rescue and reorganization involving AIP, financial troubles soon again became a concern. In 1946 APS's revenues were $92,000, the expenditures $114,000. In January of 1949 treasurer George Pegram presented a "sombre report" [K.K. Darrow's words and spelling] that the Society was in the red by $22,000 and at the fiftieth anniversary meeting in June of that year the annual rate of loss by *The Physical Review* was estimated at $60,000. In the ensuing two decades the Society's finances remained precarious [108].

Prudent fiscal management and reforms, instituted by the new APS Treasurer, Joseph Burton, stabilized the situation. To maintain solvency, the accelerating growth, combined with the steady erosion in subscriptions, has required substantial annual price increases for libraries. By 1996, a set of APS journals cost US libraries over $10,000. The increases were made palatable to APS's policy makers and constituents by the realization that the APS journals, on the basis of both the quantity and quality of the information delivered, remained, at about ten cents per page, a great bargain [93]. Nevertheless, conscious of the crisis in library funding, the increasing availability and use of (unrefereed) "e-print servers" and, perhaps, the dictum that less is more, or rather that no more is enough, and acting on a recommendation of a task force headed by former APS President Eugen Merzbacher, the Council in 1995 decreed that the growth of *The Physical Review* should be contained [32]. This was to be accomplished by a further "ratcheting up" of acceptance standards. In the 1980's and 90's the journals have prospered financially, actually generating more income than expenses (see Fig.7, for a typical year, 1996), as well as editorially. In fact, recognizing the need to help pay for the expanding public affairs and outreach programs of the Society, the Council in 1987 adopted a policy, recommended by Treasurer Harry Lustig, of budgeting the journals for a 10% surplus. The role of the journals in the financial affairs of the Society has always been dominant, first as a drain, but more recently as a source of helping to py for the public affairs programs. The 1996 contributions to revenues and expenditures of the four activities centers of the Society - Research Publications (the journals), Scientific Meetings, Membership Services, and Public Affairs - are shown in Fig.8 . Fig.9 shows, for the same year, how the earnings and deficits from each of these centers, together with the earnings from investments combined actually to produce an overall surplus [109]. Figs.10 and 11 indicate how the annual budgets both for the journals and for the total operations of the Society have increased by about a factor of ten since 1967.

V. PUBLIC AFFAIRS AND OUTREACH

Although participation in public affairs was not a major occupation of the Society until comparatively recent times and even since then has been sometimes contested by members, the possibility did, as we have seen, already figure in Webster's call for the founding meeting in 1899. And, in fact, at the meeting of

February 24, 1900, the Council created a committee to "...draw up a memorial to Congress... favoring the establishment of a Bureau of Weights and Measures..." [32]. This agency, the Bureau of Standards, was actually established, with the support of other scientific societies, in 1901, a speedier and more triumphant return on lobbying than the APS appears to have enjoyed since. (The word "lobbying" was, to be sure, not admitted to the APS's vocabulary until the mid -1990's.) Perhaps in gratitude, the Spring meeting of the Society was organized by and, in part, held at the Bureau every year from 1906 until 1965 [110], and even when many and later all of the sessions had to be moved to larger facilities in universities and hotels, staff members of the Bureau continued to take care of some of the organizational aspects until the late eighties. An effort in 1906 urging passage of a bill "which provides for use of the Metric System in all government departments" [32] has not yet achieved success. APS was again to come to the support of the Bureau of Standards in 1953, when the Secretary of Commerce in the Eisenhower Administration tried to fire its head, the physicist Allen V. Astin, because the Bureau had determined that a battery additive produced by a California firm added nothing to the life of batteries. In successfully calling for Astin's reinstatement, the Council proclaimed that "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..." [111] . A more recent intervention by APS on behalf of the Bureau, or rather its successor, the National Institute of Science and Technology (NIST), occurred in 1996, when the Society was instrumental, in concert with others, in preventing the decimation of NIST's research programs by the new anti-government programs Congressional majority .

But we have gotten ahead of the story. Except as noted earlier, the Society remained officially aloof from public affairs for much of the first fifty years of its history. The lack of involvement persisted even during the two world wars, although many members and leaders of the Society played roles in both as individuals: a major, indispensable part in World War II - the "physicists' war", and a smaller, but nevertheless significant part in World War I - which has been dubbed by some as the "chemists' war" [112]. As we noted earlier, the world wars, and particularly the second, had a significant effect on *The Physical Review* and on the Society's meetings and members**.** But it was simply not then in the Society's repertoire to participate in public affairs, much less to issue "political" statements, patriotic or otherwise [113]. That was to be left to members acting individually or through other groupings [114].

The end of the war seems to have been a watershed in this culture of restraint of the APS [115], in part as a consequence of an ascent to leadership by a generation of more international- and liberal-minded physicists. In what was to be the first of a number of assertions that physics and physicists knew few boundaries, the Council, on November 10, 1945, less than three months after V-J day, decided to treat Germans and Japanese in the same way as other foreign members whose participation had been interrupted by the war [32]. In contrast to what had occurred after the first World War, there was in fact no significant political opposition in the US to reintegrating and working with scientists from the former enemy countries. However, with the initiation and escalation of the Cold War between the United States and the Soviet Union, not only did relations with Soviet scientists become all but impossible, but many in the US who were suspected, rightly or wrongly, of harboring sympathies for communism, or of being "security risks", had their loyalties questioned and their ability to practice their professions circumscribed.

The first prominent physicist to be attacked was the eminent and outspoken Edward U. Condon, whose remarkable contributions to the welfare of science and of the country were as outstanding as his significant accomplishments in physics itself. In 1948 - two years after he had served as APS President, and while he was Director of the Bureau of Standards - the House Un-American Activities Committee pronounced Condon "one of the weakest links in our atomic security". (He was claimed to have entertained or associated with Soviet agents.) Protests erupted from the scientific community which notably included what appears to have been the first public defense by the APS of one of its members [116]. In expressing "every confidence in him as a scientist and a man", the Council, while "not qualified to evaluate the incidents which have been adduced a cause of doubt of his loyalty", stated, "yet it is clear that the action of the...Committee... was not to evaluate such incidents or to resolve such doubt but to create a situation in which this would be most difficult. We have grave fear that their action will tend to frustrate efforts of the Government to avail itself of our scientific resources and will make difficult the collaboration between scientists and the Government, on which so much of our future depends" [117]. This and the other protests, the - on this occasion - principled behavior of President Harry Truman [118] (so at variance with that of his successor, Dwight Eisenhower, during the McCarthy period), as well as the fact that there was nothing to back up the slanderous allegations, worked . After an investigation, the Atomic Energy Commission reported that while the FBI files contained "some unfavorable information" about a few of Condon's acquaintances, the Commission found "no question whatever concerning Dr. Condon's loyalty" [119] and cleared him fully [120].

Six years later, the APS again found it necessary to intervene on behalf of a member, when the Eisenhower administration revoked the security clearance of J. Robert Oppenheimer**,** who had been the Society's president in 1948 (during the persecution of Condon) and who, as chief architect of the atomic bomb, was arguably the most celebrated American physicist**.** This time, during the waning months of the McCarthy period, there was no official vindication. The investigation of Oppenheimer had, at least in part, been triggered by his earlier association with left wing individuals, and causes, and his less than truthful accounts of some events relating to these associations did not help during the hearings [121]. But few of those who knew Oppenheimer and had worked under him at Los Alamos had any doubts about his loyalty. Many distinguished fellow physicists, including the quondam APS president Hans Bethe and former presidents R.F. Bacher, K.T. Compton, Lee DuBridge, Enrico Fermi, I.I. Rabi, and Norman Ramsay, had individually testified on behalf of Oppenheimer, while Luis Alvarez was the only former president to have argued for removing Oppenheimer's clearance. (Oppenheimer's chief accuser, Edward Teller, was never elected to the APS presidency.) Now, on June 12, 1954, the APS Council

issued a statement deploring the action of the Atomic Energy Commission's hearing board, which had deprived Oppenheimer of his clearance. The Council, while conceding that it was "for obvious reasons, not in a position to render a judgment whether Dr. Oppenheimer meets the present requirements of the AEC for clearance", stated that "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." What the Council found particularly disturbing were the "new charges against Dr. Oppenheimer that arose from the [apparently cautionary] advice he gave on request and his subsequent attitude concerning the H-bomb...If a man whose advice is sought must fear that his potential utility to the government may be challenged because his recent recommendations later become politically unpopular, he may be tempted to give advice that is politically safe rather than technically valid" [32]. The Council's intervention did not dissuade the full Atomic Energy Commission, on June 29, from affirming Oppenheimer's removal from access to restricted data. Only one of the five Commissioners, former APS president Henry DeWolf Smyth, voted to reinstate Oppenheimer's clearance [122].

Along with the accusations against and persecutions of American scientists for their alleged disloyalty [123], the travel to the Unites States of foreign visitors, even from non-Communist countries, with suspect associations or opinions, was seriously impeded during the McCarthy period. On November 28, 1952, the APS Council approved a statement, pointing to the damage to science and to the country from the denials of visitors' visas to "many distinguished foreign scientists ...even for short visits to attend scientific meetings...The international notoriety of these difficulties is now such that some international scientific meetings that originally were to be held in the United States were transferred to other countries". However, the Council was careful to point out that [32] "..[it] is not questioning the propriety of excluding any person who wishes admission to this country with any idea of advancing communism here" [124].

APS's public statements in the fifties were still confined to matters that could be characterized as "non-political", in that they dealt with the freedom of physicists to do and publish their work and to communicate with one another, rather than with broader social issues. A borderline case, in which conscience struggled against abstinence from political involvements was that of (what later became known as) civil rights. Although the Council made no public statements against segregation, in the 1950's and 1960's it struggled with whether to hold meetings in Southern States unless black and white members could freely meet together [125].

Major change came to the APS with the rise in social consciousness and radicalization in the universities in the 1960's, in particular as a consequence of opposition to the Vietnam War and the sponsorship of physics research by defense agencies. Although a number of those in leadership positions shared the sympathies and convictions of the activists, the Council as a whole had at first to be pushed by these grassroots into action. And there was hesitation to proceed without approval by the membership as a whole. In the wake of the violent suppression of antiwar protests at the Democratic national convention in Chicago in 1968, many members petitioned APS not to hold its scheduled 1970 meeting in that City. The majority of the Council was against cancellation, but the Council eventually ordered a special poll of the membership by mail ballot; it then affirmed the vote of the majority of the voting members against canceling the selection of Chicago [126].

In February 1969, a group of activist physicists, led by Martin Perl (see Fig.12) - who was to become a founding member of the Forum on Physics and Society and, while serving at its second chair in 1973-74, made the Nobel prize winning discovery of the tau meson - and by Charles Schwartz [127], a physics professor and antiwar activist at Berkeley, urged APS to conduct sessions at its meetings on politically charged defense issues. Two months later, at the Society's meeting in Washington, an "official" session was held, before an audience of 2000, at which Hans Bethe, Donald Brennan, George Rathjens, and Eugene Wigner debated the Nixon Administration's proposed antiballistic missile program. The discussion had been billed as limited to "technical aspects of the ABM", but in fact touched on many nontechnical aspects as well. The following day, some 250 physicists held an orderly march to the White House to protest the ABM and then went on to call on members of Congress.

Although these protests *by physicists* intended to influence the actions of the APS and of the government were non-violent, *some* actions directed *against physicists* and other scientists who were thought to be carrying on military-sponsored research were decidedly not. A tragic case was the bombing of the building that housed, among other facilities, the nuclear physics laboratory of Professor H.H. Barschall, at the University of Wisconsin in Madison, during the night of August 23, 1970. A post-doctoral research associate was killed and a graduate student was severely injured. The laboratory, which was entirely devoted to fundamental research and totally unconnected to the military, was destroyed [128].

The most important achievement and legacy of the grass roots agitation of the sixties and early seventies for greater APS involvement in societal and political issues was, arguably, the creation of the Forum on Physics and Society. The movement for the creation of a new *division* of APS that would concern itself with the relationship between physics and society began at the January 1969 meeting with a petition circulated by Brian Schwartz, then of MIT. A newly established Council Committee on Problems of Physics and Society recommended the establishment of a *Forum* on Physics and Society; the change in designation constituted a recognition that the membership would transcend identification by field of research specialization, which was the organizing principle for the divisions. After it gave its endorsement, the Council, in 1970, decided to poll the membership, and after a large majority vote for approval, the Forum on Physics and Society was organized in January of 1972. For a number of years this new unit was, however, viewed with suspicion by some of the leaders of the Society. It was initially given less autonomy than the divisions: alone among the units it was obliged to have on its executive committee a member appointed by the Council. But it was authorized to organize invited paper sessions at the Society's meetings, which it did with

a great sense of responsibility and balance and much success. Its newsletter (really a mini-journal) *Physics and Society* has made impressive contributions to the literature on arms control, energy sources and other topics at the interface of science and public policy. And it was the Forum that pioneered the idea of APS sponsored Congressional Fellowships and got the Society to establish that highly successful and appreciated program [129]. In 1999 the Forum had about 4500 members, a number which amounted to close to ten percent of the Society's membership. By dint of its initiatives and achievements the Forum has long since won the respect of the Council, and David Hafemeister, its 1985-86 chair, could say with a good deal of justification: "The Forum is regarded as a source of manpower and ideas for the APS to utilize in preparing its public positions" [130].

The Forum on Physics and Society served as a paradigm for the organization of other self-governing and semi-autonomous aggregations of members, with interests and concerns in areas independent of or transcending the fields of research specialization. There are now four additional forums: on the History of Physics (converted in 1992 from a division), on International Physics (it had been a geographical section until 1991), on Education (founded in 1991) and on Industrial and Applied Physics (created in 1995). They all organize sessions at general and divisional APS meetings, publish newsletters, and sometimes carry out public affairs projects of their own. Without these five forums, APS would be weaker and probably also smaller than it is. In particular, still reflecting the century old feeling of physicists in industry that APS needs to be more responsive to their needs, the formation of the Forum on Industrial and Applied Physics has arguably prevented defections to engineering and applied science societies.

The sea change of attitudes at the grass roots level towards involvement with social, economic, and political issues resulted in the creation of parallel structures to pursue initiatives in these areas at the official level. Increased involvement in public affairs was also stimulated by the shortage of new physics employment in the early seventies. (A similar spurt in public activities was to be caused by the tight jobs situation in the nineties.) A number of "public affairs and outreach" committees were activated by the Council. Originally most of them were *ad hoc*, but they were later given permanence in the by-laws of the Society. These now include committees on women, on minorities, on international affairs, on the (world-wide) freedom of scientists, on education, and on (the concerns of) applied physicists. Each of these committees "advises" the Council on the promulgation of statements and the initiation of activities in its purview and conducts certain programs on its own. The earliest and, at least initially, most important and powerful of these committees was POPA, the Panel on Public Affairs, which was established in 1975. One of POPA's main achievements has been its studies of issues at the intersection of physics and society and the subsequent preparation of policy statements that were eventually adopted by the Council. A perhaps even more important contribution has been the recommendation and initiation of larger studies, by panels of external experts and with external financing, of such public interest issues as the technical aspects of the more efficient use of energy, the safety of nuclear reactors, the potential of photovoltaics, and the prospects for directed energy weapons[131].

With the future of adequate funding for physics research in considerable doubt, the Society, in 1989, created the Physics Planning Committee (PPC), to be composed of the most recognized available leaders and practitioners of research. While its original assignment, the preparation of a balanced plan for (the funding of) physics research, has proved to have been unrealistic, PPC has been instrumental in helping to organize and carry out what the Society now finally recognizes and supports as "lobbying" for physics. In recognition of this reality, the committee was renamed the Physics Policy Committee in 1997. The (tongue only slightly in cheek) answer 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 expansion of APS's programs in public affairs and the need and desire to provide support and guidance for the new committees and for the leadership of the Society, has brought about the addition of a number of physicists and other staff. In 1984 there were only three physicists, other than editors, on the paid staff: the Executive Secretary, the Deputy Executive Secretary [132], and the Treasurer. Both the Secretary and the Treasurer had originally been volunteers, seconded on a part-time basis - at first as little as one day a week - by their home institutions. Only by 1993 had both positions become full time and fully paid by APS. For many years the two headquarters "operating officers", in addition to fulfilling their prescribed constitutional functions, supervised and supported directly the expanding public affairs and outreach programs of the Society. Treasurer (1970-1985) Joseph Burton, as a result of his own interests and predilections and also because of Executive Secretary W.W. Havens' evident preference, on the whole, for the more traditional activities of the Society, played a seminal role in initiating, promoting and supporting the educational, public affairs, international and women's and minority outreach programs. His successor, Harry Lustig (Treasurer 1985-1996), building on his career and activities as a university administrator and as a former UNESCO officer, continued and expanded Burton's work for as long as possible. However, faced by the ever increasing demands of the public affairs and outreach commitments, together with a steady growth in the size and complexity of the budget, staff and "bread and butter" activities of the Society, the operating officers were gradually forced to relinquish personal operation of most of the outreach programs to other physicists, appointed to the staff to take on these functions. Most of them retained their affiliation with their home institutions and worked for the APS part-time.

First to be appointed, in 1984, was Robert Park (University of Maryland) as Director of a newly opened Washington office and author and purveyor of the eagerly as well as anxiously awaited one page, electronically disseminated *What's New*, whose "opinions are the author's and are not necessarily shared by the American Physical Society, but they should be". Subsequently, in 1995, the Washington office was enlarged and split into two operations, an Office of Public Information and an Office of Public Affairs (headed by CCNY physicist Michael Lubell.) The experienced and accomplished university administrator Kenneth Ford became APS's first Education Officer in 1986. When he was

installed as AIP's Executive Director in 1987, he was replaced by Brooklyn College's dynamic and creative Brian Schwartz, who in turn was succeeded in 1993 by Ramon Lopez, an astronomer at the University of Maryland. In 1991 New York University medical physicist Irving Lerch, a former officer of the International Atomic Energy agency, came to APS headquarters as Director of International Affairs.

In all of these areas the Society has undertaken significant programs, some initiated even before the new appointments were made. In education, high school teachers days have been added to general and divisional meetings and a "scientist-teacher alliance" is now contributing to the reform of teaching and learning in a number of school districts [133]. In the international arena, the APS, from the mid-eighties to the early nineties, conducted a highly successful "China Program" for the training, as postdocs in US universities, of many of the present leaders of Chinese physics. The program was conceived and initiated by Robert Marshak (see Fig.16), while he was president of the APS, and carried on, under the volunteer leadership of first Joseph Birman and then Benjamin Bederson [134]. After the collapse of the Soviet Union, APS, led by its 1992 President, Ernest Henley, helped to select (through the work of scores of volunteers) and to fund (first through contributions from its members and the Sloan, Meyer, and National Science foundations and later with moneys from George Soros) hundreds of Russian and other former Soviet Union physicists to enable them to survive and continue their research. Always a leading participant in the International Union of Pure and Applied Physics, APS has, in recent years, taken an active role in other international scientific organizations and initiatives and in bringing about collaboration with national and regional physical societies.

The new structures, the raised consciousness, and a number of activist presidents have, during the past two decades, led to statements on public policy matters that would not have been issued in earlier times. On November 18, 1978, the Council, by a vote of thirteen to ten with two abstentions, came out in support of the Equal Rights Amendment (for women) and, more significantly and controversially, resolved not to hold APS meetings in states that have not ratified the Amendment [135]. An unprecedented statement in favor of nuclear arms control, drafted by Hans Bethe, Sidney Drell, Marvin Goldberger, Wolfgang Panofsky, and Herbert York, was issued on January 23, 1983 [136], under the leadership of Robert E. Marshak, arguably APS's most activist and strong-willed president [137]. It evoked an extraordinary negative response from George A. Keyworth III, President Reagan's science advisor [138]. Other more recent public interest pronouncements have included statements against charlatanism, such as the claim that ambient electromagnetic fields have caused cancers, and in support of maintaining the national helium reserve.

While these statements and initiatives were, in the old tradition of the APS, disinterested and even altruistic, others were designed, in part, to help maintain the economic health of the physics community. These included support for continued funding of research in plasma physics and for the creation of a neutron source. One issue with both major economic and strongly felt ideological components, that of the SSC - the Superconducting Super Collider - opened deep fissures in the physics community, which the APS, in the end, could not ignore.

In the early 1980's, realizing that an accelerator with energies two orders of magnitude higher than those of the existing machines was required to elucidate certain features of the "Standard Model" of elementary particles or to provide vital information for a new "Final Theory", high energy physicists called for the design and construction of the SSC. The original price tag was estimated at $4 billion for construction and several hundred million dollars in annual operating costs. At the beginning and for several years to come, congressional and other political support for the program was strong, based on the still high prestige and influence of physicists -particularly high energy physicists, national pride, the prospects of jobs for workers and profits for industry, and even, on the part of *some* politicians, a genuine commitment to curiosity-driven science. But the enthusiastic, even brash promises by scientific proponents that the development of the SSC would lead to important spin-offs in areas ranging from a more effective radiation treatment of cancer to improvements in the technology of superconductors that would bring about magnetically levitated trains, also helped to win and inspire many adherents [137]. But it did not take long for political and, ominously, scientific opposition for the project to arise and to gather steam.

Most of the often bitter fighting among physicists took place outside of the APS and most of the leaders on both sides were not, at least at the time, officers in the Society. Among the most prominent and effective physicists making the case for the SSC were Leon Lederman, the Director of Fermilab, and Steven Weinberg, both Nobel laureates [140]. The opposition counted among its leaders the Pennsylvania State University materials scientist Rustum Roy and the physics Nobel laureates Philip Anderson and Robert Schrieffer [141]. (The latter would become President of the APS in 1996.) Threatened and torn by what Robert Park had called "perhaps the most divisive issue ever to confront the physics community" [142], the APS Council avoided taking a stand as long as possible. The divisional representation in the Council and the polarization between high energy physicists at one extreme and condensed matter physicists at the other contributed to the reluctance, if not an inability to do anything. (Until that point, the divisions that represented the two fields had often exhibited quite different attitudes and behavior towards the Society. To some, the largest division, Condensed Matter Physics, acted as if it were the APS, and the division of Particles and Fields, the second largest, appeared indifferent, even oblivious, that there was an APS [143].) When the Council finally did address the matter, in January 1991, it tried to reconcile the conflicting views with a somewhat ambiguous statement: 'Though "the SSC should be built in a timely fashion", the resolution said, the necessary funds "must not be [obtained] at the expense of the broadly based scientific research program of the US" [32].

When the quondam president of the Society, Nobel Laureate Nicholas Bloembergen, conveyed the statement to the Senate in April, he pointedly added that, under current fiscal circumstances, "major new initiatives, whose annual costs are projected to escalate for several years, threaten the already precarious house of Government-funded research" [144]. And he was outspoken in defending small science against the more extreme claims of the

machine's proponents, testifying that neither the superconducting magnet industry, nor magnetic resonance imaging had come primarily from the development of accelerators: "As one of the pioneers in the field of magnetic resonance, I can assure you that these are spin-offs of small-scale science" [143]. Deeply concerned that the proponents of the SSC were irresponsibly understating the cost [146], and undeterred by his simultaneously holding the office of APS President, the respected solid state physicist James Krumhansl had already in 1989 campaigned against the SSC. Now, in 1991, he estimated that perhaps 1000 physicists might be served directly by the SSC - which meant that the machine's cost of $5 billion would amount to a ten-year grant of $5 million to each particle physicist, at a time when grantees in other fields were struggling to obtain $40,000 to fund their research for a year. In 1992 a leading Congressional opponent of the SSC, Sherwood Boehlert, credited Krumhansl with having made him see the light [147].

The opposition of renowned condensed matter and some other "small science" physicists, the escalating costs - the last official estimate by the Department of Energy was 8.249 billion 1990 dollars, allegations of administrative mismanagement, and unfulfilled promises of financial participation by other countries all contributed to an unexpected vote by the House of Representative on June 17, 1992 to terminate the SSC, 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 this exemplar, *par excellence*, of curiosity driven science and for an important segment of the APS constituency, the Society's Executive Board, on June 24, issued a statement deploring the cancellation of the project [32]. The next day, forty physicists, including twenty-one Nobel laureates, sent a letter insisting on the importance of the SSC to President Bush and to Congress. Within three weeks the letter was endorsed by more than 1700 other American scientists plus 300 from foreign countries. But it was too late and too little. In spite of temporary reversals of the House vote by the Senate and continued strong support by the Bush administration, whose Science Advisor was the respected nuclear physicist D. Allan Bromley - he would become APS' president in 1996 - and in the face of only tepid support by the incoming Clinton administration, and of a new freshmen class of anti-government spending Republicans, the SSC was definitively killed in October of 1993 [148].

Bitterness and despair were rampant among high energy physicists. Roy Schwitters, a leading experimentalist from Fermilab, who had been appointed head of the SSC in January 1989, had told a reporter in early 1993 that "...the SSC is becoming a victim of the revenge of the C students" [149]. Wolfgang Panofsky, the former director of the Stanford Linear Accelerator - he had been president of the APS in 1974 and a member of the President's Science Advisory Committee before its abolition by President Nixon - attacked the extraordinary volume of oversight to which the SSC had been subjected and which had cost senior laboratory personnel enormous amounts of time, and called the collider's death "a senseless killing" [150]. Steven Weinberg, who had earlier testified that if the SSC was canceled, "you may well say good-bye to any responsible program of high energy physics, and with it...any hope in this country in our time of discovering a final theory of nature", now warned that abandoning the SSC could also begin "the killing of support for basic science in this country" [151]. More grandiloquently, Murray Gell-Mann called the cancellation "a conspicuous setback for human civilization" [152].

But, *mirabile dictu*, even 'though the loss of the SSC *was* a major set-back, the dire predictions proved to be exaggerated. High energy physicists soon saw a hope for progress in their field in the plans of CERN for a Large Hadron Collider (the LHC) and lobbied energetically and, with some success, for scientific and financial participation by the U.S. in this international project [153]. Perhaps taking their cue from the leading former critics of the SSC, Anderson and Schrieffer, who now stated, "not to build the SSC is conceivable. Not to pursue particle physics is totally unacceptable to those who are concerned with and depend on the health of science" [154], their fellow travelers in small science have generally not opposed and even supported continued major funding for high energy physics. In this effort the APS has played a positive and effective role, under the leadership of presidents from both sides of the divide, including the strong SSC proponent, Burton Richter (president 1994) and J. Robert Schrieffer. Realizing that in times of danger one should not circle the wagons and then shoot inwards, APS has in recent years lobbied effectively for support for all areas of basic and applied physics. In fact, APS's ecumenism and activism had, by 1997, under the energetic leadership of President Allan Bromley, gone so far as to enlist 110 leaders of professional societies in most fields of science to issue a "Unified Statement on Research" that calls for doubling the overall science and engineering research budgets over the next decade.

VI. MEMBERSHIP

By its second meeting in 1899 the American Physical Society had fifty-nine members; on January 1, 1999 the count was 41,786. Except for occasional minor fluctuations and an essentially flat behavior during the most recent decade, growth has been monotonic (see Fig.13). Over periods each lasting several decades, it can also be described as exponential. By the end of World War I membership stood at 935, a growth rate corresponding to an exponential doubling time of less than five years since the Society's creation. From then until the end of World War II membership grew to 5070, equivalent to a doubling time of eleven years. Much of the slowdown is attributable to the decade of the depression, 1929 -1939, in which there was only a fifty percent increase. Large growth - with the membership doubling every ten years - continued from 1945 until 1970, when membership stood at 28,207. However in the twenty-nine years since then it has increased by only 48%. Apparently reflecting the dearth of new jobs in physics in the early seventies and nineties, the APS membership actually declined temporarily during those years.

The first constitution merely provided that members could be elected by the Council on applications signed by two members of the Society, and in what must have been an early example of bootstrapping in physics, all who came to the inaugural meeting were admitted. A by-law, adopted in 1904, established a class of Associate Members. It included physics teachers, graduate students, engineers, chemists, mathematicians, and even non-scientists. They were to pay the same dues as (regular) members

and “have all the privileges of membership except that they may not vote or hold office” [32]. Annual dues, at the founding, were $5, not an inconsiderable amount for scientists who, according to Rowland, did not “earn more than the wages of a day laborer or cook” [20]. By 1911 they had risen to $6, an amount that can be inferred from the treasurer’s reporting receipts in the amount of $3323.71 from 553 members, with a footnote pointing out that “one member is in arrears $0.29". A year later when three freshly minted Ph.D.s were proposed for (regular) membership, it became the “policy of Council to elect to regular membership only such persons as have contributed to the advance of Physics” [32].

Eminent foreign scientists could be elected as honorary members. Lord Kelvin was the first to be chosen, in 1901.and. By 1909 five more had been added -Svante Arrhenius, V.F.K. Bjerknes, H.A. Lorentz, Ernest Rutherford, and Emil Wiechert; Kelvin had died in 1907. Max Planck was elected shortly thereafter and W.H. Bragg first appears on the 1915 membership roster. By 1920, with Niels Bohr having been added, there were seven honorary members, 456 (regular) members and 833 associate members. The next year, in what was little more than a change in nomenclature, members became fellows and associate members became members; fellows and members were to be nominated separately and members could be transferred to fellowship upon recommendation of the Council. In 1922 the dues were differentiated: fellows paid $10 annually and a $3 entrance fee; members paid $8 in dues and no entrance fee. Subsequently a number of members, particularly foreign members, including Erwin Schrödinger and P.M.S. Blackett, declined election to fellowship, apparently because they didn’t want to pay the higher dues. The revived *Bulletin of the American Physical Society* [155] lists eight honorary members, 487 fellows and 1685 members, for a total of 1853.

In 1928 it was suggested that the constitutional restriction on voting be abolished, inasmuch as other scientific societies extended the voting privilege to their lower classes of membership. However, it was the “sense of the Council that such a change...was not advisable” [32]. Ordinary members were finally given the vote in 1946 and in an *annus memorabilis* for democratization, 1970, they were made eligible to hold office. (In the same year Council meetings were opened to the membership.) The dues differential was abolished only in 1974, in line with the general decline in society of the philosophy of *noblesse oblige*. By that time regular annual dues had become $20, while fellows’ dues were $30. The year 1982 saw the first dues increase in eighteen years, to $30, and in the ensuing decade they rose steadily to $70, reflecting, in large measure, the need to pay the salaries of the growing headquarters staff that was required to provide the expanding services to members [156]. To help finance the growing public affairs and outreach programs, a voluntary contribution was asked for on the dues bill beginning in 1982.

Although a student membership category was proposed as early as 1915, it was not established until 1963. At first the discount was small, but it gradually became about two-thirds off regular dues. A free one year “trial” membership for graduate students was added in 1982 . Retired members had for many years been offered free membership, with a small charge for the Society’s “on-membership” publications - *Physics Today* and the *Bulletin*, but this fee was suspended when the expense of collecting it exceeded the amount collected. (A similar calculus frustrated intermittent attempts to collect dues for membership in divisions. A $1 charge was suspended in 1980 because it cost $2 to collect it with AIP’s antiquated accounting system. After APS installed its own computers, a “unit” membership fee of $5 was instituted in 1990; it is now $6.) With the realization that the fraction of retired members was steadily growing and that increasing age and formal retirement no longer meant penury for most of the “seniors”, they were asked, beginning in 1991, to pay half the regular dues. A “junior” (read postdoc) category of membership was created in 1993 , with dues at about a third of those for “ regular” members (and fellows). The latter are now (in 1999 - 2000) $95 per year.

Over the years gaining membership in APS has become progressively easier and it is now open to anyone. Becoming a fellow has however remained a much coveted honor and each division, topical group and forum is assigned an annual nominations quota of one-half -of one percent of its membership. A Council committee can add persons who may have been overlooked by the occasionally parochial specialized units. On January 1, 1999 the APS consisted of 4862 fellows (of whom 1254 were seniors) and 36,924 members (of whom 3060 were seniors, 2051 juniors, and 6395 students). The number of seniors is actually greater than shown, because some are included - but not identified as such - among the “life members”, a category that requires only a one- time payment [157]. In 1997 about 9100 APS members resided outside the United States; a survey indicated that nearly 70% of them had studied or worked in the US, and that two-thirds of them read the majority of their physics research literature in APS journals [158].

VII. THE APS IN AN AGE OF LITIGATION

For the first fourscore and seven years of its existence the APS had never been involved in a law suit. But since 1987 the Society has had to defend itself in the courts in four cases. APS has never sued anybody. All of the litigation was connected with publishing: two plaintiffs sued the Society *for not* publishing their work [159]; one sought to punish APS *for* publishing an author’s work; and in one case a third party attempted to compel the Society to reveal the identity of a referee of a manuscript that was not accepted for publication.

In 1987 the APS was served with a subpoena by attorneys for Arco Solar, the defendant in a patent infringement case brought by Solarex Corporation and RCA Corporation. Arco Solar sought the name of a referee for a manuscript that described results which could lead to improved amorphous silicon p-n junctions. The manuscript had been submitted to *Physical Review Letters* and had been rejected for publication on the strength of one of the two referees’ reports that more experiments needed to be done and that the article was better suited for the *Physical Review*. The other referee had recommended publication and had revealed his name and his action to the authors. As an element of its defense strategy, Arco Solar wanted to maintain that the submission constituted “prior art” which invalidated the patent at issue. The idea was to try to claim that the negative referee had, in fact, disclosed the new process to colleagues and, perhaps, other

competitors. In order to pursue this theory, Arco Solar needed to know the identity of the referee. But while willing to turn over his opinion and all other documents connected with the case, the APS, true to its and the common practice in scientific publishing, declined to reveal the name of the referee. APS's attorney, Richard A. Meserve [160], argued that non-disclosure was essential to the preservation of the peer-review process. The US Magistrate, Allyne R. Ross, who heard the case, found unequivocally in favor of APS, observing that "...the Society had demonstrated a strong interest in preserving the confidentiality of its reviewer's identity", and the District Court and the Court of Appeals affirmed the ruling [161]. The decision, while not establishing an absolute right to keep the names of referees confidential, nevertheless provided a presumptive precedent for it. David Lazarus, APS's quondam editor-in-chief, had the satisfaction of being able to report on the outcome in *Physics Today* [162].

In the same year, the APS was notified that it was the defendant in a federal suit seeking damages of $44,500,000 [163]. The plaintiff, who had very limited training in physics, alleged that the Society had deprived her of seven Nobel prizes by rejecting a manuscript that she had submitted to the *Physical Review*. She claimed that her invention, the "Qaddafi Field", encompassed and replaced all the fundamental laws of physics, including Newton's and Maxwell's and the Schrödinger equation. The courts were able to deal swiftly with the case, although the plaintiff, who represented herself, did try to pursue her complaint all the way to review by the Supreme Court. This bizarre and depressing case had perhaps one redeeming aspect: it showed that every citizen who feels aggrieved can obtain access to our judicial system.

The other instance in which the APS was accused of improperly refusing to publish an article presented quite a different issue. *Physical Review A* had accepted an article by a University of Maryland research associate, Thomas Kiess, for publication. When his colleagues found out about it, through prepublication of the abstract, they complained that the work had in fact been done jointly with them, and that publishing the article without recognition of them would be improper. The editors of the *Physical Review* decided to suspend publication unless and until the matter could be resolved. Kiess thereupon sued his collaborators and the APS, claiming that the refusal by the *Physical Review* to proceed with the publication of his manuscript after he had received notification of its acceptance, constituted a breach of contract [164]. The APS responded that there was no contract, that the *Physical Review's* letter of acceptance contained conditions that were never satisfied, and that even if the parties had created a contract, there was no breach because the journal had not refused to publish the manuscript. The court agreed and dismissed the case against the APS.

The most vexing litigation against APS (in a case also directed against AIP and an individual APS member) is that which has been carried on by the Gordon & Breach publishing group and its several companies, at this writing, for more than a decade. It has its origins in two articles by H. H. (Heinz) Barschall of the University of Wisconsin, one with a collaborator, which reported the cost per printed character, the "impact", and the "cost-effectiveness" of more than 200 physics journals of close to sixty publishers [165]. The articles were published, respectively, in *Physics Today* and the *Bulletin of the American Physical Society* [93]. Barschall's study showed that the Gordon & Breach journals were by far the most expensive and least cost- effective in the survey - not only when compared to those of not-for-profit societies such as APS and AIP, but also to those of other commercial publishers - but this result was not explicitly pointed out in the articles.

The officers of the two societies and Barschall were surprised to receive complaints from lawyers for Gordon & Breach against the articles and a demand, under threat of litigation, for the publication of a prescribed retraction and an apology. Barschall and the societies checked the allegations of error and concluded that they were either without foundation or insignificant [166]. Nevertheless *Physics Today* offered Gordon & Breach space for a statement setting out its objections to the Barschall articles, subject only to allowing the author to rebut allegations of error. This offer was summarily rejected [167]. As to the threats of a lawsuit, the officers of the societies found it hard to believe that the accuracy of Barschall's study and the action of the societies in publishing it would even be considered by the courts on their merits. Wasn't there a constitutionally guaranteed right of free speech and publication? However, when in 1989 suits were launched in Germany, Switzerland, and France against Barschall, APS, and AIP, the defendants had to contend with the fact that free speech protection was not as strong in those countries as in the United States, and that they had "unfair competition" laws which significantly restricted the right, even truthfully and accurately, to compare the prices and quality of products. The suits variously demanded retractions and the publication of prescribed apologies in the *Bulletin* and in *Physics Today*, injunctions against the publication of any further studies by Barschall or by anyone applying similar methodologies, and damages.

Even in the face of the strict laws, but at great effort and expense, Barschall and the Societies won their cases in Germany (as early as 1991 after unsuccessful appeals by Gordon & Breach all the way to the federal supreme court [*Bundesgericht*]) and in Switzerland (where Gordon & Breach launched four suits, and where a long string of appeals by the plaintiffs was finally and decisively rejected by *that* country's *Bundesgericht* in June of 1999. In every case, the courts, in ruling against the plaintiffs, found that the Barschall articles were licit and not false or misleading. In France, in the face of a law that Gordon & Breach would interpret to forbid *any* comparison of the prices of products that are not completely identical, the trial court found against the defendants. After several see-saw actions, the case is now again before a French appeals court.

APS and AIP had another unwelcome surprise when, on September 23, 1993, Gordon & Breach, apparently because of their losses and dimming prospects in Europe, filed suit in the United States under a statute called the Lanham Act, which (among other things) regulates advertising. Such "commercial speech" must not be false or misleading. The pursuit of the litigation in the US exceeded, in effort and cost, even the burdensome activities in Europe [168]. In August of 1994 Judge Leonard B. Sand of the Federal District Court for the Southern

District of New York issued his first substantive decision [169]. He dismissed the Lanham Act claims against *Physics Today* and the *Bulletin* because, as scholarly publications, they enjoyed the protection of the First Amendment of the US Constitution. However the matter did not rest there, because Gordon & Breach asserted that "secondary uses" [170] had been made of the articles, and the judge ruled that these uses of the survey should be subject to examination under the Lanham Act. The ruling opened the way to "discovery" of documents from APS's, AIP's and Barschall's files, which were used by the plaintiffs to try to make a case, already foreshadowed in Europe, that the Barschall research and the publication of his findings occurred as a result of a conspiracy between the authors and the societies to hide the alleged commercial intent of the undertaking [171].

After a seven day trial in June of 1997, Judge Sand found Barschall's methodology sound and the results free from errors [172]: "Barschall's methodology has been demonstrated to establish reliably precisely the proposition for which the defendants cited it: that defendants' physics journals, as measured by cost per character and by cost per character divided by impact factor, are substantially more cost-effective than those published by plaintiffs". He also found the Gordon & Breach complaint that Barschall did not examine or report on the costs *to them* of producing their journals irrelevant [172]: "If G&B believes librarians will make more optimal decisions if they consider information other than that provided by defendants, it's solution is to augment rather than censor the available truthful information". And, perhaps even more significantly, Judge Sand gave credence to the societies' discovery, during the long years of litigation, that "the evidence persuasively demonstrated that the present suit is but one battle in a 'global campaign by G&B to suppress all adverse comments upon its journals' " [173]. In January of 1999 the U.S. Court of Appeals for the Second Circuit rejected Gordon & Breach's appeal of Judge Sand's decision. This appears, at last, to be the end of the case in the United States. APS and AIP can celebrate not only their victory (tempered only by the fact that Barschall, did not live to see it - he had died on February 4, 1997), but also their steadfastness and willingness, in the face of a large drain of money [174] and effort - the societies and Barschall had to defend themselves in thirteen courts of law in four countries - to see the case through. The credit for this belongs not only, or even primarily to the determined operating officers (in the case of AIP, first Kenneth Ford and then Marc Brodsky), but to the Council and Executive Board of APS and the Governing Board of AIP. On the many occasions on which the case came before these bodies for discussion and decision, and in the face of some sentiment to settle it, even on restrictive and dangerous terms, the representatives of the membership stood firm. Among the APS presidents during the period, Burton Richter and Kumar Patel should be singled out for their steadfast leadership; in the AIP, Hans Frauenfelder led the Governing Board in refusing to abandon the case, except on honorable terms. Although, as *Physics Today* observed [175], the case had no broad economic implications for AIP and APS, the societies pursued it as a battle in defense of truth, free expression and the competence and integrity of a valued member [176].

VIII. LEADERSHIP

During the century of its existence APS has had eight-five presidents [177], all of them well known and highly regarded physicists. Twenty-one of them won Nobel Prizes [178]. Two were women, C.S. Wu in 1975 and M.S. (Millie) Dresselhaus in 1984. At first presidents as well as all the other officers and the members of the Council were nominated by the Council and elected by mail ballot of the members. Only one candidate was nominated for each position and there was heavy voter participation and unanimity or near unanimity in approving the nominees [179]. By 1962, a Nominating Committee appointed by the Council selected the candidates; although there was competition for election to the Council, still only one person was nominated for entry into the presidential line. In 1969 the burgeoning of populist sentiment in the Society led to *two* candidates being nominated for vice-president elect, the stepping stone to the presidency, and a meaningful choice (write-ins on the ballot had been permitted earlier) has been available to the member-voters since [180]. This has not prevented a decline in voter participation as the membership grew; the recent rate has hovered at about 20%. Generally the most important factor in winning elections (although not indiscriminately in gaining a nomination) has been the fame of the nominee as a physicist. With but one exception [181], Nobel laureates have always won over their opponents.

Almost all presidential line officers have carried out their obligations conscientiously, but they have differed in the amount of time they have given to the office. In recent years some presidents have easily devoted half of their effort to it. As can be glimpsed from this narrative, the impact they have had on the Society and on society has also varied. This is also true for the "operating officers", the secretary (later executive secretary, and now executive officer), treasurer, and managing editor (later editor-in- chief). But the impact of their service, which in many cases lasted for decades, has perhaps been more consequential than that of the presidents. In particular, as the secretary and the treasurer moved from volunteer, to part-time, to full-time status, and both the size and complexity of the operations they carry out and oversee have grown, good performance has become critical. In order to help assure that these offices are occupied by the best available persons, nation-wide searches are now carried out when vacancies occur, election is by the Council, and the (renewable) terms are for five years. The following pages present biographical sketches of six APS secretaries and treasurers, with emphasis on their service to the Society. The subjects were chosen because they served for at least ten years and made noteworthy contributions, and because the author was able to find information about them. With the unthinkable exception of W.W. Havens, Jr., living persons were excluded, and not only because the frequently best sources of documentation, obituaries, were not available for them.

Ernest George Merritt (1865 -1948)

We have already met Ernest Merritt as one of the two founder-editors of *The Physical Review* (see Fig.3) and, together with Edward Nichols, as one its most prolific contributors during the early years. In addition, he was also not only a cofounder of the APS, but served as its first secretary, from 1899 to 1912 [182], and as president in 1914-1915. (He had been secretary and later

chairman of Section B - Physical Sciences of the AAAS.) As APS's secretary, his main responsibility was organizing and recording the frequent meetings of the Society; in a crisis he had to deliver a paper himself to fill out a program .

As a boy of eight, in Indianapolis, he already evinced an inclination towards his future vocations, editor and scientist. He had founded, edited, printed, and produced two journals, the "Sea Breeze" and "The Mountain Echo", and had obtained a small telescope; the *Indianapolis Journal* reported that his "eager study of the stars may some day make him famous". However, he failed his first course in physics at Cornell, where he had enrolled to study mechanical engineering. Nevertheless, he decided to make physics his career and after receiving a masters's degree in the subject, rose through the ranks to assistant professor in 1892. He then spent a year in Berlin studying with Max Planck (among others) and the two became life-long friends, with Merritt sending relief packages to the family at the end of World War II. He became a full professor at Cornell in 1903 and was head of the physics department from 1919 until his retirement in 1935. He delighted in the conjunction of his name and title after that: E. MERRITT, EMERITUS. Paul Hartman, who got to know Merritt near the time of Merritt's retirement, reports he was "like an elf, full of life, sparkling wit and conversation, outgoing, interested in all manner of things, enthusiastic and bubbling over" [183].

Merritt's scientific interests were diverse. His first technical article (which appeared in volume I of *The Physical Review*) was "On a method of photographing the manometric flame with applications to the study of the vowel A". It made use of a translated photographic plate and the "manometric" flame - a primitive oscillograph in which a small bright flame made sensitive to sound vibrations is imaged on a moving plate. Together with Nichols he undertook a series of investigations on the luminescent properties of over 100 materials. But Merritt had other interests as well: acoustics, radio propagation, gaseous discharges, cathode- ray experiments and, in his later years, photography. According to the memorial statement for him in the Cornell Faculty Necrology, he not only "thought always to analyze his results and interpret them in the simplest possible terms", he was also an excellent teacher: "When demonstrating the then new phenomena of electric waves to... students, he was the envy and the inspiration of his pupils because of his skill in throwing together crude pieces of apparatus that would work perfectly to demonstrate the point in mind." He took great delight in his teaching. He was exercised by the inadequacy of the funds for research provided by the University and did much to increase them . Even 'though he was a Quaker, he directed submarine detection work at New London during World War I and in World War II made suggestions to DuBridge about directions in which the Radiation Lab at MIT might go. Although he did not make momentous discoveries in his research, he made large contributions to his university, to the American physics community and to the Physical Society, which he served for just short of fifty years

George Braxton Pegram (1876-1958)

George Pegram (Fig.14) got his first job at Columbia University in 1900 as a young assistant in physics (he was already studying there when the APS was founded in 1899) and retired in 1956 as chairman of the Committee on Government Aided Research, two years before his death. In the intervening years he served his institution as research investigator, teacher, and, save for President Nicholas Murray Butler, arguably its most important and accomplished administrator. He was chairman of the physics department from 1913 to 1945, dean of the School of Mines, Engineering and Chemistry from 1917 until 1930, and vice-president of the University in 1949-50. He accepted each position out of a deep sense of responsibility, did a superb job, and then struggled for permission to resign so that he could return to full time work in physics. "During these years ...he played a key role in bringing about America's rise to greatness in physics. At the outset of his career, like many another aspiring American student of science, he had gone to Europe to round out his education and by the close of his long career, students from all over the world were beating paths to the great centers of physics in the United States" [184].

Although Pegram made respected individual contributions to physics research (his dissertation, in 1903, "Secondary Radioactivity in the Electrolysis of Thorium Solutions" foreshadowed his later interests and accomplishments) he is now better remembered for organizing and furthering important group efforts. In World War I he played a significant role in anti-submarine research, when a Columbia group, headed by A.P. Wills, used sound waves for locating submarines. Soon after the discovery of the neutron, Pegram and his group at Columbia elucidated some of the major properties of neutrons and their interactions with other particles. In the late 1930's Pegram learned of Enrico Fermi's intention to bring his family to the United States and invited Fermi to join the faculty at Columbia. W.W. Havens, Jr. reports [185] that after Niels Bohr brought news of the discovery of the fission of uranium under neutron bombardment, "John Dunning, a member of Pegram's group, soon demonstrated that energy could be released... and that uranium 235 was the important isotope" [63]. He goes on to say that Pegram's connection with the atomic project at Columbia was twofold. "First he assembled and coordinated the team of physicists who performed the crucial experiments and had operating responsibility for the role of Columbia as a major center of nuclear research. Second, he was a member of the advisory group that originated the uranium project ...[it] became the Uranium Section with Pegram as vice-chairman... and resulted in the formation of the Manhattan project..." Throughout the war, Pegram headed Columbia's Committee on War Research, of whose activities those connected with undersea warfare were second in importance only to the atomic project. At the end of the war Pegram was instrumental in the establishment of the Brookhaven National Laboratory.

How with all these scientific and societal, as well as personal interests and accomplishments (in his sixties he won a "cup" soldered together out of laboratory junk, for besting all other tennis players at a summer meeting of the American Physical Society) Pegram found the time and energy to be a founder and leader of the American Institute of Physics (he wrote its by-laws and served as its secretary from its founding in 1931 until 1945 and as its treasurer from 1938 until 1956) and to serve the American Physical Society as treasurer for thirty-nine years**,** is difficult to comprehend. Karl K. Darrow, whose term as APS's

longest serving secretary overlapped Pegram's stewardship of the treasury for sixteen years**,** has this to say about Pegram's relationship with the Society [186]: "He never quite got over his regret at having missed, through some absurd mischance or quite uncharacteristic negligence, the convening of ...[the] American physicists from which sprang the American Physical Society...in May of 1899...Pegram did attend the first of the meetings of the new Society in October of that year, and fifty-six years later he was still attending them [187]. He was Treasurer of the Society...[from] 1918 to 1957, the longest service ever given to the Society by any individual [as an officer] [188]... It would be impossible to overstate the influence of George Pegram on the evolution of the American Physical Society already in the middle thirties ... and when he was the elder statesman whose opinion was always sought, who was a reservoir of knowledge on the history and practices of the Society, and whose judgement was always held in respect."

Karl Kelchner Darrow (1891 - 1982)

Karl Darrow (Fig.15) was APS's secretary from 1941 until 1967. The membership grew from 4000 to 23,000 during his reign - the word seems apposite, in spite of the democratic nature of the Society. To many of the members he was "Mr. American Physical Society". His deputy (1955-1966) and successor (1967-1990), W.W. Havens, Jr., wrote in an obituary for Darrow in *Physics Today*, somewhat ambiguously : "The manner in which he ran the American Physical Society will never be duplicated" [189]. In a more expansive appreciation of his predecessor, Havens was more generous: "Karl Darrow managed the American Physical Society adeptly for a period of twenty-six years" [190]. However in a remarkable thirteen page, single spaced, private letter of 6 January 1969 to the then APS president, Luis Alvarez [191], in which he assesses the state of the Society and proposes major reforms, Havens was critical of Darrow's legacy: "I am sure you know that Karl Darrow never wanted anything to change; in fact, he preferred to have the Society operate in the same manner that it did before he became Secretary. He never wanted the Society to start any new activities" [192].

K.K. Darrow, who was a nephew of the celebrated lawyer Clarence S. Darrow, studied at the University of Chicago, receiving his Ph.D. in 1917 under Millikan. His thesis involved a measurement of the specific heat ratios in hydrogen. Immediately after completing his doctorate, he joined the Western Electric Company as a research physicist and became a member of Bell Laboratories on its founding in 1925, staying until his retirement in 1956. At Bell, Darrow devoted a major portion of his effort to the interpretation and appraisal of a broad range of current scientific literature for his colleagues to keep them informed of developments in science which related to their research activities. He wrote over two hundred articles for professional and technical journals, including many for the *Bell System Technical Journal*. The value of his critical reviews not only to workers in the field but to aspiring students was exceedingly high [193]. Darrow also authored several books, including *Introduction to Contemporary Physics*, *Electrical Phenomena in Gases,* and *The Renaissance of Physics and Atomic Energy*.

The first fifteen years of Darrow's service as APS secretary overlapped with his full time employment at Bell Laboratories. If he was resistant to the Society's taking on new tasks or sponsoring new kinds of specialized meetings, he managed the existing meetings structure and the growth of the meetings not only with great diligence and aplomb, but also in a creative spirit. His preambles in the APS *Bulletin*, in which he described the locations of the meetings, and his other secretarial writings, including his still famous instructions on how to deliver an effective paper, are models of clarity and subtle humor [194]. The same dry humor is also apparent in his minutes of Council meetings. The meetings were not always very well attended or conducted in strict conformity with Robert's Rules of Order. Thus, Darrow's minutes of the June 1948 meeting at the University of Wisconsin begin: "Present were: F.W. Loomis (Vice-President) and G.B. Pegram (Treasurer). No question was raised as to a quorum" [32]. And Darrow concludes his minutes of the 1961 meeting in Chicago with "The Chicago Council meeting faded out between 1:30 and 2 P.M., without formal motion of adjournment or recognizable instant of cessation" [32].

Darrow was a man of style, culture, and habit. He regularly combined his conscientious attendance at scientific meetings with visits to the local art galleries. He held the same seats at the old New York Metropolitan Opera House for forty-eight years and then obtained new seats when the new house opened in Lincoln Center. He habitually spent the summer months in Europe, thereby all but shutting down the operations of the Physical Society [195]. He fought valiantly to keep alive the older social traditions of the APS, requiring, for example, Society officers to wear tuxedos to meeting banquets (after he had lost the battle to make everyone there dress for dinner), "so that members could identify them" [196]. He generously instructed his contemporaries in the correct use of Latin [197]. His life and achievements provide sterling evidence if any more is needed, that C.P. Snow's theory of the two orthogonal cultures, one scientific, the other humanistic, does not hold symmetrically.

Shirley Leon Quimby (1893-1986)

Like most of APS's earlier operating officers, Shirley Quimby not only had a long life, but a long association with the Society, serving as Treasurer from 1957 until 1970 [198]. When he took over as treasurer, the Society had no satisfactory bookkeeping or accounting system. Quimby effected the first transition from a back-of-the envelope operation to a more or less conventional system, befitting the growth in the membership and in budgets [1989] that had occurred since World War II. As a member of the executive committee and governing board of AIP at a time when the Institute did most of the publishing for APS and its other member societies, Quimby was an effective guardian of the physics community's finances during a time of great expansion.

Like most previous APS secretaries and treasurers since the time of Merritt, Quimby spent his professional life at Columbia University. He came there after World War I, in which he had served in the U.S. Navy, at the New London base, working, like Pegram, under Albert Wills on antisubmarine devices. When Wills returned to Columbia, Quimby followed him there to get his Ph.D. under him and began a long career of research in solid-state physics. During World War II he returned to the Navy, where he helped develop anti-magnetic mine devices. Quimby was an outstanding experimenter. He pioneered the use of quartz crystals

to make precise measurements of elastic constants in solids, developing among other techniques, the "elastic oscillator", a device consisting of an ultrasonic driver cemented to a second crystal that was to be studied. He showed that from the resonant frequency of this oscillator one could obtain sound velocities and, therefore, elastic constants with high precision. He trained many outstanding graduate students.

Like Darrow, Quimby had a number of outside interests, and some of them were less scholarly than Darrow's. He was widely recognized as an accomplished amateur magician and he was extremely proud of being the commodore of the New York Yacht Club. After his retirement from Columbia, he developed an interest in unraveling the complex calendar of the Maya Indian civilization and wrote an extensive tract on the subject [200].

Joseph Ashby Burton (1914-1986)

Little in Joseph ("Joe" to everyone) Burton's background would seem to have prepared him for his unmatched achievements and initiatives as treasurer (1970 - 1985) of the American Physical Society. Born and raised in rural Virginia - his grade school class had six pupils - he did his undergraduate work at Washington and Lee University and obtained his Ph.D. in chemistry in 1938 from The Johns Hopkins University. He joined the research staff at Bell Telephone Laboratories the same year. Burton's early research was with low work function photocathode materials and with luminescent phosphors, both of which were important for color television. Following the invention of the transistor, he became deeply involved in the growth of semi-conductor single crystals, leading a study of thermally driven convective mass transport in growth from the melt. He also made critical contributions to understanding the incorporation of impurity atoms during crystal growth.

In 1954 Burton became head of the semiconductor physics research department and, in 1958, director of the chemical research laboratory, a position he held until 1971. During this period he also stimulated and promoted new research efforts in nuclear physics, biophysics, and space physics. In 1971, Burton became director of physics research and continued to contribute his vision and support to the scientists in his organization. He retired from Bell Labs in 1976 [201].

While still a full time scientist and research director at Bell Labs, Joe Burton volunteered his services to the APS, first as deputy treasurer (1969-70) to the failing Shirley Quimby and in 1970 as the Society's treasurer. Only on his retirement from Bell in 1976 did he receive a salary from the APS, and that was set for an effort of three days per week, even 'though he worked for the Society full time. His record of safeguarding and nurturing APS' assets is outstanding. He developed a simple, easily understandable, but professionally impeccable accounting and administrative system which, with some modifications, has stood the Society in good stead to this day. Faced with the crisis in physics funding of the early seventies, he saved the Society from financial ruin, by insisting that its journals, which had been steadily losing subscriptions, had at least to break even. In fact he was able to achieve modest surpluses which the Society invested in the markets. As a result, during his tenancy, the net assets of the Society rose from a negligible amount to almost $10 Million.

While Burton's administrative skills and financial successes could perhaps have been predicted from his career at Bell Labs, his other contributions to APS were decidedly unusual, even unprecedented, for a treasurer. He became the untiring and singularly effective initiator, sponsor, and executor, at APS headquarters, of the Society's new programs in education, outreach and international affairs. These included summer internships for physics students in industry, a government funded program of travel grants to meetings for students, projects to improve the status of women in physics, a program of industrially funded undergraduate fellowships and mentoring for minority physics majors, the organization of conferences and programs to help physicists in underdeveloped countries, and others. As a volunteer member on APS's Education and Minority Committees, this author had the privilege of working with Burton and of observing him in action. He was an untiring, committed, but hard-headed liberal activist. Programs had to work in order to be undertaken and sustained and, for the most part, they had to be supported with outside funds raised expressly for them. Joe Burton was the chief, and, usually, the only fund raiser, cheerfully exploiting his connections in industry and tirelessly knocking on new doors. One of his lasting contributions was to convince Jean Dickey Apker generously to endow an award in honor of her late husband and Burton's friend, the physicist LeRoy Apker, that each year bestows major recognition and large monetary prizes on the most outstanding undergraduate physics students in the nation. In 1997 the Society was able to commemorate his work for the public good by renaming the newly endowed Forum Award, which recognizes "outstanding contribution to the public understanding or resolution of issues involving the interface of physics and society" as the Joseph A. Burton Award.

Joe's daughter, Delano Burton May, reports [202] that he was a supportive and accepting father, treating the members of his family and everyone he came in contact with always as contributing peers and never as subordinates. She attests to his life- long self-reliance: "He learned to play tennis against the wall of his father's barn. He learned bridge and chess from the Encyclopedia Britannica." And, while he always had time for his family - his motto was "work hard and have fun" - he must often have been tired after work, for "when he read bedtime stories to us, he routinely fell asleep before we did".

After breaking in this writer as his successor for three months - an invaluable but insufficient apprenticeship - Joe Burton retired from APS on September 30, 1985. He immediately embarked on what he hoped would, but may have realized would not come to pass, a new career with a Washington association working for arms control. On 31 August 1986 he succumbed to a recurrence of the cancer that he had bravely battled during his final years as Treasurer.

William Westerfield Havens, Jr. (1920 -

One year after having joined the APS in 1940, W.W. Havens, Jr. (see Fig.16) began to serve the Society as a volunteer on the local (Columbia University) committee for the annual meetings at the University. He became Deputy Secretary (to K.K. Darrow) in 1955 and succeeded the latter, with the new title of Executive Secretary, in 1967. He stayed on in that position through 1990.

After graduating with a major in mathematics from the College of the City of New York in 1939, Bill Havens embarked on graduate studies in physics at Columbia and he was on its staff from 1940 until his retirement in 1985. From 1941 to 1945 he worked there on the Manhattan project and he completed his Ph.D. thesis, under J. R. Dunning, on the feasibility of constructing a time-of - flight neutron spectrometer, in 1946. Together with James Rainwater he built such a spectrometer and it and several Havens designed successors were used for decades in important research. During World War II the Columbia Neutron Velocity Spectrometer supplied fundamental information to the metallurgical project at the University of Chicago for the design and construction of the Oak Ridge and Hanford reactors and for Los Alamos. After the war Havens and his collaborators continued to obtain fundamental neutron cross section data for use in the nuclear energy program, both for thermal and fast breeder reactors. From 1948 to 1951 Havens worked in meson physics, designing and constructing equipment to be used with the new Columbia synchrocyclotron at Irvington-on-Hudson, but then returned to neutron physics, a field in which he remained active for the remaining decades of his research career. Having become a full professor at Columbia in 1955, he served as director of its Division of Nuclear Science and Engineering from 1961 until 1977. From 1979 until 1984 Havens was director of Columbia University's Energy Research Center. He contributed to numerous national and international bodies concerned with the use of nuclear energy for peaceful purposes, serving, *inter alia*, as a technical advisor to the US delegation to the Atoms for Peace Conference, as chairman of the United States Nuclear Data Committee of the Atomic Energy Commission, as executive secretary and chairman of a similar committee for the European Nuclear Energy Agency, and an advisor to the International Atomic Energy Agency.

When Bill Havens took over, as a part-timer, in 1967, APS had barely the equivalent of two full-time employees (not counting those in the publications office at the Brookhaven National Laboratory). They worked out of the Pupin building at Columbia University, to which the Physics Department had moved from Fayerweather Hall in 1926. When he retired, as full-time Executive Secretary, at the end of 1990, there were close to forty, housed in the APS office at the American Institute of Physics' headquarters building on East 45th Street in Manhattan and in AIP's offices at Woodbury, Long Island. (The Society's close to one-hundred editorial employees, by that time, were located in an APS owned facility at Ridge, on Eastern Long Island.) What had started as a "mom-and- pop" operation - and at that one with decidedly part-time parents - had become the headquarters of a society with thirteen divisions, six topical groups, the Forum on Physics and Society and fifty-six committees, that awarded thirty-six physics prizes, published 70,000 journal pages, and held or sponsored forty-five national and international conferences each year [203].

Havens helped to initiate major changes, one of them, even while he was still Deputy Secretary and in the face of opposition by Darrow. Seeing that the Society would be torn apart, unless the Divisions were given more autonomy and power, whether he liked it or not, he worked with a committee composed of past presidents Robert Bacher, William Houston, and John Wheeler, which prepared the fateful enabling amendments to the constitution that were adopted in 1966. The changes in the *modus operandi* of the Society that led to the growth of the staff and the move to a downtown office were, however, not on Havens' agenda at the time he assumed office. In his January 1969 letter to Alvarez [191], he maintained that the Executive Secretary should continue to be an active physicist, functioning out of his laboratory or office, and devoting not more than one day a week to working for the Society. The same should be true for the Treasurer. While a Business Manager and a small staff should be hired, most of the business functions of the Society should be handled by AIP. An important exception to this delegation of responsibilities was to be communication with APS's members: the Society should recapture that function. By the same token APS and not AIP should undertake new scientific projects for which there was a need. A specialized, very successful conference on magnetism, held by AIP after it had been turned down by Darrow because "The American Physical Society did not have any facilities for making the arrangements", should have been organized by APS.

Thus Bill Havens was a progressive force, but a most reluctant "empire builder". He was also a prodigious worker. He not only arranged and ran all general scientific meetings and edited the *Bulletin* (whose frequency he increased to eleven issues per year so that it could report goings-on in the Society to the membership), but was a voting member of just about every important organ and committee of the Society and of AIP. He participated as a member, advisor, or facilitator in many of the POPA and external studies that the Society undertook during his term of office [204].

In his later years, Bill Havens appeared to some as conservative, but that was largely because, possessed of a phenomenal memory, he sometimes scotched "new" proposals that he knew had been tried before and had failed [205]. In spite of the growth in size and activities during Havens' tenure, APS, somehow, as David Lazarus has observed [206], "always sustained its initial innocence, [its] *amateurism* (in the original... sense of the word...'lover', not in it modern connotation 'less than professional'). That is the essential 'Havens touch' ... the incredible juggling act of keeping all the increasingly numerous balls in the air... always with grace and skill, and without ever losing sight of the fact that APS should remain a society of and for physics and physicists...Our society has had many excellent presidents during Bill's tenure... and each of them was treated with proper deference and respect.. (even 'though some might very well have needed a lot of cuing from Bill... how to run the show). Bill always kept a keen sense of his own role and its proper limits, combined with a strong respect for the elected officers of the Society and their role."

IX. CELEBRATIONS AND REFLECTIONS

The fiftieth anniversary of the APS was celebrated in a ceremonial session in Sanders Theatre of Harvard University on Thursday June 16, 1949 during an unusual summer meeting in the East (see Fig.17). After opening words from Harvard's president, J.B. Conant, messages from world famous individuals, including Niels Bohr, were read. G.B. Pegram then spoke on "The early years of the American Physical Society" and G.F. Hull on "Early

meetings of the American Physical Society". (Frederick Bedell's reminiscences "What led to the founding of the American Physical Society" [11], were presented four months earlier at the APS meeting in Berkeley.) K.K. Darrow followed with "The recent history of the American Physical Society". There was a reception in the Fogg Museum. The general session on Friday was in keeping with the occasion. E.U. Condon spoke on "The development of American physics", but he objected to and refused to limit himself to the word "American" in the assigned title. Other papers were "Physics in industry"- interest in this subject was *not* discovered only in the 1990's - by C.G. Suits of the General Electric Company, and "The future of physics", by F.W Loomis of the University of Illinois, then the APS president. At the ensuing Council meeting, the Treasurer reported that *The Physical Review* was still losing money [12].

In contrast, the 100th anniversary celebration was a week-long, grand, and expensive affair. Even after having raised about $1 million for special events from corporate and agency sponsors, it cost the APS close to $4 million of its own money to put on the meeting and pay for special exhibits and publications [206]. The APS meeting itself occupied seven days (and nights), from March 20 through 26, but ancillary events, including a triennial general assembly of the International Union of Pure and Applied Physics (IUPAP), took place before and in conjunction with the meeting. A Physics Festival was put on for the public in eight Atlanta locations and featured thirty-nine popular lectures, demonstrations , exhibitions and performances. The highlight of these was the 1999 APS Lilienfeld Prize lecture "The universe in a nutshell" by Stephen Hawking in the Atlanta Civic Center before an audience of 5000, including many of the participants in the APS meeting. The Festival and other special events were thought up and orchestrated by Brian Schwartz, APS's former Education Officer and Associate Executive Secretary, who was now the leading animator of centennial programs.

Registration at the scientific meeting was 11,239, making it, by a long shot, the largest physics gathering ever held. Most of the scientific sessions and many other events took place in the commodious and well equipped Georgia World Congress Center [208]. Four times a day there were seventy simultaneous sessions, organized, as usual, by the divisions and other participating units [209]. Most of them, also as usual, consisted of ten minute contributed talks, but there were also some forty centennial symposia and roundtables with invited speakers [210]. There were only three daytime plenary sessions (events with no scheduled competition). On the opening day, APS's 1997 President, D.Allan Bromley, presented a review of a "A century of physics", which was reminiscent in its sweep of the address given by APS's first President, Henry A. Rowland, in 1899. In the plenary session on Monday March 22, Steven Weinberg spoke authoritatively on the "Physics of the very big and very small" - elementary particles and cosmology; Harold Varmus, the Director of the National Institutes of Health, recounted the essential contributions of physics to the life sciences and pleaded for more money for physics under the title "The impact of physics on medicine and biology"; and Joel Birnbaum of Hewlett-Packard spoke on "Physics and the information revolution". The theme of the applications of physics was continued in the third plenary session by Mary L. Good, a chemist and former assistant secretary of commerce, under the title "Physics and technology". "Physics and materials" - one of the bridges to technology - was the topic of the lecture by Venkatesh Narayanamurti, a former Bell Labs scientist and director of Sandia National Laboratory. The session closed on a high cultural note with a talk by the historian Martin Klein on "Physics and the American culture".

The keynote address was given by the Secretary of Energy, Bill Richardson - President Clinton and Vice-President Gore having declined invitations to do so. Richardson read a speech in which he warned, to heartfelt approval from the audience, against allowing the current preoccupation with violations of security and the allegations of spying at national laboratories to destroy scientific visits by and exchanges with nationals of other countries. While vowing to "maintain and strengthen the tall fences that protect the nation's secrets", he declared, "we can't be intimidated into closing ourselves off. It is critical that our [Department of Energy] laboratories - which house so many of our important research facilities and our finest scientists - do not become isolated from the world" [211]. In his retiring President's address, Andrew Sessler reviewed the history of the Society, with emphasis on its role in public affairs. He described the APS as today being "in excellent shape...by far and away the strongest physical society in the world and one of the strongest professional societies in America...Because we stand on the shoulders of giants...we are ready to move on to the next 100 years..." [212].

As unusual as were the plethora, quality and scope of the scientific and science and society sessions, the number and opulence of the social events were positively astounding for a physics gathering. On the day before the opening a luncheon brought together forty-five Nobel laureates (see Fig.18) with high school teachers from throughout the country and local students and on that same evening there was an International Banquet in honor of the delegates to the IUPAP assembly. On the evening of March 23 in a gigantic hall of the World Congress Center, seventy-four institutions, from Arizona State to Yale University, held "Grand Reunions" for their alumni -with food ranging from the elegant to Nathan's hot-dogs in the City University of New York compound. But the highlight of the festivities was the evening "Centennial Gala" celebration at the Fernbank (Science) Museum on March 21. Attended by close to 7000 physicists and their companions - a noticeable fraction of them in black tie or evening gowns - the event featured lavish food and drink, interesting exhibits, male (Einstein and Oppenheimer) and female (Mme. Curie), impersonators, and a variety of entertainments, including a "physics chanteuse" [213].

The lectures and social events were for the people who came to the meeting, but the Centennial served also as the occasion for the production and first showing of several exhibits that will have long term use and value. Among these were a Nobel Prize Gallery, displaying the photographs and noting the achievements of all physics Nobel laureates; an interactive exhibit "Physics in our Lives", which is intended to travel to schools and colleges; a "Units Expo", in which many of the divisions, topical groups, forums, and sections showed off the activities and achievements in their areas (scientific and geographic); and a museum-quality exhibit of the history of the Society with a familiar sounding title [214]. Perhaps the product of most lasting value was the "Wall

Chart" *A Century of Physics*, which, through eleven panels of text and photographs, traces the progress of physics in the twentieth century in five parallel "time-lines": the cosmic scale, the human scale, the atomic scale, the living world, and technology [215].

Finally, the Centennial was the inspiration for APS to undertake the publication of two books. "More Things in Heaven and Earth - A Celebration of Physics at the Millennium" [216] consists of nine "historic perspectives" essays and forty-five "case studies", encompassing all areas of physics and its applications. They were written by scientists, including fifteen Nobel laureates, who are household names in late twentieth century, and, in some cases, also mid-century physics. "Physics in the 20th Century" [217] is a "coffee table book", which a review in *The New York Times* characterized with the headline "An Art Book on Physics? Yup, With the Details" [218].

As the Society celebrated its 100th anniversary, its finances were sound - even flush - with assets, on June 30, 1998, of $ 80,652,060, of which $ 62,779,644 constituted the Society's Reserve Fund (net worth). It published highly respected and successful journals, held useful and well attended meetings, and engaged in a panoply of public affairs programs. Yet there are both old problems and new challenges to be coped with. The conundrum of how to keep on financing the journals with an ever declining number of library subscribers and how to collect enough from readers for the electronic versions who are used to free or very low cost access, has not been solved. 'Though there is considerably less discord and competition among the various fields of physics and segments of the Society than there was a decade ago, it is not clear that a single Physical Society and its meetings will always be seen as the most effective way to promote the advancement of the knowledge of physics, not to mention the advancement of its disparate practitioners. And paradoxically, the generally welcomed, aggressive pursuit by the Society of the economic welfare of the discipline - the lobbying for funds - which is now sometimes indistinguishable from the pursuit of jobs for physicists [219] carries dangers of its own.

Not that in a culture which, if one did not know better, one would think consists *only* of self-serving interest groups, the physics community can afford to be disinterested and disengaged. Even if it wanted to, its friends in government - and by no means only in the federal agencies with whom there is a congruence of economic and professional interests - but also in the Congress, practically beseech the APS to lobby them for funds.

But while undoubtedly necessary, this form of political engagement carries with it three sets of dangers. The first may arise when the APS speaks out, not on economic, but on political matters, as it did through much of its history, in defense of the Astins, the Condons, and the Oppenheimers, or on controversial public issues such as arms control and ballistic missiles, or against "junk science" and pseudoscience. The public may well discount the findings and statements as those of just another self-serving special interest group. A second and related danger is that the Society will actually refrain from engaging these issues and making statements out of fear that to speak out will offend politicians and members of the public whose support and good will is needed in the battles of the budget. This has not happened yet, but some leaders have used this very argument in urging against statements that they feared would engender a negative reaction (particularly when they themselves were against the content of the statement under consideration).

The third danger is perhaps the most vexing. It is the temptation, in pursuit of support for science in general and one's research in particular, to say things that one knows are not accurate or relevant, because one believes that the public and the politicians want to hear them. But again scientists are being urged to do just that [220]. In justification it is said -often accurately -that this approach works, at least for a time. Thus for more than four decades physics research (and teaching), including the most basic research with no discernable or even conceivable applications, was handsomely supported by the uncontested popular belief that it all was necessary to fight the cold war [221]. With the cold war over and physics budgets threatened, some have come to believe that this was a mistake [221]. Now the emphasis in lobbying for better support for physics is on its unquestionably essential contributions to technology and to medicine. Since antiquity science and scientists have always been supported, at least in part, for what they could do for their king and country. But for the scientists themselves and - so the perhaps self-referential belief goes - ultimately for all of civilization, purely curiosity driven research undertaken for no reason except to want to know, is just as important and worthy of support [223]. If that is the case, science and particularly physics should be presented to the public on that basis. Skepticism - one might even call it *de haut en bas* cynicism - that this will work may not be fully justified. As the negative reaction by a reviewer for *The New York Times* to what he perceives to be justifying each physics discovery in the 20th century by its practical applications shows [218], not everyone outside of science devalues curiosity-driven research. And the astronomers who would find it difficult to claim many practical benefits for their science have seen their field and their research command a great deal of public interest and support [224].

Perhaps physics and its promoters should more resolutely take their cue from a great scientist whom they share with the astronomers, Subrahmanyan Chandrasekhar, who defended and praised science for its poetry and its beauty "to which the human mind responds at its deepest and most profound" [225]. Not that the APS has betrayed this legacy or that its leaders are not striving to cope with striking the delicate balance between pursuing and promoting basic as well as applied physics. As the 1999 President, Jerome Friedman, has expressed it on the occasion of the Centennial, "...the physics community must continue to reach out to the public and the government with the message about the intellectual *and* practical benefits of science [emphasis added]" [226]. Most, but not all, of the Society's membership and constituency agree with giving the disinterested quest for knowledge equal status with promoting the utilitarian and economy-driven pursuits of science. Other representatives of the physics community, including AIP which, from its beginnings, has assumed the task of improving relations and cooperation with industry, emphasize the corporate orientation more. The dichotomy, if not the imbalance, which APS's first President Henry Rowland saw and expressed so clearly a hundred years ago, "the pursuit of so-called practical science which ministers to our physical needs" as opposed to "the grander portion of the

subject which appeals to our intellect alone" [20], is still with us [227]. Its resolution - insuring a *modus vivendi* for an elitist profession in an egalitarian society - will challenge the American Physical Society in its second century.

ACKNOWLEDGMENTS AND DISCLAIMERS

I wrote this article on the occasion of the centenary of the American Physical Society. It is an attempt to present a balanced account of the Society's origins and evolution, and of its works to advance and diffuse the knowledge of physics through its journals, meetings, and activities in the public arena. It is certainly not complete and - having been written by a physicist who was an APS officer from 1985 to 1996 and a volunteer before and after those years - perhaps more idiosyncratic than the work of a professional historian would have been.

Except for occasional passages and references that were required to provide context for events which affected the Society or for the actions that it undertook, this work does not deal with the scientific or the socio-political history of physics in the twentieth century. The sociology and politics are covered thoroughly by Kevles's "The Physicists - The History of a Scientific Community in Modern America" [2], where he also provides the scientific background needed for his purpose. Many accounts of the *scientific* history of physics in the twentieth century have been and will be provided on the occasion of its *fin de siècle*, including, on a professional level, the APS-Springer work "More Things in Heaven and Earth - A Celebration of Physics at the Millennium" [216], and on a more popular level the *wall-chart* "A Century of Physics" [215], that was produced by APS for distribution to schools.

Melba Phillips has written and published, in the *American Journal of Physics*, an excellent - and for this work invaluable - account of the first fifty years of the Society [12]. While she felt obliged to decline an invitation to work with me in bringing it up to date, she was enthusiastic about the project and pointed me to the unpublished manuscript from which the *American Journal of Physics* article was produced. The editor of that journal, Robert Romer, was kind enough to provide me with a copy of the manuscript. Other particularly useful sources have been the magisterial tome "The Physical Review -The First Hundred Years" [101], and the engaging slim volume "A Memoir on the Physical Review - a history of the first hundred years" by Paul Hartman [100], both published to mark the *Physical Review*'s centenary in 1993. Being able, in the present article, to refer readers to these two works has allowed me to give less space to the *Physical Review* here than, as APS's' leading contribution to the dissemination of physics, it would otherwise require.

The APS has neither commissioned nor sponsored the writing of this history, having decided, probably wisely, to concentrate its efforts and resources at the Centennial to celebrating physics, rather than itself. Still, it seemed to me that, inasmuch as the Society has been a significant part of the history of physics in this century, an APS-centered account would also be of interest and value. When no one else came forward to write one, I did. Late in the planning for the Centennial, APS did decide to include an annotated display of its history among the exhibits. Curated by Sara Schechner, that exhibit [214] has adopted, not accidentally, a similar title, "To Advance and Diffuse the Knowledge of Physics - 100 Years of the American Physical Society", as the one of this article; naturally its preparation and the final work on the article have had a symbiotic relationship.

The magazine *Physics Today* decided to observe the end of the century and the one hundredth anniversary of the APS with a special issue "Physics and the Wider World". One article in it, "APS and the Wider World" [228], is devoted to the beginnings of the APS and to part of the history of its public affairs activities. It consists, in effect, of edited excerpts from the present, much larger work.

The foregoing makes it clear that this article is, in no sense, an "official" history of the APS. All interpretations and unattributed opinions are mine. I do however want to thank the following present and former APS officers and staff members, and other colleagues, for having critically read portions of the article in various stages, for having provided data and other information, and for logistical support: Stanley Brown, Karie Friedman, Barbara Gill, Amy Halsted, David Hafemeister, Bill Havens, Irving Lerch, Trish Lettieri, Gloria Lubkin, Tom McIlrath, Richard Meserve, Eugen Merzbacher, Claire O'Neill-Sinks, David Pines, Barrie Ripin, Sara Schechner, Brian Schwartz, Roger Stuever, George Trigg, Spencer Weart, and Mark Wilson. 'Though the list is long, it is almost certainly not complete. Needless to say, any remaining errors are mine. The superb historical documents and photographs collection in the Niels Bohr Library of the American Institute of Physics [229], the Council minutes in the APS office, and the complete and accessible collections of the *Bulletin of the American Physical Society*, of the *Physical Review*, of *Reviews of Modern Physics*, and of other journals in the library of the Los Alamos National Laboratory were invaluable resources.

NOTES AND REFERENCES

a) Mailing address: 304 Chula Vista Street, Santa Fe, NM 87501. E-mail address: lustig@aps.org.

1. "the first great American scientist after Franklin"{*The New Encyclopedia Britannica* (Chicago, 1975), 15th ed., Micropaedia Vol IV, p.1029}**,** and first head of the Smithsonian Institution, who took the initial steps to cultivate a physics community. In discussions leading to the organization of the American Association for the Advancement of Science (AAAS) in 1847, he proposed that physics should have a section of its own in the Association (but that did not happen until 1882). The other major science organization, the National Academy of Sciences, founded in 1863, was reorganized by Henry between 1867 and 1872 into an honorary society for recognizing and advancing original research. The Academy's early members were principally from the physical sciences {George H. Daniels, *Science in American Society* (Alfred A. Knopf, New York, 1971)}.

2. Daniel J. Kevles, *The Physicists-The History of a Scientific Community in Modern America* (Harvard University Press, Cambridge, MA, 1995), 2nd print., p.7.

3. ibid., p.26.

4. A.G. Webster, Presidential Address to the American Physical Society, "Some Practical Aspects of the Relation Between Physics and Mathematics", Phys. Rev. **XVIII**, 297-318, (1904).

5. Melba Phillips, "Arthur Gordon Webster, Father of the APS ", Phys.Today **40** (6), 48-52 (1987).

6. Kevles, op. cit., p. 77.

7. 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." (Kevles, op. cit., p. 25). At the age of twenty-seven, he was appointed the first professor of physics at the newly founded Johns Hopkins University. While working in Helmholtz's laboratory in Berlin, he had succeeded in demonstrating that an electrically charged rotating disk would produce a magnetic field. Back at Hopkins he meticulously obtained an authoritative measure of the ohm and an improved value for the mechanical equivalent of heat. Then, in 1882, he revolutionized the study of light spectra through his invention and use of the Rowland grating (ibid., pp. 26-27). When he assumed the presidency of the APS he was already ill and he died in office on April 16, 1901. In his obituary for Rowland {"Henry Augustus Rowland, Physicist", Phys. Rev **XIII** (1), 60-64 (1901)}, E.L. Nichols records Rowland's extraordinary accomplishments and goes on to say: "The recognition of Rowland's genius was early and unusual...In 1881, when he was only 33 years of age, he became a member of the National Academy of Sciences, the youngest man probably upon whom that honor has ever been conferred". (The record probably still stands.) But Nichols adds: "For routine teaching he had neither taste nor aptitude and even of the more advanced students only those who were able to brook severe and searching criticism reaped the full benefit of being under him". (One would be surprised to see such a frank appraisal of the teaching performance of a distinguished physicist-colleague in a physics journal today, but not necessarily because it would never be deserved.) It seems unnecessary, for the audience for which this article is intended, to provide any biographical information on Michelson, except perhaps to remark that he was not only the first American Nobel laureate in science - he received the physics prize in 1907 - but also the first, in what was later to become a long list of *foreign-born* physicists, who served as presidents of the APS. He appears, incidentally, not to have been very diligent as president - seven successive proceedings of meetings in 1901 and 1902 carry the notation "in the absence of the President, Vice-President Webster presided" - and failed to give a presidential address.

8. Gibbs, chary of organizations, had earlier declined to help organize the Mathematical Society: " [though] I have felt favorably inclined towards the plan....[in view] of my confirmed absenteeism in the few societies to which I belong, it seems hardly worth while for me to join in the undertaking..." {Lynde Phelps Wheeler, *Josiah Willard Gibbs* (Yale U.P., New Haven, CT, 1951), pp. 181 -182}. Aware of these sentiments, Webster apparently did not try to involve Gibbs in the organization of the Physical Society and, in fact, Gibbs never became a member.

9. Although Webster remained all his life a classical physicist and apparently did not assimilate the new developments coming from Europe, he was important and highly esteemed. J.J.Thomson praised him and O.W. Richardson remarked: "None of those who, like myself, had the privilege of being associated with him will ever forget his great geniality, his quick mind, and his forceful methods of expression. Any scientific gathering which secured his presence was assured of success." Webster, by every appearance, also was not only a genial but a contented man for most of his life. In 1910 he reported to the secretary of the Harvard class of 1885: "My life has been entirely devoted to scientific work [this was not quite accurate - he also pursued his interests in languages and writing], which I have thoroughly enjoyed. I ... have ample time for my own researches. My life has been totally uneventful, unmarred by accident or sadness. I have hardly been ill since leaving college, a result of the use of the gymnasium then and since, and the avoidance of athletic contests. My scientific work has been rewarded by election to the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences...". Yet, on 13 May 1923, he killed himself, using a gun he had obtained the day before, ostensibly for use in his research laboratory. Melba Phillips (Ref. 5, from which all quotations in this note are taken) reports that the new president of Clark University, Wallace W. Atwood, had clashed with Webster over academic freedom issues during the "red scare" of the early 1920's. Among other actions, Atwood had banned the left-leaning *Nation* magazine, to which Webster had been a frequent scientific contributor, from the University's library. More directly threatening to Webster, Atwood was clearly embarked on a course of diminishing graduate work and research at Clark. He abolished the graduate department of mathematics, forcing two full professors into retirement. There were rumors that the entire graduate school was to be closed and that physics would go next. In 1922 Princeton University conferred the honorary degree of Doctor of Science on Webster, but at Clark he was in imminent danger of losing his job. The shocking and astonishing event of Webster's suicide was noted in scientific circles both in the US and abroad. It was the subject of a special feature in the *New York Times* and there was a five column obituary in *Science.* There was only a brief -'though moving - obituary in *The Physical Review*, written by its managing editor, G.S. Fulcher, who had been a student of Webster. The Council of the American Physical Society took no notice of the death of the Society's founder. Phillips rightfully deplores this disregard and her 1987 article served finally, but only partially, to repair the omission.

10. Michael Pupin, *From Immigrant to Inventor*, Scribner's, New York, 1925, pp. 91-103.

11. Phys. Rev **75**, 1601-1604 (1949).

12. Melba Phillips, "The American Physical Society: A Survey of Its First 50 Years", Am. J. Phys. **58** (1), 219-230, (1990). The call to the meeting is reprinted as Appendix A.

13. Kevles (op. cit., p. 77) states that there were thirty-eight participants. He apparently assumes, erroneously, that Rowland

and Michelson were there.

14. Ref. 12, Appendix B gives the names and institutions.

15. As early as 1893, a firm of druggists had offered to exchange its magazine with the newly founded *Physical Review* (*Meyer Brothers Druggist* to E.L. Nichols, 23 February 1893, Cornell University Rare Manuscripts Division).

16. Amy Halsted, *From Manhattan to Maryland - The American Physical Society and Its Relocation"*, unpublished masters thesis**,** Baruch College of the City University of New York (1993), p.3. The main contribution of this work is to tell the story of the controversial move of the Society from New York to College Park, which was debated from 1988 to 1990, and took place in 1993.

17. Kevles, op. cit., p. XXIV.

18. To be sure, much of the time, particularly in the flush post World War II years, when there were two to four times more openings than the number of physicists looking for jobs, the placement service provided more of a benefit to the country than to the physicists. In 1956, Paul D. Foote reported, {"Physics Then and Now", Phys.Today **9** (9), 21 (1956)} that, at the APS meeting in New York City, the recruiters mobbed the fifth and sixth floors of the hotel, enticing and enlisting candidates for industrial, governmental, and academic positions.

19. Phys.Today **26** (5), p.32 (1974).

20. Bull. Am. Phys. Soc. **I** (1899); reprinted in Spencer Weart, ed. "*Selected Papers of Great American Physicists*, American Institute of Physics, New York, (1976), pp. 91-103.

21. "As a new fact arrives the scientist changes it [the probability of truth] from one compartment to another...The ideal scientific mind, therefore, must always be held in a state of balance which...new evidence may change in one direction or another. It is in a constant state of skepticism, knowing full well that nothing is certain. It is above all an agnostic with respect to all facts and theories of science as well as to all other so-called beliefs and theories. Yet it would be folly to reason from this that we need not guide our life according to the...knowledge that we possess...Our only course...is to act according to the chances of our knowing the right laws. If we act correctly, right; if we act incorrectly, we suffer. If we are ignorant we die. What greater fool, then, than he who states that belief is of no consequence provided it is sincere." Apparently physics had to contend with both postmodernists and "final theorists" even in Rowland's time.

22. Rowland characterized the dichotomy as "the pursuit of so-called practical science which ministers to our physical needs" as opposed to "the grander portion of the subject which appeals to our intellect alone". He unapologetically declared curiosity driven research to be the more valuable of the two: "He who makes two blades of grass grow where one grew before is the benefactor of mankind; but he who obscurely worked to find the laws of such growth is the intellectual superior as well as the greater benefactor of the two." But he also gave full recognition to the need for and the usefulness of applied, practical work. After deploring the ignorance of and lack of attention to medical science, he said ... all the sciences are linked together and must advance in concert. The human body is a chemical and physical problem, and these sciences must advance before we can conquer disease. But the true lover of physics needs no such spur to his actions. The cure of disease is a very important object and nothing can be nobler than a life devoted to its cure. The aims of the physicist, however, are in part purely intellectual: he strives to understand the Universe on account of the intellectual pleasure derived from the pursuit, but he is upheld in it by the knowledge that the study of nature's secrets is the ordained method by which the greatest good and happiness shall finally come to the human race."

23. "Where", he asked, "are the great laboratories of research in this city, in this country, nay in the world? We have a few miserable structures here and there occupied by a few starving professors who are nobly striving to do the best with the feeble means at their disposal. But where in the world is the institute of pure research ... with an income of $100,000,000 per year? Where can the discoverer in pure science earn more than the wages of a day laborer or cook? But $100,000,000 per year is but the price of an army or navy designed to kill other people. Just think of it, that one percent of this sum seems to most people too great to save our children and descendants from misery... "

24. to use Kevles's (op. cit.) ubiquitous and accurate, but, in today's political atmosphere, somewhat risky term.

25. Kevles, op. cit., p. 43.

26. ibid., p. 50.

27. Bull. Am. Phys. Soc. **1** (1), 4-14 (1925).

28. Kevles, op. cit., p. 87.

29. The decision to organize that society was actually made at a scientific conference of astronomers and astrophysicists, organized by George Ellery Hale and held in October 1897 in connection with the inauguration of the Yerkes Observatory. It took two years - until September 1899 - for the society formally to come into existence. The hotly debated name adopted at the time was the "Astronomical and Astrophysical Society of America". The older astronomers, reflecting their training and orientation, wanted simply to call it the "Astronomical Society", but Hale had a very different society in mind - one that would include more than the old astronomy. He wanted to establish a society that would attract physicists, because he saw physics as central to the pursuit of astronomy and he thought that he had a chance of doing so, because the APS had not yet been formed. In fact his initial choice for a name was the "Astronomical and *Physical* Society of America" [emphasis added]. A number of prominent physicists, among them Michelson and Rowland, participated in the meetings that led to the establishment of the society and in fact the latter was a major force in the inclusion of "Astrophysical" in the name. Had Hale succeeded in his endeavors to annex physics, an American Physical Society might not have been created in 1899. It is amazing that there appears to be no reflection of this history in the accounts of the founding of

the APS. In 1914 the AAS received it present name, “American Astronomical Society”. By that time astrophysics had been fully accepted and it was no longer necessary explicitly to call attention to the legitimacy of the subject in the name. {”The American Astronomical Society’s First Century”, David H. DeVorkin, ed. Published for the American Astronomical Society through the American Institute of Physics (1999), pp. 3-19, 27-34.}

30. The first paragraph of the report provides a summary. “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. This feeling is quite general, and whether justified or not, has been definitely evidenced by the formation of such organizations as the Optical Society, the Acoustical Society, the Rheology Society, and others. It is also evidenced by the contemplated formation of the Society of Applied Physics and another Society of Applied Mathematics, the latter being sponsored mainly by mathematical physicists. The feeling is still further evidenced by the fact that numerous papers dealing with pure and applied physics are not even submitted for the consideration of the *Physical Review* but are published in various chemical, engineering, photographic, and geological journals. This state of affairs is a serious reflection upon the limited activity of the Physical Society in the general field of physics” (Ref. 12, 224). It is not clear whether the writers of the report and those for whom they spoke were aware of or impressed by the increasingly pervasive and successful application of quantum mechanics to such subjects as chemistry and (what is now called) material science. Neither Foote’s criticism of the Society nor his industrial affiliation and orientation seems to have been counted against him: he was elected president for 1933.

31. Contrary to Phillips (Ref. 12, 222) this decision was made not by the Council, but by the membership at a meeting (the 39th, at the University of Chicago, on May 30th, 1907) where the minutes record that “The Council brought before the meeting a request from the College Entrance Examination Board that the Physical Society cooperate with it in the formation of a Committee to consider the revision of the definition of the Board’s present entrance requirements in Physics. After discussion it was moved, and carried by a large majority, that the invitation be declined on the ground that the teaching of Physics and all pedagogical matters lie outside the province of the American Physical Society”{Proceedings of the American Physical Society, Minutes of the Thirty-Ninth Meeting, Phys. Rev. **XXVI**, 1184 (1908)}.

32. Minutes of the Council and Proceedings of the American Physical Society, on file at the office of the American Physical Society, College Park, MD.

33. The others were to establish a student membership and to make available a special subscription to *The Physical Review* for individuals who were members of societies interested in the teaching of physics. (Ref. 12, 222.)

34. For an example, see “The Teaching of Physics - With Especial Reference to the Teaching of Physics to Students in Agriculture”, Bull. Am. Phys. Soc. **1** (11), Supplement, 25 pages (1925-26).

35. A full account of APS’s actions and inactions in education in the first three decades of the century and of the events that led to the formation of the AAPT, as well as of the subsequent history of the Association, is given by Reuben E. Alley (http://www.aapt.org/aaptgeneral/96hist.html).

36. The other goals were to influence the style and extent of graduate education, to make faculty and students aware of the challenging technological problems of industry, and to examine the need for continuing education of practicing physicists (Ref. 32).

37. the well known and versatile physicist, author, and university administrator Kenneth W. Ford. He had been president of the AAPT in 1972 and would go on to become executive director of AIP in April 1987 . Ford’s history illustrates the fact that all along there were persons of substance whose leadership in both APS and AAPT helped to foster positive interactions. Thus J.W. Buchta, who had held senior editorial positions on the APS’ *Physical Review* and *Reviews of Modern Physics*, later became AAPT’s first *full-time* executive officer. Judy Franz, APS’s executive officer since 1994, was president of AAPT in 1990-1991. And Edward U. Condon served both societies as president: APS in 1946 and AAPT in 1964-65. Another common bond is the AAPT’s respected and engaging *American Journal of Physics*, in which a number of APS members publish and which many more read for profit and pleasure.

38. This unique institution “combining the functions of a government agency, a private foundation, and an industrial trade association” (Ref. 12, 224), which also directly supported researchers in physics and, to a much larger extent, chemistry, had been funded thorough the resale to “loyal Americans “ of German-held plants and patents that had been seized by the US Department of Justice following World War I.

39. ‘Though AIP’s history is shorter and, perhaps, less portentous than APS’s, it deserves an up-to-date presentation of its own. Early accounts were given by K.T. Compton, {“The American Institute of Physics”, Rev. Sci. Instrum. **4**, 57-58 (1933)} and H.A. Barton, {“The story of the American Institute of Physics,” Phys.Today **9**, (1), 56-66 (1956)}.

40. Some of the leading lights in the Society - particularly those with interests and achievements in several areas of physics - viewed this development with apprehension. Thus Eugene Wigner, who was to become president of the Society in 1956, wrote to J.H. Van Vleck (president in 1952) on July 25, 1945: “...It seems to me that if we split up the American Physical Society into many sub-organizations we may do an excellent job as an employment agency for people who want to specialize in certain fields. However, the charm of physics consists for me , and I am sure for most of our colleagues, in the fact that it comprises all the phenomena of the non-living world and that a Society which has abandoned general interest in all this is not a physical society any more. As you say, the example of the American Chemical Society should be a warning to us all...” (Ref. 229).

41. The dates of organization and capsule descriptions of the divisions and other units of the APS, as well as lists of their past and present officers, are given in the American Physical Society 1998-1999 Centennial Membership Directory, pp. A-12 to A-20.

42. W.W. Havens, Jr., private communication. That there was strong sentiment for giving the divisions recognition, representation, and power is evident from a report in the 1966 *Bulletin* of the results of a meeting of divisional officers with the Council: "The Council notes with sympathy the views presented in favor of a strong divisional structure for The American Physical Society and recommends...[that] 1)Each clearly recognized field of physics should be represented by a Division. 2) Each Division should be represented on the Council. 3) Each Division should be responsible for organizing or advising on the presentations for Society meetings and topical conferences." {Bull. Am. Phys. Soc. II, **11** (1) 6 (1966)}. These proposals were spelled out in detail in the proposed new Constitution that was presented to the members in a subsequent issue {Bull. Am. Phys. Soc. II, **11** (4) 666-684 (1966)}. K.K. Darrow did not like the new provisions. In his *Valedictory*, upon his retirement as Secretary at the end of the 1967 Annual Meeting, he writes: "...That some leaders of Divisions want a voice in the Council is understandable; but the divisive forces have gained in strength, and will tend to convert the Society into a likeness of Place Vêndome in Paris, where the harmonious façades designed by the original architect now disguise a medley of interiors totally changed and not always changed for the better". The 1966 constitution made several other changes, including having the Council, instead of the membership, elect the Secretary and the Treasurer, and specifying the duties and mode of operation of the Council in much greater detail than before, and Darrow didn't like any of them: "...Our old Constitution was a masterpiece of economy and flexibility, giving immense freedom with a minimum of restrictions. Much of the new Constitution consists of commands laid upon the Council and the officers to do things that they were doing already, or things that they could have done had they deemed it judicious. Unconstrained, the officers have wrought as well for the Society as though they had been bound by such constraints; unguided, they have furnished their own guidance; uncontrolled, they have needed no control..." {Bull. Am. Phys. Soc. II, **12** (1) 5 (1967)}.

43. Forums, which had in the meantime been established, were each given one voting councillor regardless of size, so long as it met a minimum threshold. Geographic sections, were given non-voting representation ("advisors") on the Council, if their membership exceeded the threshold.

44. Finally there is a provision for non-voting "administrative representatives"- the director of AIP and high ranking APS staff members. In 1997 the Council consisted of the seven officers, two other ex-officio (voting) members - the chair of the Nominating Committee and of the Panel on Public Affairs - twenty divisional councillors, four forum councillors, sixteen general councillors, five section advisors, and nine administrative representatives, for a total of sixty-three participants.

45. This has led, during the past year, to a consideration of reversing the growth of the Council by reducing the number of general councillors and returning the representation for each division to one, regardless of size, as well as eliminating the section observers. In order to preserve the representation from the various constituencies, an alternative approach would leave the size intact, but involve the councillors more in the running of the Society by requiring them to serve, in larger numbers, on Council committees that will prepare "legislation" for the full Council.

46. Bull. Am. Phys. Soc. **II**, 37 and 59 (1901). He wrote to his mother: "I left for New York after Christmas in order to attend the meeting of the American Physical Society. The meeting was held in Columbia University, where I gave two papers which were pretty well received, as I am the only worker in the field of excited radioactivity in the English-speaking world..." {Arthur Stewart Eve, *Rutherford*, Cambridge University Press (1939)}. At McGill, during his seven year stay, he wrote eighty papers {Thomas Edward Allibone, "Rutherford, Lord", in The New Encyclopaedia Britannica, Macropaedia, **16**, 107 (1975)}.

47. "The magnetic and electric deviation of the easily absorbed rays from radium" {Phys. Rev **XVI** (3) 181-182 (1903)} under "Proceedings of the American Physical Society -Minutes of the Eighteenth Meeting. A footnote announces that "the minutes of all meetings of the American Physical Society and abstracts of papers presented to the Society will hereafter be published in the PHYSICAL REVIEW. The publication of the *Bulletin of the American Physical Society* has been discontinued". Rutherford continues with "Does the radioactivity of radon depend on its concentration?" {Phys. Rev. **XVIII** (2) 117-118 (1904)}; " The heating effects of the radon emanation" (with H.T. Barnes, ibid., 118-120); "Radioactive charge" - an invited paper at a joint meeting with the International Electrical Congress {Phys. Rev. **XIX** (4), 298 (1904)} - the meeting was in September 1904 in St. Louis, but the talk is listed in the *Physical Review* Proceedings by title only; "Some properties of the alpha rays from Radium, II {Bull. Am. Phys. Soc. **XXII** (2) 80-81 (1906); and "Magnetic and electric deviation of the alpha rays" (ibid).

48. Phys. Rev **XVI** (3), 183 (1903).

49. ibid., 184-192.

50. "Report of progress in ruling diffraction gratings", Phys. Rev **XX** (6), 389-90 (1905); " Reciprocal diffraction phenomena", ibid., 391); "Use of the concave mirror with diffraction gratings, ibid.

51. Phys. Rev. **XXII** (2), 122-123 (1906).

52. Phys Rev. **XXIV** (2), 227 (1907).

53. Phys. Rev. **XXIV** (1), 116-118 (1907).

54. Phys. Rev. **XXII** (6), 318 (1906).

55. Phys. Rev. **XXIV** (4), 379 (1907).

56. Phys. Rev. **XXII** (2), 82-110 [it was a long talk] (1906).

57. Phys. Rev **XXVI** (96) 497 -511 (1908).

58. At the meeting of the Society, in October 1899 - the one following the creation - all four papers were read by founding members, one by Rowland, one by Pupin, and two by Webster; in addition there was Rowland's presidential address. The following meeting, in December, featured a joint session with the American Mathematical Society which heard AMS President R.S. Woodward's address on the "Century's progress in applied mathematics" and a paper by Pupin on "The propagation of electric waves along non-uniform conductors". This time there were three contributed papers, by Rowland, Webster, and one non-founder, D.B. Brace. At the June 1900 meeting, which was joint with Section B of the AAAS, the number of papers reached sixteen, but the meeting thereafter again had only four. The 1901 joint meeting with AAAS had six papers, four of which were read either by title or by stand-ins; the location of the meeting at Denver (in the High School Building) - the first time that a meeting was not held at Columbia University - almost surely accounted for the dearth of papers and attendees. In 1902, back at Columbia, the Society, meeting alone, was able to muster fourteen papers. The 22nd meeting, in December 1903, was held at Central High School in St. Louis and attracted twelve papers. The 23rd meeting in February 1904, back at Columbia, had only six. The 24th meeting, in April 1904 in Washington, set a record with twenty papers; it was broken at the 26th meeting at the University of Pennsylvania in 1905, when twenty-nine papers were read. Columbia made a temporary come-back at the 28th meeting of April 1905, where thirty-seven papers were given, including the three by Michelson, but soon relaxed to its lower norm. The 33rd meeting in June 1906 was the first to be held at Cornell and attracted thirty-one abstracts. At the 34th meeting in December at the University of Chicago, which had twenty-one papers, a resolution was adopted "directing the attention of the Council to the desirability of holding a regular yearly meeting in Chicago". (Sixty years later, in the wake of the suppression of the anti Viet-Nam war demonstrations, members petitioned the Council *not* to hold its 1970 meeting in Chicago; see Section V.) That same month, the joint meeting with the AAAS meeting at Columbia set a new record of forty-five papers. The number fifty was reached at the 1907 meeting in Chicago, where papers were given over four days including New Year's eve and New Year's day.

59. The 1905 version of the APS' Constitution and By-Laws and list of members, issued by the Society as a separate pamphlet while the *Bulletin* was not published (having been partially absorbed by *The Physical Review)* contains the announcement "Members are...requested to state the time required for the presentation of each paper. If the time is not stated by the author the time announced on the program will be fifteen minutes". Volume I of the resumed *Bulletin,* for 1925-26, provides an interesting and informative picture of how the meetings had evolved from twenty years earlier, and how often and where they were held.

60. Phillips (Ref.12), citing APS Secretary (1923-1928) H.W. Webb, reports that "Millikan was especially adamant on the subject, but three days of sessions, eighteen papers per session, lasting until 6:00 p.m. on Saturday with *no* audience finally reconciled him".

61. This at the time practically unique fellowship program played an important role in furthering the development of the most promising American physicists and scientists in other fields. Being named a fellow not only conferred a signal honor on the recipients, but provided much needed resources.

62. The nature of cosmic rays was the subject of the longest and perhaps most heated debate at APS meetings, according to John Blewett (private communication, February 18, 1999) and other participants and listeners. The chief protagonists were Robert Millikan, W.F.G. Swann, and Arthur Compton (all presidents of the APS, in 1916-17, 1931-32, and 1934, respectively). All that was known for a long time was that cosmic rays were very energetic, but attempts to identify their source yielded cryptic results. Speculations - some wild - about their nature and origin could therefore neither be proved nor disproved for many years. Millikan continued to insist that they were gamma radiation, even when Compton conclusively demonstrated that the intensity of the radiation depended on magnetic latitude. It took more than thirty years to discover its true nature: for the most part positively charged atomic nuclei arriving at the top of the atmosphere. Kevles (op.cit., pp.179-80, 231-3, 236, and 240-2) has much of interest to say not only about the controversy, but also about the light it cast on the protagonists, and especially on the strong religious convictions of Millikan.

63. The abstract of the paper (given on 27 April 1939) by Booth, Dunning, and Slack "Fission of uranium and production of delayed emission by slow neutron bombardment", Bull. Am. Phys. Soc. **14** (2), 19 (1939), does not substantiate the interpretation of a statement by W.W. Havens, Jr. (Ref. 185) that Dunning et. al. at that time demonstrated Uranium 235 to be the important isotope in fission. The abstract confines itself to announcing that the talk will give the range in air of fission products of uranium and the energy distribution of the fission products and reports the measured cross section of delayed neutron emissions after exposure to a strong neutron source to be 1/100 of the value for the fission cross section by slow neutrons. It references a letter to the editor that appeared on March 1, 1939 in *The Physical Review* by Andersen, Booth, Dunning, Fermi, Glasoe and Slack {"The fission of uranium", Phys. Rev. **55** (5), 511-12 (1939)}, which, in turn, contains the following sentence: "As suggested by Professor Bohr, a possible explanation [for the known fact of uranium having a sharp resonance for slow neutrons of about 25 ev that does not lead to fission but to the formation of U^{239}] is that the fission does not occur from U^{238} but from U^{235} which is present in an amount of somewhat less than 1 percent." Bohr made that suggestion in a letter to the editor of *The Physical Review,* which appeared just two weeks earlier, on February 15 , 1939, and was written on February 7 {"Resonance in uranium and thorium disintegrations and the phenomenon of nuclear fission", Phys. Rev. **55** (4), 419 (1939)}, where he advances *theoretical* arguments that "... we have the possibility of attributing the effect concerned to a fission of the excited nucleus of mass 236 formed by the impact of the neutrons on the rare isotope of mass 235". The definitive paper by Bohr and Wheeler on fission, published on September 1, 1999 { "The mechanism of nuclear fission", Phys. Rev. **56** (5), 416-450, (1939)} again states on theoretical grounds that "a considerable part of the fission

phenomena ...[are] reasonably attributable to the rare isotope U^{235}." Thus it is unlikely that any experimental identification of U^{235} as the responsible isotope was announced before then. Of course we do not know what, if anything , was *said* at the April meeting, that went beyond what was published. The authoritative account by Roger H. Stuewer, "Bringing the news of fission to America" {Phys. Today **38** (10), 2-10 (1985)} recounts the fascinating story of the interplay between Bohr, Lise Meitner, Otto Frisch, and others, in arriving at and announcing the interpretation of Otto Hahn's, Fritz Strassmann's, and Meitner's discovery and of the head start that Enrico Fermi and the Columbia group had in initiating follow-up experiments. It does not deal with the experimental identification of U^{235} as the fissionable isotope, nor with the question whether the experimenters and Bohr announced their results first in print (in *The Physical Review*) or at an APS meeting. It is worth noting that in 1939 the delay between the submission of letters to *The Physical Review* and their appearance in print was easily short enough for the publication to have occurred first.

64. The Committee consisted of Gregory Breit (chairman), Jesse W. Beams (who was to become APS's president in 1958), George Pegram (the APS treasurer whose term, from 1918 to 1957, spanned the time of his war-time service), and later, Eugene Wigner (APS President 1956), who was added at Breit's request. H.A. Barton of AIP was put in charge of the repository of secret papers; he carefully noted the date of receipt of each paper (Ref.12, 226), which was important for establishing priority when many of the papers were published after the War.

65. In his announcement of the meeting, Secretary K.K. Darrow wrote: "Those whose knowledge of the Society began after Pearl Harbor will be surprised at the magnitude of the program, which is a reminiscence of prewar days and a foreboding of the future. Gone are the times of small meetings with ample intervals for leisure and for discussion, which for the past three years have reminded our older members of the early days of the Society. It is no longer possible to arrange the papers so that everyone can hear everything in which he may be interested, and the Secretary can only hope that he came somewhere near to achieving the minimum amount of interference possible under the limitations of time" {Bull. Am. Phys. Soc. **21** (1) 3 (1946)}.

66. For the benefit of very disengaged or very young readers, the editors of *Physics Today* found it necessary, in an excerpt from this article, to add the explanation that the term was "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" (Ref. 228).

67. The program for the 1926 annual meeting includes an obvious crank abstract, "Theory of the magnetic nature of gravity**"** {Bull. Am Phys. Soc. **I** (5), (1925-26)}.

68. In fact few "eccentric" abstracts are submitted and even fewer authors actually show up to give the papers. Usually they are slotted for the beginning or end of *bona fide* sessions, but occasionally they have been accorded a session of their own, under the rubric "Miscellaneous Topics". Those, like this writer, who have been importuned into chairing such sessions, tend to favor the distributional approach.

69. The New York Times, July 16-19, 1952. According to these reports, Peakes was "upset" because the APS had refused in 1949 to publish a pamphlet by him, entitled *So You Love Physics*. He had the work privately published and sent it to 6500 APS members. By 1952 he was convinced that his electronic theory held the key to prolonging human life. He went to the APS office to "kill some physicists", but found only the eighteen year old Eileen Fahey. He said that he hoped that "the shock of the murder" would draw attention to his ideas.

70. In the 1930's a single room in New York at the Hotel Pennsylvania cost $3.50 and prices were at that or an even lower level throughout the depression. After the War, hotel prices rose first slowly and, beginning in the 1980's, very rapidly, and by the 1990's had reached three figures (before the decimal point) in the large cities of the East and West coasts. The 1999 Centennial Meeting was held in Atlanta, rather than in one of the historically and politically more appropriate locales, New York or Washington, because in Atlanta a room in the headquarters hotel could be obtained for "only" $131 per night. Official dinners in 1925-26 were $2.00, except for Washington, where they cost $2.50. (Washington seems to have been an expensive city even then.) For those who did not want to pay that much, the *Bulletin* also carried information on restaurants famous for (what would now be called) ethnic dishes: thus, in New York, dinners at the Russian Tea Room were $0.75 and $ 0.95, while at Luchow's the (then perhaps justly) famous German restaurant, dinner was $1.50. By the nineties, in order to keep the "banquet" at the Spring meeting going at all, APS was selling tickets at the subsidized price of $30.

71. At a meeting at the old New Yorker hotel in Manhattan in the late fifties, the author overheard two bellboys (as they were then called) commiserating about the lack of business, "I don't understand these guys", one said, "all they do is stand around all day and talk". "Yeah", replied the other, "and not one of them has asked me for a girl yet." And W.W. Havens remembers, when in 1987 the March meeting was held for the first (and last) time in Las Vegas, the local paper reported that, with the physicists in town, the casino take was the lowest in history (W.W. Havens Jr., private communication). We have been unable to document Havens' recollection, but *si non è vero, è ben trovato*.

72. At the Society's founding and for many years thereafter participation in APS's meetings had been free of charge. In 1952, the Society's Secretary, K.K. Darrow, announced that "a registration fee of one dollar will be requested. The parlous financial situation of the Society, of which our members are destined to hear more, requires this alteration" {Bull. Am. Phys. Soc. **27** (4) 3 (1952)}. In 1959 the fee was raised to two dollars for the annual meeting because, as Darrow explained a year later, "... what with the need of renting so capacious a hall as the Manhattan Center and of paying other expenses attendant on conventions in hotels [these meetings] are costly affairs" { Bull. Am. Phys Soc. II, **1** (1) 1 (1956)}. In 1959, in an attempt to induce recalcitrant members to pay up, Darrow added, accurately, "To those acquainted with the fees of other societies [the two dollar fee] is more likely to appear absurdly small than unbearably large" {Bull. Am. Phys. Soc. II, **4** (1) 2 (1959)}. This

demonstration of APS's frugality and restraint apparently did not move all attendees, for in 1962 Darrow had to become more insistent and even to threaten a (minor) sanction: "The registration fee stays at the modest figure of two dollars. We insist on registration and we do not accept messages to be posted [on the message board] from anyone who has not yet registered"{Bull. Am. Phys. Soc. II, **7** (1), (1962)}. By 1996 the least expensive registration (that for a regular member who sent in the fee sufficiently in advance) for a "general" meeting was $195. Students, retired members and otherwise unemployed members (i.e. those classes who had little prospect of having their fees covered by employers) were assessed much less. At that, APS's registration fees have remained smaller than those of many other professional associations. The *Bulletin* was also initially free. In 1925 an annual subscription, for the six issues, cost $1; by 1939 it had risen to $5. By the nineties, members had been given the opportunity to subscribe to the eight to ten issues individually, at prices ranging from $7 to $14 (for the massive March meeting issue, which in 1998 weighed 1.7 kg). In 1999, "domestic non-members" (i.e. libraries) could subscribe to the *Bulletin* for $470 for the year. With programs and abstracts available over the Internet, *Bulletins* were no longer mailed out in advance of meetings. However copies continued to be available, gratis, to registrants at the meetings.

73. Even 'though the March meeting continued to be called a general meeting, K.K. Darrow, as early as 1952, recognized its specialized and, to him, divisive nature, deploring the "diversion of contributed papers in electron physics and solid state physics to Divisional and other meetings...The Annual Meeting is [therefore] coming to be dominated by nuclear physics and its generality is in danger of being lost"{Bull. Am. Phys Soc. **27** (1), (1952)}.By 1962 he was more specific: "The 'March' meeting, 'though in principle a general meeting of the Society, is practically a congress of three divisions of the Society - ...the Division of High Polymer Physics, the Division of Solid State Physics, and the Division of Chemical Physics. This year, only one of its forty-five sessions...lies outside the fields of all three" {Bull. Am. Phys. Soc. II, **7** (1), (1962)}. Other divisions had been holding their own separate meetings since the fifties, but they apparently went unrecognized by the *Bulletin* until 1963, when the notices of meetings to come included announcements of the *Fifth* [emphasis added] Annual Meeting of the Division of Plasma Physics, and of the Annual Meeting of the Division of Fluid Dynamics.

74. One measure to help assure better communication and help reduce alienation from the Society was taken in 1990, when Executive Secretary W.W. Havens, Jr. and Treasurer Harry Lustig instituted an annual "unit convocation" at headquarters, to which the chairs and secretary-treasurers of the divisions, topical groups, forums, and sections are invited.

75. Kevles, op. cit., p.40.

76. ibid., p.81.

77. The first few volumes contain reviews of books by such physicists as Mach, Ostwald, J.J. Thomson, Nernst, Heaviside, Poincaré, Helmholtz, Pascal and Rayleigh**.** Vol. **XII** (4), 254-256 (1901) carries an extensive review of the *Festschrift* ("*livre jubilaire"*) for H.A. Lorentz on the twenty-fifth anniversary of his having received the doctor's degree. It contains contributions by Wien, Planck, Poincaré, Wiechert, Thomson, Boltzmann, Rayleigh, and others. The reviewers, for the most part Nichols and Merrill, evidently had no problems with the untranslated German and French works in their original languages.

78. Phys. Rev **2**, 109-24, 133, 136-43, (1913). Millikan's first publication in *The Physical Review* had occurred in 1896 when he was a graduate student; it was a study of the polarization of the light emitted by the incandescent solid and liquid surfaces {Phys. Rev **III**, 81-98 (1896)}. (Volumes of the journal were designated with Roman numerals before the take-over by the APS in 1913; at that time a new series, labeled with Arabic numerals, was begun). Another group of interesting papers, from the pre-APS period, were those by E.F. Nichols and G.F. Hull on the pressure of heat and light radiation {Phys Rev. **XIII**, 307-308, 317-320 (1901); **XV**, 26-50, 91-104 (1903)}.

79. Phys. Rev. **21**, 483-502 (1923).

80. Phys. Rev **30**, 705-740 (1927).

81. Phys. Rev **34**, 1293-1322 (1929).

82. Phys. Rev **XXV**, 31-38, 60 (1907).

83. Phys. Rev. **2**, 409-410, 415-416, 430 (1913).

84. Phys. Rev. **2**, 450-457, 485-486 (1913). The editors and contributors to the Stroke volume (Ref. 101) selected fifteen articles that were published in *The Physical Review* before 1930 for inclusion among the 200 reprinted articles. Unsurprisingly, nine of these and all four from the first two decades fall into the category "Science and Technology". Among another 800 articles, reproduced on a CD ROM, there are forty-five dating from before 1930. The book and disk, although entitled THE PHYSICAL REVIEW - The First Hundred Years, actually covers, with a few exceptions, only the first nine decades. The total number of articles published in *The Physical Review* before 1930 was about one-thirtieth of that published since then. For example, twenty articles were published in the first year; by 1913 the count had risen to only seventy-five; by 1933 it had reached 480 articles and letters; in 1953 it was 1423; in 1973 it was 4654; and by 1993 it reached 11,698. The last two numbers include the by then separate *Physical Review Letters.* (Fig. 5 shows the numbers of articles received and published annually by the *Physical Review* and *Physical Review Letters* since 1963). Fifteen pre-1930 papers among the 200 selected for reprinting from the entire ninety-year period is thus not only a respectable, but a disproportionately impressive showing. The higher *percentage* of articles deemed worthy of preservation may seem, at first sight, to invalidate the conclusion that in its early years *The Physical Review* occupied a less important place among physics journals than after 1930. Putting aside the unlikely possibility that the editors of the book used more lenient selection criteria for the early period, this seeming inconsistency is resolved by noting that the standing of a journal is judged *by the number and the fraction of the world's important papers* published in it. By these two measures, the later *Physical Review* is a clear winner, in spite of the fact that the ratio

of important to total articles *appearing in the Physical Review* judged important is smaller than in earlier years. The large *number* of ephemeral papers published is cited in justification by those who advocate more stringent acceptance criteria as an act of mercy towards the journal's overloaded readers and financially strapped library purchasers.

85. *The Physical Review* may have benefitted even before their arrival: Victor Weisskopf reports (Ref. 101, p.12) that his first paper in *The Physical Review* was submitted in 1936, while he was still in Europe. "I thought my chance of getting a job in the U.S. would be enhanced if I published a paper in the *Physical Review* on a topic of special interest in the U.S. [Niels] Bohr visited the U.S. every year to 'sell his refugees' ".

86. A sample of important *Physical Review* articles and letters of the thirties includes: R.J. Van De Graaff, "A 1,500,000 volt electrostatic generator" {**38**, 1919-1920, (1931)}; G. Breit and I.I. Rabi, "Measurement of nuclear spin" {**38**, 2082-2083 (1931)}; L. Onsager, "Reciprocal relations in irreversible processes" {**38**, 2265-2279 (1931)}; H.C. Urey, F.G. Brickwedde, and G.M. Murphy, "A heavy Hydrogen isotope of mass 2 and its concentration" {**40**, 1-15 (1932)}; E.O. Lawrence and M.S. Livingston, "The production of high speed light ions without the use of high voltages" {**40**, 19 -35, (1932)} - in fact the invention of the cyclotron; A.H. Compton, "A geographic study of cosmic rays" {**43**, 387-403 (1933)}; C.D. Anderson, "The positive electron" {**43**, 491-494 (1933)}; E. Wigner and F. Seitz, "On the constitution of metallic sodium" {**43**, 804-810 (1933)} - an early classic solid state paper; Einstein, Podolsky, and Rosen, "Can quantum mechanical description of physical reality be complete?"{**47**, 777-780, (1935)} - the famous EPR paradox paper - and Niels Bohr's answer to it, under the same title {**48**, 696-702, (1935)}; G. Breit and E. Wigner, "Capture of slow neutrons" {**49**, 519-531 (1936)}; I.I. Rabi, JR. Zacharias, S. Millman, and P. Kusch, "A new method of measuring nuclear magnetic moment" {**53**, 318 (1938)}; P.A. Cerenkov, "Visible radiation produced by electrons in a medium with velocities exceeding that of light" {**52**, 378-379 (1937)} - the first observation of the phenomenon following the theory of Frank and Tamm; J.M.B. Kellogg, I.I. Rabi, N.F. Ramsey, Jr., and JR. Kellogg, "An electrical quadrupole moment of the deuteron {**55**, 318-319 (1939)}; H.A. Bethe, "Energy production in stars"{**55**, 103 (1939)}; and, of course, N. Bohr and J.A. Wheeler, "The mechanism of nuclear fission" {**56**. 426-450 (1939)}.

87. Spencer Weart "The last fifty years - a revolution?", Phys Today **34** (11), 37-49 (1981).

88. The early editorial triumvirate of Nichols, Merritt and Bedell had been succeeded by the latter alone, as Managing Editor, at the time of the take-over by the APS in 1913. G.S. Fulcher held this position from 1923 to 1925.

89. Abraham Pais, in Ref. 101, p.7.

90. Phys. Rev. **33**, 276 (1929). Only one year after launching *Reviews of Modern Physics*, and following a decision of the APS Council at its meeting of December 1930, Tate inaugurated and became the editor of yet another APS journal, one devoted to applied physics. Originally simply called *Physics*, the publication received its present name, *Journal of Applied Physics* ,in 1937, upon being taken over by AIP. Although APS divested itself of the journal largely for financial reasons - this was during the period when even *The Physical Review* had to be financially managed by the newly formed umbrella organization - the APS action was seen by some as renewed evidence of the Society's stuffy disdain for practical work, or at least of the waxing and waning of interest in the applications of physics (Ref. 100, p.151).

91. Eugene Garfield, Current Comments **26** (1988).

92. H.A. Bethe and R.F. Bacher " Nuclear physics. A: stationary states of nuclei", Rev. Mod. Phys. **8** (2), 82-229 (1936); H.A. Bethe **"**Nuclear physics. B: nuclear dynamics, theoretical", Rev. Mod. Phys. **9** (2), 69-244 (1937); M. Stanley Livingston and H.A. Bethe, "Nuclear physics. C: nuclear dynamics, experimental", Rev. Mod. Phys. **9** (3), 245-390 (1937).

93. Henry H. Barschall, "The cost-effectiveness of physics journals", Phys. Today **41** (7), 56-59 (1988); H.H. Barschall and J.R. Arrington, "Cost of physics journals: a survey", Bull. Am. Phys. Soc **33** (7), 1437-1447 (1988).

95. The numbers of citations were: 2506 for S. Chandrasekhar, "Stochastic problems in physics and astronomy", Rev. Mod. Phys. **15**, 1-89 (1943); 2430 for C.C.J. Roothan, "New developments in molecular orbital theory", **23**, 68-89 (1951); 1165 for the same author's "Self-consistent field theory for open shells of electronic systems, **32**, 179-185 (1960); 1320 for K. Alder, A. Bohr, T. Huus, B. Mottelson and A. Winther, "Study of nuclear structure by electromagnetic excitation with accelerated ions", **28**, 432-542 (1956); 1236 for A.M. Lane and R.G. Thomas, "R-matrix theory of nuclear reactions", **30**, 257-353 (1958); and 1164 for L.S. Kisslinger and R.A. Sorenson, "Spherical nuclei with simple residual forces", **35**, 853-915 (1963). The large number of citations of the Roothaan papers is at least in part attributable to their appeal to chemists, a much larger community than physicists. The interest of astronomers in the Chandrasekhar article also added to its citations, but it is highly likely that physicists by themselves would have put it on the list of the top 100. The fact that *Reviews of Modern Physics* has been consistently hospitable to neighboring areas of science and to cross-disciplinary approaches is worth noting: according to Garfield (Ref. 90) it was even singled out, in the 1950's, by an advisory committee to the *Genetics Citation Index* as the only physics journal that was important to the emerging field of molecular biology. The core gospel of the Bethe bible, "Nuclear physics. B: Nuclear Dynamics, theoretical", published in 1937, easily made it into the top 100 with 334 citations. This is remarkable in view of the fact that the half-life for citations of *Reviews of Modern Physics* articles is about ten years (which, to be sure, is longer than the half-lives of other physics journals), and that the citation count covered the period from 1955 until 1986.

95. "Science and Technology of Directed Energy Weapons", N. Bloembergen and C.K.N. Patel, [study] co-chairmen, Rev. Mod Phys **59** (3, part 2), S2-202 (1987). Both Bloembergen and Patel later served as presidents of the APS, in 1991 and 1995, respectively.

96. K.K. Darrow, who was APS's Secretary from 1941 until 1967, in his obituary for Tate {K.K. Darrow, *American Philosophical Society Yearbook*, 325 (1950)} suggested that *The Physical Review* should be known as *Tate's Journal*, in analogy with *Peggendorf's Annalen* (later the *Annalen der Physik*).

97. In his valedictory upon his retirement Condon reported that he had been appointed editor for the term 1957-1959 and that this term had never been extended. Since no one showed up to do the work, he served nine years as a "usurper" {E.U. Condon "The past and the future of the *Reviews of Modern Physics"*, Rev. Mod. Phys. **40**, 876-8 (1968)}.

98. The size and readership of *Reviews of Modern Physics* were in decline when Pines was invited to consider becoming its editor. He refused at first, saying that he could hardly be the editor of a journal to which he had just canceled his own subscription. The members of the journal's board were able to change his mind (Ref. 91) and Pines instituted a number of reforms that have greatly benefitted the journal and the physics community. Among these was the solicitation of "perspectives and tutorial articles in rapidly developing fields... intended to convey to graduate students, and to physicists in other fields, a sense of why a topic is of current interest...and what are its likely future directions". Among the new editor's successes were the 1975 article by Kenneth Wilson on his solution of the Kondo problem {"The renormalization group: Critical Phenomena and the Kondo problem", Rev. Mod. Phys. **47** (3), 773-841 (1975)} - work for which Wilson subsequently received the Nobel prize - and the two articles in the same year by A.J. Legettt {"A theoretical description of the new phases of ^{3}He, Rev. Mod. Phys. **47** (2), 331-414 (1975)} and by John Wheatley {" Experimental properties of superfluid ^{3}He", ibid., 487-535} on the newly discovered superfluid ^{3}He - articles which remain the "bible" for researchers in *that* field. In a similar spirit, following a suggestion by Ugo Fano, the journal strove to publish, in each issue, several "colloquia" - short, non-technical presentations of work of current interest, written in the style of a colloquium talk (or at least the Platonic ideal of such a talk). Fano solicited and edited these colloquia from 1992 to 1995**,** a task that is now in the hands of Anthony Starace.

99. Throughout the war, the size of *The Physical Review* declined every year, from 2564 pages in 1939 to 668 pages in 1945. In 1946 the number recovered to 1730. Important papers during the years 1940-46 included G. Racah, "Theory of complex spectra" {Phys. Rev. **61**, 186-197 (1942)}; three contributions by L. Onsager, "Anisotropic solutions of colloids {**62**, 558 (1942)}, "Crystal statistics" {**62**, 559 (1942)}, and "The distribution of energy in turbulence"{**68**, 286 [1945)}; F. Bloch, "Nuclear induction" {**70**, 460 (1946)}; E.M. Purcell, H.C. Torrey, and R.V. Pound "Resonance absorption by nuclear magnetic moments in a solid" {**69**, 37-38 (1946)}; and E. Wigner "Resonance Reactions" {**70**, 606-618 (1946)}. While there were no American papers on fission, in 1940 there was still a letter on spontaneous uranium fission, sent from Leningrad on June 14 by G.N. Flerov and K.A. Petrjak, and published two weeks later {**58**, 89 (1940)}. And in 1944 we find an article from the USSR by D. Iwanenko and I. Pomeranchuk on the maximum energy obtainable with a betatron {**65**, 343 (1944)}. Some of the papers published in 1946 and thereafter were, to be sure, work that had accumulated during the war as a result of the voluntary censorship. Thus, the chemical separation of plutonium, achieved in 1941, was not published until 1946 {G.T. Seaborg, E.M. McMillan, J.W. Kennedy, and A.C. Wahl, "Radioactive element 94 from deuterons on uranium", **69**, 366-367 (1946)}, when the following footnote was added: "This letter was received on [28 January 1941], but was voluntarily withheld until the end of the war..." Notwithstanding Melba Phillips' statement (Ref. 12, 227) that "...the *Reviews of Modern Physics* suffered a critical shortage of papers. No one had time to prepare review articles...", that journal's size did not shrink significantly during the war years.

100. Paul Hartman, The Physical Review - a history of the first hundred years . Sponsored by Cornell University. Published by The American Physical Society and the American Institute of Physics. (AIP Press, Woodbury, NY 1994).

101. The Physical Review - The First Hundred Years. A selection of seminal papers and commentaries. H. Henry Stroke, ed. Published by The American Physical Society and American Institute of Physics (AIP Press, Woodbury, NY 1995).

102. The splitting, in 1964, into an "*A"* and a "*B*" section, and, in 1966, into four "numbers", was mostly for convenience in publication; all subscribers received all sections. Beginning in 1967, five numbers appeared each month, reflecting the growth of solid state physics; members (but not libraries) could now receive annual subscriptions to each number separately. In 1970, in a more significant development, four subject matter sections were created: *A - General Physics, B - Solid State Physics* (changed to *Condensed Matter Physics* in 1978 and to *Condensed Matter and Material Physics* in 1998), *C - Nuclear Physics*, and *D - Particles and Fields*. Almost immediately *B* and *D* were split into *B1/15* and *D 1/15* respectively and *A* had followed suit by 1988; by 1990 the two sections had acquired the different subtitles, "*General Physics"* and "*Atomic, Molecular, and Optical Physics"*. Each section could be separately subscribed to by members and libraries could separately order each lettered journal, but not the individually numbered sections. In 1991, *D15* acquired the title "*Particles, Fields, and Gravitation"* and, in 1993, *A* spun off *A15* as *E - Statistical Physics, Plasmas, Fluids, and Related Interdisciplinary Topics*. Altogether every month nine *Physical Review* "books" are now published; the number is nine, rather than seven, because the two numbered *B* sections each require two separately bound volumes. With the 1970 reorganization, the name *The Physical Review* (with the article) ceased to exist; there are, in fact, five semi-autonomous journals with their own names, *Physical Review A, Physical Review B*, etc. (without the article). We will refer to these journals collectively as the *Physical Review* (with the article "the" in regular, rather than in italic font). The trend has been to appoint part-time "remote" editors - working physicists at universities and research laboratories - to be in charge of the journals for definite terms. In some cases they have been backed by full time, full editors at Ridge. Only *Physical Review B* has had a sole, inside, full editor - Peter Adams - all along. *Physical Review A* has successively had C.L. Sneed, R.H. Tucker, Benjamin Bederson, and Bernd Crasemann at its helm. *Physical Review C* has been run, in succession, by H.H. Barschall and Sam Austin. *Physical Review*

D was headed, from Ridge, by Simon Pasternack and Stanley Brown, and then by external editors Lowell Brown and Erick Weinberg, with Dennis Nordstrom working with the latter two at Ridge. Since its inception, *Physical Review E* has been directed by remote editor Irwin Oppenheim.

103. Private communication, October 30, 1998, from George L. Trigg, who was associated with *Physical Review Letter*s for close to thirty years, first as assistant editor to Goudsmit and then as editor.

104. In addition to Goudsmit and Trigg (see Note 103), the editors of *Physical Review Letters* have been Simon Pasternack, Gene Wells, George Basbas, and Stanley Brown at the editorial office at Ridge, and James Krumhansl, Robert Adair, George Vineyard, and Jack Sandweiss from their remote locations. The *Physical Review Letters* outside editors are less remote than those of the *Physical Review* journals; they come regularly and often to Ridge to work closely with their colleagues.

105. Prestigious, yes; but according to *The New York Times*, also "the most impenetrable periodical in the English language". In an article (April 20, 1993), marking the journal's centenary celebration, the *Times* claimed that "In Physics Review, intelligibility is required only for the first paragraph; then the equations begin". The *Times* must have liked the phrase "most impenetrable periodical in the English language" so much that it repeated it in an obituary (December 23, 1995) for Nathan Rosen, whose paper, written with Einstein and Podolsky, had appeared in *The Physical Review* {"Can quantum mechanical description of physical reality be complete?", Phys. Rev **47**, 777-780 (1935)}. In a letter to the editor of the *Times* (December 28, 1995), the APS Editor-in-Chief, Benjamin Bederson, responded that "...in addition to publishing the famous article....concerning determinism (or lack thereof) in nature, Physical Review also was the first place to present the invention of the semiconductor, the maser and many aspects of the laser. There must be a very skillful crew of interpreters somewhere out there who are translating these impenetrable articles for the rest of us!".

106. Fig.6 actually shows the numbers of manuscripts *submitted*, rather than the number of papers *published*, by geographic origin (US versus foreign) of the authors. The ratio of acceptances to submissions for non-US manuscripts has been slightly smaller than for US manuscripts.

107. The position that there is something ethically or conceptually wrong with page charges is not one of the credible reasons. The refereeing of the results of one's research and their communication to other scientists and to the public are an indispensable part of the research process and should be paid for along with the other costs. At about $50 per page (the average APS charge in 1995) they were a trivial component of many research budgets. Because they are voluntary, scientists who do not have external or institutional support, or who have other reasons not to pay them, do not need to do so. Page charges have the financially attractive feature of scaling with growth in the number of articles published. However, in Europe they have been looked at askance (the European Physical Society used to publish an "honors list" of physics journals that did not request page charges) and many of the APS's journals' authors reside in areas of the world where there is no tradition or possibility of paying page charges. Commercial publishers generally do not have them in their repertoire, which has been a contributing factor both for the proliferation of commercial journals and their high subscription prices. In the APS, in the late eighties and early nineties, page charges became a divisive issue. High energy and nuclear theorists, in particular, felt that they were an avoidable drain on their tight budgets and, in a number of cases, submitted their papers to commercial journals rather than to the *Physical Review*. The APS tried to cope with this problem by suspending or reducing page charges for *Physical Review C* and *D* on a "pilot project" basis. At the end of the trial period, in 1995, the Treasurer, with the support of the Publications Committee and a majority of the Council, moved towards an equalization of page charges, which would have involved reinstating or increasing the charges for *C* and *D*. There was a revolt by leaders of the Particles and Fields and Nuclear divisions, including the resignation by the editor and most of the editorial board of *Physical Review D.* Coming on the heels of the SSC controversy (see Section V) and the still lingering animosities in the Society, the Treasurer and the Council reversed themselves and moved towards eliminating or reducing page charges for electronically submitted manuscripts in all fields, while maintaining or raising them for conventional submissions. As electronic "compuscript" submissions are becoming the dominant mode, page charge income is all but disappearing for the *Physical Review*.

108. On October 10, 1955, Karl Darrow wrote to President R.T. Birge, who had apparently suggested that the Society establish a (second) prize: "...Our Society cannot afford to distribute $1000 prizes, other than those for which the money is given to us (meaning actually the Buckley prize). Our financial policy is still that of giving the Physical Review all that it wants and requiring the other activities of the Society to make do with the remainder. Actually the foregoing statement is too weak: Our policy is to give the Physical Review all that it wants, even when this entails a deficit, and to expect the other activities of the Society to add as little as possible to the deficit. This system must be changed..." (Ref. 229). The system *was* eventually changed. However in spite of the ensuing financial prosperity of the Society, prizes and awards (there are now some fifty of them) are still financed from corporate and individual gifts and, in some cases, the surpluses from divisional meetings. From time to time the Council has questioned the continued proliferation in the number of prizes, evidently on the Gilbertian maxim that "if every one is somebody then no one's anybody". (The reference is to W.S. [William Schwenk] Gilbert in *The Gondoliers*, not to the William Gilbert who might well have supported the establishment of a prize in magnetism.) However, several task forces, the most recent under former President Mildred Dresselhaus, in 1998, have reported that stopping the creation of more awards was either undesirable or impossible. Instead their importance could be enhanced by increasing the stipend. While this has been accomplished for some awards, divisions have resisted it for others, if it meant conferring the prize every two years, instead of annually. For a description of the prizes and awards and a list of recipients, see the American Physical Society Centennial Membership Directory, pp. A21 - A40 (1998).

109. The rule has been that Meetings and Membership Operations are to be budgeted to break even, while the surplus from the Journals is to be used to pay for the costs of Public Affairs Programs that cannot be met from grants and from individual and corporate contributions. In 1996 the journals achieved their surplus as a result of the income and expenses shown in Fig. 7. The bulk of the revenues come from library subscriptions. Under a long established policy members receive journals at only the marginal (distribution) cost of their copy; for on-line subscriptions this has now been set at $25 per journal. In spite of the steady, long term decline in library subscriptions, they constitute an ever increasing fraction of the revenue. Expenses have three main components, each accounting for about 30%: Editorial, Composition**,** and Printing and Distribution. (In Fig. 7B editorial and composition expenses are lumped together and also make up a large fraction of the "allocations".) Some readers may be surprised at the high editorial costs, i.e. those of receiving, receiving, refereeing, accepting or rejecting manuscripts, and preparing them for composition. In 1996 these costs amounted to about $350 per manuscript received or $500 per manuscript published. After all APS pays neither its authors (except for nominal honoraria in the case of *Reviews of Modern Physics*) nor its (more than 25,000) referees. But while authors and referees come free, mediating between and otherwise interacting with them decidedly does not. APS's editorial costs may be somewhat higher than those of other publishers because it maintains a centralized editorial facility for all its journals (except *Reviews of Modern Physics*). (In contrast, many other scientific and scholarly journals are fully edited at the institution where their editor resides, and receive support from those institutions.) Although most of the APS journals have "remote" *senior* editors, operating from their home institutions for part-time compensation from APS, the Society maintains an editorial in-house staff for its publishing operations of about 120, including some twenty-five Ph.D. physicists, at the central facility at Ridge on Eastern Long Island of New York. The location is close to the Brookhaven National Laboratory where APS's editorial operations were carried on rent-free, under Goudsmit, until 1970, when the Laboratory instituted an annual rent of $25,000 {Bull. Am. Phys. Soc. II **15** (9), 1234 (1970)}. The APS-built and owned facility has had to be substantially enlarged twice and now measures 30,000 square feet. There is a consensus that the unusual centralized *cum* remote editors *modus operandi* of the APS journals adds to their quality. As Ben Bederson has put it (Ref. 101, p. XII): "Because all full-time editors of all our journals are physically located at one site, an editorial coherence and consistency is obtained that would not have occurred otherwise. Editors of different journals can easily consult with each other, and lend their expertise to each other as needed." The fact that the fixed costs of publishing the journals - editorial plus composition/ production- amount to about two-thirds of the total, before a single copy is printed, is what makes library subscription prices so sensitive to the (shrinking) numbers of subscriptions, but also accounts in large measure for the fact that the APS journals are so much more "cost-effective" than those of other physics publishers: even after decades of significant and apparently unstoppable declines in circulation, *Physical Review* sections typically still have from 1100 to 1600 library subscribers, *Physical Review Letters* has 2100, and *Reviews of Modern Physics* 1800, while the numbers for the journals of most other publishers are much smaller. For a more detailed exposition of the economics of journal publishing , see Harry Lustig, "Economic Issues in a Time of Transition" in *Electronic Publishing for Physics and Astronomy*, André Heck, ed., Kluwer Academic Publishers, Dordrecht (1997), or Astrophys. and Space Science **247**, 117-132 (1997).

110. The loss of the last meeting site at the Bureau of Standards was mourned by K.K. Darrow in 1966: "A misfortune foreshadowed last year has come to pass: owing to the departure of the National Bureau of Standards for a rural locality, we have lost one of the most ancient shrines of the Society, the East Building Lecture Room in which hitherto the Society has been holding sessions for so long that the memory of man runneth not to the contrary" {Bull. Am. Phys. Soc. II, **11** (2), (1966)}.

111. Phys. Today, **6** (5), 20-21 (1953; **6** (10), 18-20 (1953). A petition from a group of APS members in the Washington area, including Karl Herzfeld, N.P. Heydenburg and a future editor of *Science,* Philip Abelson, asking the Council to take action on behalf of Astin and the Bureau used more colorful language: "...Any scientist who bends his findings for the sake of the business community or the labor community or a political party is untrue to his trust and to the American people. The Apostle Paul has said 'the truth shall make you free', not 'the market place will make you free'. We request the Council to declare, in the name of the American Physical Society, that a scientist, in government or out of it, must be guided by truth alone, without bending it to conform to political or business pressures, or we might just as well be in Soviet Russia" (Ref. 229).

112. During World War I it took effort and time to persuade the government that scientists and not only military officers and engineers, could make a contribution to the war effort (Kevles, op. cit., pp.106-138).Two governmental agencies were set up, the National Advisory Committee for Aeronautics, in 1915, and the Naval Consulting Board (the progenitor of the Naval Research Laboratory) in 1916. The Aeronautics Committee's appropriation, in 1916, after it had been raised by Congress seventeen fold, was $85,000. The Naval Board did receive $1,500,000 for an experimental research laboratory, whose staff would include "scientific civilian assistants". The most respected and listened to civilian advisor to the government on matters of military preparedness was Thomas Edison; he told the Secretary of the Navy that he did not think that scientific research would be necessary to a great extent. The Naval Consulting Board's membership was drawn overwhelmingly from the country's major engineering organizations and included only two scientists. One of them was Arthur Gordon Webster, but he was there as a representative of the American Mathematical Society. He pressed hard for the appointment of members from the American Physical Society, as well as from the National Academy of Sciences**,** but was told that Edison, who has compiled the membership list, had omitted the APS "because it was his desire to have this Board composed of *practical* men who are accustomed to *doing* things, and not *talking* about it." The Mathematical Society was included "because Mr. Edison realizes that *very few really practical* men are...expert mathematicians, and thought it advisable to have one or two men on the Board who could figure to the 'nth' power, if required". In October 1915, George Ellery Hale, the distinguished

astronomer, who was then foreign secretary of the National Academy, launched an intensive campaign to secure a place for and the participation of the Academy in the defense effort. The outcome was the formation of the National Research Council (NRC) in June of 1916. Without a governmental appropriation of its own, the Council had to scrounge for funds from private industry and from the military. The differences in culture between these two groups and the scientists represented by the NRC, who insisted that not only applied but also pure research should be undertaken, made for a difficult relationship. However scientists were able to make major contributions, particularly in the field of antisubmarine warfare. Three APS personalities, in addition to Webster, deserve particular recognition for bringing about and pursuing the participation of physicists in the war effort. Michael Pupin secured industrial support for the NRC. Robert Millikan, as chairman of the NRC's committee against submarines, proposed the commencement of submarine detection experiments at the New York City laboratories of Western Electric. He later took charge of all Signal Corps research, as Major Millikan, Army Reserve, and served, during that time, as the 1916-17 president of the APS. And early in 1918 Charles Mendenhall, who was to become APS's president for 1923-24, was appointed the commanding officer of the Signal Corps Science and Research Division's laboratory for the development of aeronautical instruments at Langley Field, Virginia. The contributions of physics and physicists to World War II are too well known to require and too extensive to permit much documentation here. Indeed, this time, most of the leadership of the scientific effort for the war was exercised by APS-connected physicists. The two prominent exceptions were the chemist James Conant and the engineer Vannevar Bush. Together with Karl Compton and other physicists they established and led the National Defense Research Committee, compiling lists of extant facilities, critical projects, and available scientists, and letting contracts. The inventorying of scientists led to the only known instance of official participation by the APS in the war effort, when the Council authorized a committee to assist in the compilation of a National Roster of Scientific and Specialized Personnel (Ref. 12, 225-226). Thousands of scientists and engineers responded to the national effort, including Albert Einstein, who reminded the Roster officials that he "was always interested in practical technical problems". The two major new science based war projects, the Radiation Laboratory at MIT (the "Rad Lab") and the Manhattan Project were inspired and mostly led by past and future APS presidents. The Rad Lab was directed by Lee A. DuBridge (APS president in 1947) with the essential help of his "son of a bitch" associate, F. Wheeler Loomis (president, 1949). (Loomis , in fact, 'though an autocrat, was an amiable autocrat, a trait which served him well in building a first class physics department at the University of Illinois during his long headship from 1929 to 1957.) The most important leaders in the Manhattan project were Arthur Compton (1934) as head of the Metallurgical Lab at the University of Chicago, and J. Robert Oppenheimer (1948) at Los Alamos (Kevles, op. cit., pp. 293-326).

113. In addition to the participation in the compilation of the roster of scientists, the only action during the second world war was a December 1941 statement by the Council, urging the government to allow well-qualified students to proceed with their studies as a means of assuring "a supply of thoroughly trained young men for defense and future needs" (Ref. 32).

114. In 1938 almost 1300 American scientists and scholars, representing 167 academic institutions and ranging ideologically from the profoundly conservative Robert Millikan to the decidedly marxist, eminent mathematician Dirk Struik, issued a manifesto. It condemned the fascist suppression of science**,** castigated Nazi racial theories, asserted the legitimacy of modern theoretical physics and concluded: "Any attack upon freedom of thought in one sphere, even as nonpolitical a sphere as theoretical physics, is an attack on democracy itself" (Kevles, op. cit., p. 287).

115. It was in large measure because taking stands on "political" issues was a novelty and continued to be a relative rarity for a prestigious scientific society which was correctly perceived as quite different from an advocacy group, that APS's pronouncements and studies on scientific freedom, civil liberties, and, later, arms control and national security were often effective. Physicists, including prominent members of the APS, continued strongly to affect these areas in other ways. One was to work in and on government from the inside, in such positions as members of the President's Science Advisory Committee, the (White House) Office of Science and Technology, or on the advisory councils of cabinet departments and as leaders of science - oriented agencies. Another was to found and lead advocacy organizations and publications, such as the Federation of American Scientists, the *Bulletin of the Atomic Scientists*, the Union of Concerned Scientists, and the Pugwash Conference. Concise but enlightening accounts of the operations and contributions of these groups are given by Panofsky and by Gottfried in the March 1999 issue of *Physics Today* {Wolfgang K. H. Panofsky, "Physics and Government", Phys. Today **52** (3), 35-40 (1999) and Kurt Gottfried "Physics in Politics", Phys. Today **52** (3), 42-48 (1999)}.

116. The New York Times (March 5, 1948) stated with only slight hyperbole, that the American Physical Society, in a move "unprecedented for an organization devoted exclusively to the affairs of pure science, entered the field of politics yesterday with a letter vigorously assailing the actions of the House Un-American Activities Committee in reference to Dr. Edward U. Condon ...The distinction between this message and those from other organizations lies in the fact that the American Physical Society prides itself on its aloofness from all matters except the intricacies of pure physics."

117. Ref. 32. The signatories of the letter, "the Officers and Council of The American Physical Society" were : J. R. Oppenheimer - President, Karl K. Darrow -Secretary, George B. Pegram - Treasurer, J.A. Bearden, J.W. Buchta, Karl T. Compton, Henry Crew, Lee A. DuBridge, Harvey Fletcher, F. W. Loomis, Theodore Lyman, Ernest Merritt, R A. Millikan, P. M. Morse, I.I. Rabi, Frederick Seitz, W.F. G. Swann, John T. Tate, Louis A. Turner, Merle A. Tuve, and George E. Uhlenbeck - as representative a collection of American physicists in the first half of the twentieth century as could have been imagined, had they been conjured up especially for the purpose.

118. In June of 1948 Philip Morse (who was to become APS's president in 1972), resigned as director of Brookhaven National Laboratory, as he revealed several months later, in protest against "irresponsible smears" by the House Un-American Activities Committee (New York Star, September 14, 1948, p.1). On September 13, President Truman, at the 100th meeting of the AAAS, accused "some politicians - and I can name them - of creating a totalitarian climate for"...and a "smear campaign" against atomic scientists, without whom "we would have no atomic energy program ...We cannot drive scientists into our laboratories, but, if we tolerate reckless or unfair attacks, we can certainly drive them out". He then publicly shook hands with Condon in a gesture that no one could misunderstand (Kevles, op. cit.., p.380). Truman had not always been a hero to liberal physicists. In the weeks before the dropping of the atomic bombs on Japan, he and his advisors turned deaf ears to the entreaties of James Franck, Leo Szilard, and other physicists, including some at Los Alamos, not to drop the bomb for moral reasons, or so as not to endanger the future of mankind. At least, some of them argued, the use against the Japanese population should be postponed until a demonstration drop in an uninhabited area took place that might result in surrender by Japan. The contrary advice of the military and of the majority of the Manhattan project's and other scientific leaders, including Oppenheimer, Arthur and Karl Compton, Bush, Conant, Fermi, and Ernest Lawrence, that there was no acceptable alternative to direct military use, was decisive.

119. Kevles, op. cit., p. 379.

120. Condon never completely overcame the effects of his persecution and in fact the attacks on him continued for much of his lifetime. He was not reluctant to recall the period or to take those who had failed to act to protect him and other victims of McCarthyism to task**.** In 1957, when he was a professor at Washington University in St. Louis, he told an APS meeting in that city that in 1955 he was offered the post of physics department chairman in "a leading university" But the university chancellor withdrew the offer "because a high government official threatened that ...the university would lose all of its federal funds..." And he accused the Eisenhower administration of having permitted "persecution" of scientists as a matter of "settled policy" ("U.S. Scientists Persecuted, Condon Says", *St. Louis Globe-Democrat*, November 30, 1957.) An informative account of Condon's rich and varied life - his remarkable scientific achievements and his political courage and great personal honesty - is given by Philip M. Morse {"Edward Uhler Condon 1902-1974, Rev. Mod. Phys. **47** (1), 1-6 (1975)}.

121. A body of opinion holds that the real reason for seeking, at this late moment, to deprive Oppenheimer of his security clearance was that Edward Teller and AEC chairman Lewis Strauss were out to rid themselves of a still powerful figure in the nuclear armaments debate. For a recent exchange on this subject see Kurt Gottfried**,** "Physics and Government", Phys. Today **52**, 3, 44 (1999); a letter to the editor on the subject by Ben R. Oppenheimer (no relation to J.Robert) and replies to it by Gottfried and by Harry Lustig {Phys. Today **52** (6), pp. 13, 15, 1999)}.

122. Phys. Today **7** (8), 7 (1954).

123. Not all APS members who had problems with security clearances were famous, and in at least one instance the Society itself was implicated. On January 1, 1955 a member, John H. Sweer, wrote to APS Secretary K.K. Darrow stating that his employer had requested access for him to certain classified material. The Eastern Industrial Security Board had referred to certain reasons that in its judgement required it to deny the request. Among these was: "Subject, on his PSQ, lists membership in the American Physical Society since 1938. This organization contributed $3000.00 to the defense of a Canadian scientist who was implicated in the Russian espionage ring uncovered there in 1947. The society has been reliably described as having the announced purpose of exchange of scientific information between scientists in the United States and those of the Soviet Union." The member asked Darrow for the facts about the $3000 and stated that unless the Society has adopted a revision of article 2 of its constitution, he would cite it in response to the second allegation. The story about the donation to the defense of the Russian spy was apparently a complete fiction and the APS has, of course, never substituted the exchange of scientific information with the Soviet Union for the advancement and diffusion of the knowledge of physics as its purpose. The outgoing APS president, Hans Bethe, "was horrified by the matter " and in a letter of January 12, 1955 to Darrow, and to R.T. Birge, his successor as president, not only agreed with Darrow that "we certainly must demand a retraction", but also "an investigation how such slanderous statements arose and request that the persons responsible be removed from positions of influence in the Eastern Industrial Personnel Security Board" (Ref. 229).

124. Ref. 32. The APS's protest does not appear to have done much good, at least in the short run. In 1954, P.A.M. Dirac, then at Cambridge University, was denied permission to enter the United States to spend the year at the Institute for Advanced Studies in Princeton {Phys. Today **7** (7), 7 (1954)}.

125. On December 16, 1952, incoming President Enrico Fermi wrote to Secretary Karl Darrow "...I agree entirely with your suggestion that there should be no banquet unless all our members are allowed to attend. In fact, I would go somewhat further than this...it is not wise for our Society to call a meeting in which a distinction on the basis of color [with respect to housing accommodations] is explicitly mentioned on the summons card. I realize that our Society is non-political, however, by recognizing officially a color issue, we might actually give indirectly support to a trend that is political and that I am sure the overwhelming majority of our members disapprove..." (Ref. 229).

126. The vote was 8559 against reversing the decision and 6405 for doing so. Altogether 15,217 ballots were cast from those sent out to the 25,874 members (Ref. 32), an unusually high rate of return. Almost two decades earlier, during the cold war inspired restrictions on who could speak at universities, the APS had to face, apparently for the first time, a decision to move a meeting for reasons of principle. The Ohio State University, on whose campus the March 1952 meeting was to be held, had instituted a requirement of screening those who would be allowed to speak on its campus. No consultation of the membership was necessary or contemplated on that occasion. Acting on a firmly established

commitment to scientific freedom, and after a brief discussion by the Council, APS past president F. Wheeler Loomis wrote to the Ohio State Physics Department "that the Physical Society could under no circumstances tolerate any screening by any outside agency, of its speakers or its program". In informing the APS President, C.C. Lauritsen, of the plans that were being quickly made to move the meeting, Secretary K.K. Darrow simply stated: "For reasons too self-evident to require description, our Society cannot meet under such conditions". The president of Ohio State University backed down (Ref. 228).

127. Already two years earlier, in 1967, Charles Schwartz had proposed an amendment to the APS constitution to allow one percent of the membership to force a vote on any (social or scientific) issue of concern. According to Barry M. Casper {Phys. Today **26** (5), 31 (1974)}, the proposal had its roots in a letter which Schwartz tried to publish in *Physics Today* urging physicists to oppose the Vietnam war. The editor turned him down, saying that the letter did not deal with "physics as physics" or "physicists as physicists". The Council submitted the proposal to the members with a recommendation against it and it was defeated by a margin of three to one (Ref. 32). (The amendment put forward by Robert March of the University of Wisconsin in 1971, which is mentioned in Section I of this article, was an attenuated echo of the Schwartz proposal).

128. The target of the bombing was a mathematics research institute, located in the same building; it was funded by the U.S. Army, but was not doing classified or war-related research. The death of the post-doc, the destruction of Barschall's laboratory together with all of his research records for the previous twenty-five years, and what he considered the physics department's insensitive and inadequate response to the tragedy caused Barschall to terminate his career as an experimental nuclear physicist - where he had made major contributions - and to leave the University of Wisconsin for two years. When he returned as the John Bascom Professor of Physics, Nuclear Engineering and Medical Physics, he resumed his teaching, but turned his research to medical applications of neutrons for cancer treatment , a field in which he carved out a new, distinguished career (Robert Adair and Willy Haeberli, "Henry Herman Barschall 1915-1997", National Academy of Sciences *Biographical Memoirs* **75**, The National Academy Press, Washington, DC 1998). He redoubled his volunteer activities for the American Physical Society, serving as the (unpaid) editor of *Physical Review C* from 1972 to 1987, and secretary-treasurer of the Forum on Physics and Society from 1988 to 1993. He became an expert in scientific publishing, a field in which his studies of the cost of physics journals (Ref. 93)brought him recognition and honors from librarians, as well lawsuits by a commercial publisher whose journals fared poorly in Barschall's price and citation studies (see section VII).

129. Over the past twenty-seven years, the Forum has conducted more than 200 sessions at regular APS meetings, ranging from arms control topics such as land-based intercontinental missiles and safeguards on plutonium and highly enriched uranium, through environmental and health-related subjects such as the risks of climate change and the linear model of low dose radiation damage, to the inroads of pseudoscience (which featured a talk by the magician-debunker James Randi on "Fooling Some Scientists Some of the Time"). The Forum has sponsored studies and short courses, out of which have come seven books, among them "Physics Technology and the Nuclear Arms Race", "Energy Sources: Conservation and Renewables", and "Global Warming: Physics and Facts". A series of conferences and publications on the crisis in physics jobs anticipated later official APS initiatives on this subject. Under the Congressional Fellowship program, physicists, selected and supported by APS, spend a year in Washington in a Congressional office. While many of the forty APS Congressional fellows to date have returned to their home institutions or to another job in science, wiser in the ways of Washington, others have remained in or returned later to government or other public service, often in important positions. One of the currently prominent returnees is Rush Holt, who was a Congressional Fellow in 1982-1983 and was elected to Congress is 1998 as a Democrat from New Jersey. The only other physicist in Congress, Representative Vernon Ehlers (Republican, Michigan), was never a Congressional Fellow, but like Holt, was made a fellow of the Society upon his election to Congress. Both Ehlers and Holt served (years before) on the Forum's Executive Committee. The Forum's initiative to institute the Congressional Fellowship Program was supported and implemented by the Society's Executive Secretary, W.W. Havens, Jr. and it helped to endow the Forum and the APS' new activism with respectability. In 1973 Havens wrote to the then chairman of the Forum, Barry Casper: "... by establishing a Congressional Science Fellowship, the American Physical Society gives its blessing to this type of activity and encourages physicists to become engaged in public service science...I believe you should stress the fact that the APS is supporting the long range goal of legitimizing for physicists other than traditional teaching and research in universities and industry." An informative account of the events that led to the formation of the Forum and of its early years is given by Barry Casper in *Physics Today* {"Physicists and public policy: the 'Forum' and the APS", Phys. Today **26** (95), 31-37 (1974)}. The story is brought up to date by David Hafemeister, a later Forum chair (1985-86), member of the APS Council (1988-91) and chair of the Council's Panel on Public Affairs (1996-97) (Ref .128).

130. David Hafemeister , "History of the Forum on Physics and Society", Physics and Society **28** (1), 3 -5 (1999).

131. A complete list of publicly issued APS policy statements appears on p.32 of Phys. Today **52**, (3) 1999.

132. The position was first established when W.W. Havens became Deputy Secretary (to K.K. Darrow) in 1955. It was abandoned when Havens succeeded to the renamed position of Executive Secretary in 1967, but was revived in 1974 with the appointment of Mary L. Shoaf as Deputy Executive Secretary. She was succeeded, from 1980 to 1982, by David W. Kraft, who was followed, from 1982 to 1984, by Lawrence R. Bickford. Miriam A. Forman served from 1985 to 1990. Havens' successor (1991-1993) as Executive Secretary, N. Richard Werthamer, "renormalized" the title to Associate Executive Secretary, and appointed Brian B. Schwartz, who was already serving as the Society's education officer, to the job. All of these deputies and associates were part time. When Judy R. Franz became APS's Executive Officer (rather than Executive Secretary) in 1994, the

associate's title was changed accordingly. Barrett H. Ripin has served as Associate Executive Officer since 1994.

133. For a more complete account of APS' education, minority and women's programs see "Education Outreach", a Special Issue of *APS News* (January 1998).

134. "The APS China Program: Chinese-American Cooperative Basic Research Program in Atomic, Molecular and Condensed Matter Physics of the American Physical Society 1983-1991. Final Report of the American Coordinating Committee, Harry Lustig, ed. (The American Physical Society, 1992).

135. Phys. Today **32** (1), 101 (1979).

136. Phys. Today **36** (3), 63-64 (1983).

137. Harry Lustig, "Two presidencies: The City College of New York and the American Physical Society" in *A Gift of Prophecy - Essays in Celebration of the Life of Robert Eugene Marshak*, E.C.G. Sudarshan, ed. (World Scientific, Singapore, 1994, pp. 303-309); Ernest M. Henley and Harry Lustig, "Robert Eugene Marshak 1916-1992", National Academy of Sciences *Biographical Memoirs* **76** (The National Academy Press, Washington, DC, 1998).

138. Keyworth criticized the APS (of which he was a fellow) for its "arrogant action" in seeming to challenge President Reagan's armaments policies. He said he was shocked to learn that its Council had taken an official stand on nuclear arms reduction despite the "specific will of its membership " that the Society refrain from political action and stick to science. His remarks, which appeared in *Physics Today* **36** (5), 8 (1983), were reportedly toned down considerably from an even angrier first draft. ("Physicists Arms Stand Criticized" *The New York Times*, May 7, 1983). Marshak, citing past engagement by the Society with public issues, replied that Keyworth was mistaken in asserting that the membership had opposed the taking of stands on urgent public matters and suggested that the Administration should "welcome the balanced tone of the Council's resolution and should "embrace its sober message" about the need for arms control {Phys. Today **36** (5), 9 (1983)}.

139. Some of them imaginatively but wildly misinterpreted or exaggerated the claims of scientist-proponents; thus, Deputy Secretary of Energy Henson Moore III (quoted from US Senate Hearings by Kevles, op. cit., p. XXI) stated that magnetic resonance imaging had been made possible by the work on superconducting magnets for the SSC, and New Orleans Congressman Robert Livingston praised high energy physics for producing, among other things, "virus remedies, maybe even for aids"(quoted from the Congressional record by Kevles, op. cit., p. XXIV).

138. Stressing that the Super Collider was expected to reveal the presence of the Higgs boson, Lederman attempted to explain its importance by telling a Senate hearing to think of a group of extraterrestrials watching a soccer game who are somehow incapable of seeing the ball: "They see a lot of people running around seemingly at random in a chaotic disorganized activity, but if someone postulated the existence of a soccer ball, then the whole thing becomes clear and simple and elegant" (US Senate Hearings, quoted by Kevles, op. cit., p. XVI). Later, in 1993, Lederman would refer to the Higgs boson as the "God particle" (Leon Lederman, with Dick Teresi, *The God Particle: If the Universe is the Answer, What is the Question?*, New York, 1993). Weinberg preferred to emphasize that physicists were desperate for the SSC because they were stuck in progressing towards a final theory of nature - a complete, comprehensive, and consistent description that accounted for all the known forces and particles in the universe. The SSC was a good bet, he stressed, not because it would reveal the deity or enhance American prestige, but, even if it did not find the Higgs boson, would expose the existence of new forces and phenomena that would bring the achievement of a final theory closer (Steven Weinberg, *Dreams of a Final Theory: The Scientist's Search for the Fundamental Laws of Nature*, Random House, New York, 1992).

141. Roy, who had been critical of American science policy since World War II for giving too much support to esoteric fields of research, considered high-energy physicists "spoiled brats" for wanting a multibillion machine when the country was running up $200 billion annual deficits (Kevles, op. cit., p. XXIV). Anderson 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 cost and with far greater payoffs than did elementary particle research. Schrieffer, who called himself a "loyal opponent" of the machine who admired and respected particle physics, nevertheless said that it cast no light on the behavior of ordinary matter even in its disaggregated forms, and that it was therefore irrelevant to most of atomic and molecular physics and to chemistry, and as such to any science with utilitarian potential (Kevles, op. cit., p. XXV).

142. R.L. Park, The Scientist, June 15, 1987.

143. The Division of Condensed Matter Physics had 6441 members, the Division of Particles and Fields 3463. Altogether less than half of the APS membership belonged to any division or topical group, a statistic which casts doubt on the image of APS as an exclusive club of single-minded practitioners of research.

144. Phys. Today **44** (3), 79 (1991).

145. Senate Hearings, as quoted in Kevles, op. cit., p. XXVI. In a later letter to an official at Fermilab, Bloembergen did allow that superconducting wire technology had, in fact, greatly benefitted from work at Fermilab and for the SSC and that this had improved the equipment in magnetic resonance imaging..

146. James Krumhansl, private communication, March 15, 1999.

147. Consequently he derided the SSC for its endlessly increasing costs, threats to other science, and unwarranted predictions of spin-offs for competitiveness. "Contrary to all the hype, the SSC will not cure cancer, will not provide a solution to the problem of male-pattern baldness, and will not guarantee a World Series victory for the Chicago Cubs," Boehlert opined. And he doubted "that the most pressing issues facing the Nation include an insufficient understanding of the origins of the universe, a

deteriorating standard of living for high-energy physicists, or declining American competitiveness in the race to find elusive subatomic particles." (Senate Hearings, as quoted by Kevles, op. cit., p. XXIX).

148. Kevles, op. cit., pp. XXX -XXXV.

149. Malcolm Browne, "Building a Behemoth Against Great Odds", The New York Times, March 23, 1993, p. B9.

150. Irwin Goodwin, "After Agonizing Death in the Family, Particle Physics Faces Grim Future", Phys. Today **47** (2), 87, (1994).

151. House Hearing, as quoted in Kevles, op. cit., p. XXXIII.

152. Kevles, op. cit., p. XXXVIII.

153. The LHC will, however, have only a third of the energy that the SSC was designed to achieve. It is scheduled to begin operating in 2005. By early 1999, 590 American scientists and engineers - more than two-thirds of them refugees from the SSC - were working on the European machine (Malcolm W. Browne, in The New York Times, January 19, 1999 p. D5). In spite of upgrades at Fermilab and at SLAC, the "replacement"of the SSC by the LHC marks a shift in experimental high-energy physics from the United States to Europe. Continued US participation depends on the increasingly uncertain annual funding decisions of Congress. The now frequently exercised power of the Congress to renege on international commitments, by refusing to authorize previously promised funds (the refusal to pay the required dues to the United Nations is the most dramatic example), has meant that "the United States has a very bad reputation as an international partner now, particularly since the fiasco over the International Thermonuclear Experimental Reactor [ITER]" (Burton Richter, as quoted in The New York Times, ibid.). According to an agreement signed by the US, ITER was to be built, in Japan, with support from that country, the US, Europe, and Russia. After more than $1 billion had been spent, Representative James Sensenbrenner, the chairman of the House Science Committee, blocked US participation, thereby apparently dooming the project.

154. Kevles, op. cit., p. XLI

155. Second Series **I** !926). (Einstein would not be elected until 1930. Altogether, the APS had sixteen honorary members over the course of its history, 'though never all at the same time. In addition to those already mentioned, they were Louis de Broglie, James Chadwick, P.M.S. Dirac, H.A. Kramers, Max von Laue, and Arnold Sommerfeld. The category of honorary members became redundant after foreign physicists could be elected to regular fellowship and membership and became depleted in 1988 with the death of de Broglie.) Not including residents of Canada, of which there were about twenty-five in 1926 - a surprisingly small number, considering that the Canadian Association of Physicists was not yet in existence - we estimate, from the addresses, that there were close to fifty foreign members and fellows. The fellows included Abraham Joffe of Leningrad, Russia (as the USSR was designated in the 1926 Membership List, in a display of either nostalgia or anticipation); Charles Darwin of Edinburgh, Scotland; M. Le Duc De Broglie of Paris, France; Victor Hess of Graz, Austria; and Sir C.V. Raman of Calcutta, India. An E. Shrödinger (sic) of Zurich, Switzerland is also on the list, not as a fellow, but as an ordinary member. Schrödinger was one of those who refused to become fellows because of the higher dues. Perhaps his name was misspelled in retaliation. More than a dozen of the members residing abroad, such as Edward U. Condon, were Americans who were studying or working there. For authentic overseas members, Japan led the list with nine, China followed with five and the other countries represented - Italy, England, Poland, Germany, Holland, and Belgium - each accounted for three or fewer.

156. Dues were to be used only for services directly connected with membership based operations such as mailings, *APS News*, and the collection of the dues themselves. Meetings and, *a fortiori*, the journals had to pay for themselves. Unlike many other professional associations, APS stayed away from providing commercial "services" to its members, such as issuing credit cards or endorsing or selling other products. An important exception has been the American Physical Society Insurance Trust program. Established in 1969 and joined in 1970 by AAPT and subsequently by other AIP member societies, the Trust makes available group term life insurance and other coverage (including the special bonus of double indemnity for accidental death or dismemberment). The program is particularly useful for those members who cannot obtain inexpensive term insurance at their places of employment.

157. Life memberships date to the very beginning of the Society, but in 1899 only one member took the plunge of betting that a saving was likely to result. At that time a life membership cost $50, ten times the annual dues. In recognition of today's longer life expectancy, the ratio is now fifteen.

158. APS 1998 Annual Report, p. 4.

159. In spite of the fact that the *Physical Review* almost certainly provides more opportunities than any other journal to appeal the recommendations of referees and the decisions of editors not to publish a manuscript, there have been aggrieved authors before and since. A few have turned nasty, for example accusing the editors and the Society of being part of a Jewish conspiracy to prevent the dissemination of a refutation of Einstein's relativity. Some have implicitly or explicitly threatened law suits, but before 1987, none of these threats ever materialized. The most egregious and tragic case of a (mentally ill) rejected author taking revenge was that of Bayard Peakes, mentioned in Section III.

160. Meserve, a partner in the Washington law firm Covington & Burling, is a physicist (as well as a lawyer) and fellow of the APS. He has successfully represented the Society in all the cases described here. In late 1999, upon confirmation as head of the Nuclear Regulatory Commission, he left Covington & Burling and relinquished his position as APS's legal counsel.

161. Solarex Corp. v. Arco Solar, Inc., 121 F.R.D. 163, 179 (E.D.N.Y. 1988); Arco Solar, Inc. v. American Physical Society, 870 F.2d 642 (Fed. Cir. 1989).

162. David Lazarus, “In Defense of Confidentiality”, Phys. Today **42** (10), 57-59 (1989).

163. Slaby v. American Physical Society, No. 87-3172 (D.D.C. 1987).

164. Kiess v. Rubin, Civ. No 95-CV-01267 (Md. Cir. Ct. 1995).

165. The cost per printed character (perhaps better “*price* per printed character”) is the amount paid by an American library for an annual subscription to a journal divided by the total number of characters published in that journal during the year. (In order to neutralize the effect of variations in typography and page size, Barschall and some investigators in other fields before him used characters rather than pages in the denominator.) The impact is the average number of times that articles from a journal were cited during the two years following their publication, as determined by the Institute for Scientific Information. It was Barschall’s innovation also to obtain and report the quotient of the price per character divided by the impact, resulting in the cost-effectiveness. Readers of the *Bulletin* article, if they were so inclined, could thus calculate that there was a factor of eighty between the journal with the highest price per character on the list, Gordon & Breach’s *Physics and Chemistry of Liquids,* and that with the lowest , the American Astronomical Society’s *Astrophysical Journal.* With the impact figured in, the cost-effectiveness difference between these two journals became a factor of 409. There were two articles because *Physics Today* was only able to publish a summary of the results (which included some background to the “library crisis” of rising journal costs and a discussion of what could be done to ameliorate it), and the *Bulletin* was consequently used by the author to document the methodology and to provide the complete results.

166. The claims included that Barschall passed over such differences as copying licenses, airmail delivery, and Gordon & Breach’s “flow system”, under which libraries were charged not by the year, but by the volumes published. To the extent that these issues had any relevance at all, their effects fell within Barschall’s announced 20% margin of uncertainty. There was also a complaint that Barschall did not take into account all of G&B’s journals. Their absence was in line with the announced criteria for the inclusion of journals in the survey, and when they were taken into account, the results for Gordon & Breach did not improve. And as the litigation developed, the plaintiff’s case concentrated increasingly on the claim that the articles were improper because Barschall failed to note that Gordon & Breach’s journals, because of their “specialized nature” and low circulation, *should* cost more than those of other publishers.

167.This offer for resolving the complaint was maintained by APS and AIP during the many years of the ensuing litigation.

168. Dozens of briefs and counter-briefs were filed and motions made; hundreds of documents were produced, and, eventually, more than a score of witnesses were examined either by deposition or at trial.

169. Gordon and Breach Science Publishers S.A. v. American Institute of Physics, 859 F. Supp. 1521 (S.D.N.Y. 1994).

170. The “secondary uses” included the distribution of a draft to some librarians at a convention, and the favorable mention of the Barschall findings in the 1988 annual presidential letter to the membership by APS President Val Fitch, with included the phrase ”tell your librarian about it”.

171. In one of the European suits, Barschall was characterized (in translation) as “a disguised megaphone”, “a common market-hawker” and a lazy researcher. The allegation of a conspiracy was based largely on the fact that before the initiation of the survey there had been some consultation between Barschall and APS and AIP officials about whether a survey would be useful, and while it was in progress, some correspondence about Barschall’s work. During one of these exchanges the APS treasurer made the suggestion that Barschall might explicitly mention the favorable results for the societies’ journals. The suggestion was rejected. The reason put forward by Gordon & Breach for the societies’ allegedly enlisting Barschall in a marketing effort was their need to maintain library subscriptions in the face of sharply increased prices. While it is true that prices had to be raised, in the face of declining numbers of subscriptions and of income from page charges, most of the increase was necessitated by the steep increases in the numbers of articles submitted and published. The societies clearly welcomed the news that, in spite of the increases, their journals were still (perhaps even more than before) extremely cost-effective. Some in AIP and APS did see an advantage in publicizing the results among librarians while others, including the APS treasurer, saw their value in justifying, to understandably concerned, library-sympathetic colleagues on publications committees and councils, the painful price increases that were necessary to keep the journals solvent.

172. OPA (Overseas Publishing Ass’n) Amsterdam BV v. American Inst. of Physics, 973 F. Supp. 414 (S.D.N.Y. 1997).

173. APS and AIP were able to document ten instances of (mostly successful) attempts at intimidation, including of librarians at two campuses of the University of California, at Colorado State University, and at the University of Liège, Belgium; a professor of chemical engineering at Oregon State University; two professors of chemistry at Northern Illinois University; a scientist at IBM; the Institute of Electrical and Electronic Engineers; the European Mathematical Council; and the American Mathematical Society and its Executive Director personally.

174. In Europe, under a system in which the courts typically award partial compensation for the expenses of the victorious party, the societies were able to recoup a fraction of their costs. In the United States the Lanham Act allows the possibility of such compensation only in “exceptional cases”, a definition that is usually applied to mean completely frivolous suits. Judge Sand found that Gordon & Breach’s actions did not meet that threshold. The Court of Appeals, although observing that the “litigation may not have been strong on its merits”, upheld the district court. APS’ expense would have been even higher, had Richard Meserve not represented it on a reduced-fee basis in this case (as he has in all other cases) in recognition of the Society’s non-profit status.

175. Irwin Goodwin "Federal Court Rules for APS and AIP in Dispute with Gordon & Breach over Survey of Journals" Phys. Today **49** (10), 1997.

176. Extensive documentation about this case is available on the Web at <barschall.stanford.ed> and at <www.library.yale.edu/barschall>.

177. Until 1932, presidents (with the exceptions of B.O. Peirce and H.A. Bumstead) served two year terms. Since then they have had one year terms, except in 1941 when, after George Pegram's resignation (note 183), G.W. Stewart served for six months, and for Val Fitch who, in 1988, stayed in office for a second year as a result of George Vineyard's untimely death. For most of the early years the serving vice-president was explicitly but routinely elected by the Council to the presidency until the succession was made automatic. In 1963 the position of vice-president elect was created; the person chosen succeeded automatically to the vice-presidency and then to the presidency. In 1980 the hierarchical nomenclature was changed to vice president, president-elect and president. With the past president also having some official functions, running for vice-president of the APS now implies, upon election, a four year commitment of service. The four elected officers together constitute the "presidential chain", an important subset of the executive board. A complete list of presidents, as well as of vice-presidents and presidents-elect who were unable to succeed to the presidency, appears on p. A-8 of the 1998-99 APS Membership Directory.

178. They are, in order of their APS presidency: A.A. Michelson, R.A. Millikan, A.H. Compton, P.W. Bridgman, J.H. Van Vleck, Enrico Fermi, H.A. Bethe, E.P. Wigner, Felix Bloch, C.H. Townes, John Bardeen, L.W. Alvarez, E.M. Purcell, W.A. Fowler, N.F. Ramsey, A.L. Schawlow, V.L. Fitch, Nicolaas Bloembergen, Burton Richter**,** J.Robert Schrieffer, and Jerome Friedman. Thirteen received the prize (or, in the case of Bardeen, one of his two prizes) before serving as APS president, seven after serving, and one - Schawlow - during his presidency. In 1968 the presidential line constituted a perfect line-up of Nobelists: Charles Townes was immediate past president, John Bardeen president, Luis Alvarez vice-president, and Edward Purcell vice-president elect. For more on the Nobel laureate - APS president nexus, see Michael Scanlan, "Nobel APS Presidents", in *APS News* (January 1996).

179. Thus the proceedings of the 8th meeting of the Society, on December 27, 1900 state that the tellers "reported a total of 74 votes cast [from a total membership of 96]: H.A. Rowland, 73 for President; A.A. Michelson, 73 for Vice-President; Ernest Merritt, 74 for secretary; W. Hallock, 74 for treasurer; Henry Crew, E.B. Rosa, 74 for Councillors , and these persons were declared elected". Apparently one voter felt alienated from those officers whose titles merited capitalization.

180. W.W. Havens remembers (private communication) that in 1972, when C.S. Wu was put up as the first female candidate, she ran unopposed. Whether this was an act of chivalry, condescension, or realism, we do not know. Contested elections for the presidency, and even for the Council, although undoubtedly an improvement over single name slates, have deprived the Society of the services of some outstanding individuals.

181. This occurred in 1989, when C.N. Yang lost the election for Vice-President to Walter E. Massey, who was the first (and only) African-American nominated for the presidential line. (After Massey became Director of the National Science Foundation, he resigned from his APS office and did not succeed to the presidency.) In general, minority and women candidates have been elected when they were put up for office in the APS. In recent years the fraction of women on the Council and on the Executive Board has tended to exceed their fraction of the membership.

182. Merritt's minutes, 'though clear, are extremely laconic. On the few occasions when he missed a meeting, the minutes taken by secretaries-pro-tem appear, by contrast, positively verbose.

183. Hartman, op. cit., pp.36-44.

184. Lee Anna Embry in *National Academy of Sciences Biographical Memoirs* **41,** 356-407 (The National Academy Press, Washington, DC), p. 358.

185. W.W. Havens, Jr. in *Dictionary of American Biography 1956-60,* pp. 500-502. See, however, note 63.

186. Karl K. Darrow in *Year Book of the American Philosophical Society 1961,* p.157.

187. John Von Vleck recalls that once during the early fifties when scientists frequently traveled between New York and Boston on the New Haven railroad's night sleeper, the Owl, Pegram missed the sleeper on a trip to Boston. In order not to be late to the meeting of the Physical Society the next morning, he took the next (coach) train and sat up all night. When one remembers that he was in his seventies at the time, his devotion to the APS becomes apparent (Embry, op. cit., p. 391).

188. Darrow continues: " On the other hand his term as President of the Society [for the first half of 1941, simultaneously with being treasurer!] was the shortest on record, and this was characteristic of him. In the middle of what should have been Pegram's year long presidency, the Vice-President who, in the normal course of events should have succeeded him, announced that he would not ...[be able] to serve [as President in the following year], because of serious family problems. Pegram instantly resigned the presidency and the Vice-President was forthwith appointed to the rank for the year, so that his name follows that of Pegram in the roster of the presidents. Pegram always said that he resigned because he was so busy, but we all knew the truth."

189. W.W. Havens, Jr. "Karl Darrow", Phys.Today **35** (11) 83-84 (1982).

190. W.W. Havens, Jr. "Karl Kelchner Darrow (25 November 1891 - 7 June 1982)" in *Proceedings of the American Philosophical Society* 1983, pp. 95-99.

191. made available to this author by W.W. Havens, Jr.

192. Darrow's valedictory {Bull. Am. Phys. Soc. II, **12** (1), 5 (1967)} bears out Havens' assessment of his predecessor's conservatism, at least in Darrow's later years. In addition to the passages already quoted (Note 42), Darrow wrote: "Now I take my leave of the post which I have so long been honored to fill by the suffrage of the Society. The post has been extinguished by the new Constitution, and no one hereafter will ever sign one of these Preambles over the title of 'Secretary'. [In fact the title had merely been changed to 'Executive Secretary'.] I have enjoyed these twenty-six years, and I hope that everyone will refrain from calling my work or myself 'dedicated'. I am proud to belong to the *ancien régime* with George Pegram and John Tate dearly held in remembrance...I rejoice to have been part of the *piccolo mondo antico*, the 'little old world' of the Society into which I came, unified, unregimented, and serene - the Paradise Lost which so many are desperately trying to regain in conferences limited in size by narrowing of the scope or closing of the doors. Talleyrand said that *celui qui n'a pas vécu sous l'ancien régime n'a pas connu la douceur de vivre*. I often think of this when I see our members thronging the corridors of the official hotels, leafing through the BULLETIN to discover which sessions they must forego in order to attend which others, and squeezing into halls that were expected to be large enough but prove to be too small. I thank the members of the Society who elected me over again until elections were ended..." In fact what happened is that the new constitution of 1966 transferred the election of the operating officers - the Executive Secretary, the Treasurer, and the Editor-in-Chief - from the membership to the Council. Darrow was promptly replaced by his deputy, Bill Havens.

193. Charles H. Townes (APS president in 1967) has reported that when he was an undergraduate at a southern college in the early 1930's, its physics department was so poorly supported that it didn't have *The Physical Review* in its library. He was advised to consult Darrow's articles on current developments in the *Bell System Technical Journal*, which somehow was being sent gratis to the local municipal library. The young student did read Darrow's review articles and this convinced him to become a physicist (Ref .190).

194.The *New Yorker* magazine at one time even reproduced his lucid and lively instructions as to what the absent minded or un-metropolitan professor should do in case he found himself, in New York, on the Lenox Avenue rather than the Broadway subway train in trying to get from a mid-town hotel to a meeting of the Society at Columbia University (Ref. 190).

195. W.W. Havens, Jr., private communication. No wonder that Darrow was peeved by the decision, in 1961, to move the APS Thanksgiving meeting to October; he realized that if he were to be involved in its preparation, he would have to shorten his summer vacation, and wrote, testily : "The inconveniences of preparing a Bulletin with a summertime deadline are considerable, and the Council has provided that this task may be delegated, preferably to those who have pressed for the change" {Bull. Am. Phys. Soc. II **7** (8), 527 (1961}.

196. When he was invited to participate in a meeting of the (British) Institute of Physics, he expressed disappointment that the dinner would be "informal". Explaining his "tenacious rearguard action to keep at least some traces of formality at the banquets of the American Physical Society", he said that one of his arguments has always been "that Britain will feel ashamed of us if we quit dressing for dinner. Can it be that Britain is also softening in this respect?" (Letter to H.R. Lang, May 1, 1956 in the Center for the History of Physics [Ref. 228]). Darrow's insistence that it was the tradition of the APS which required formal dress at meeting dinners may have been ahistorical. The minutes of the 27th meeting of the Society of February 25, 1905, record that "On motion the Council was requested to consider a plan for holding an *informal* dinner in connection with the meetings of the Society {Phys. Rev. **XX** (3), 172 (1906). Emphasis added}.

197. In a 1968 letter to the editor of AIP's house organ, he wrote, in part: "I have read your issue just now ... I doubt the Latinity of your latinist. Bucca --which in your caption is properly an ablative, buccâ-- signifies by itself the cheek, and specifically the inside of the cheek; therefore lingua in buccâ is in itself the full translation of tongue in cheek. Then how did cavum oris get into the caption? If it is inserted as a synonym for buccâ, cavum should also be in the ablative; cavo oris. The phrase would then be: lingua in buccâ, id est in cavo oris.....Speaking of Latin, I have just been re-reading the Pervigilium Veneris. If you have any contributors who are not so regular as you wish ...try sending them its last two lines, which (as perhaps I do not need to remind you) are: Perdidi Musam tacendo, nec me Apollo respicit. Sic Amyclas, cum tacerent, perdidit silentium...". Three days letter Darrow writes: "I have rewritten the last stanza of the Pervigilium Veneris, so that you may use it on delinquent contributors. Alii cantant, vos tacetis; quando ver venit vestrum? Quando fitis ut chelidon ut tacere desinatis? Perdetis Musam tacendo, nec vos Apollo respicet; Sic Amyclas, cum tacerent, perdidit silentium. {"Karl K. Darrow, the Editor's Editor Edits" in *Inside AIP*, **VII** (27), 31 December 1968}.

198. For most of the history of the Society, the operating officers, having been volunteers, had open-ended appointments; finite, renewable, five-year terms were adopted only in the 1980's. In a gentler age, apparently no one had the heart to ask the venerable men, to whom the Society owed so much, to retire when the time had come. W.W. Havens writes in the already quoted letter to Alvarez (Ref. 190): "I do not think it wise to have the Society operated by a tired old physicist because of my few unfortunate experiences with individuals who should have retired but would not."

199. Apparently advance budgeting had not been the previous treasurers' strong suit. In his letter (Ref. 108) to the 1955 president, R.T. Birge, K.K. Darrow describes the precarious financial condition of the Society: "Our policy is to give the *Physical Review* all that it wants, even when this entails a deficit, and to expect the other activities of the Society to add as little as possible to the deficit. This system must be changed..." He goes on: "I think we ought to have someone draw up a budget for 1956, and I am glad to report that our Deputy Treasurer [Quimby, who occupied that position from 1955 to 1957] is taking a keen

interest in the finances of the Society so that I may propose at the Chicago Meeting that he be asked to draw up a budget for the year 1956" (Ref. 229).

200. Arthur Nowick and W.W. Havens, Jr**.**, "Shirley Leon Quimby" (obituary), Phys.Today **39** (11), 119-121 (1986).

201. Walter L. Brown and William W. Havens, Jr. "Joseph A. Burton" (obituary), Phys.Today **40** (4), 108 (1987).

202. Private communication, 5 May 1998.

203. The fact that, with this growth, APS functioned well and everything got done quickly and efficiently, did not prevent some members of the Council, from corporate backgrounds, from complaining, near the end of Havens' tenure, that the Society was still being run as a mom-and-pop operation. It is true that Havens and his two
colleagues as headquarters operating officers, Burton and then Lustig, tended to have an approach that was simultaneously hands-on and collegial, and tried to avoid bureaucratic structures and corporate modes and habits. Havens would widely distribute most pieces of correspondence that came into the office so that everyone would know what was going on and almost every day the physicists in the office would lunch together in a neighborhood cafeteria, in order to discuss and organize the pending tasks and to make plans for the future. It is also true that until Burton's time there were no formal personnel policy or handbook and until Lustig's no personnel manager, evaluation procedure, or five-year budget plans. And there certainly were no management consultants or annual staff retreats. But during Bill Havens' time, and in large measure due to his skills and attitude, not only did the Society grow in size and influence, but it was also a good place at which to work. And important changes did take place.

204. A complete list of publicly issued APS policy studies appears on p.32 of Phys.Today **52** (3), 1999. As a precursor to one of these studies, Havens and Marlon Fiske of General Electric organized a conference on "Physics and the Energy Problem" and edited the proceedings (American Institute of Physics, 1974). Since Havens' retirement, APS has not undertaken any other major studies. A POPA proposal, in the early nineties, to conduct a review of the status of renewable energy research and development could was not undertaken because of the inability to secure external funding.

205. In a memoir written on the occasion of Havens' retirement (Ref. 206), David Lazarus, who was APS' editor-in-chief from 1981 to 1991, said "He can remember any detail of any matter that ever transpired at a meeting of the APS executive committee or council in the past quarter century. He is the only man I know who can take perfect minutes in his sleep. Whenever any group started to do something stupid at a meeting, it was always Bill who came up with the proper historical account of why that didn't work before, back in 19XX, so we had better not try it again!"

206. David Lazarus, "Bill Havens and APS: A Thank You Note", Phys. Today, **44** (5) 59 -61 (1991).

207. When the Treasurer, in 1992, first proposed a budget of $500,000 for special events at the Centennial, councillors objected not only to the cost but to the events themselves, fearing that they would disrupt the normal divisional routine of the March and April meetings. Happily, as the officers and council members got caught up in the excitement and the public service ramifications of the once- in- a- hundred- years- event, and as the net assets of the Society continued to grow, the opposition dissipated and considerably more ambitious plans were laid and carried out.

208. The APS Meeting did not fill the enormous building. During the first two days, some 30,000 dentists and associated professionals cohabited the Congress Center with the APS. Their name badges carefully delineated the station of the wearer - "dentist", "dental technician". "laboratory assistant", and so on. Companions had badges with titles such as "dentist's spouse". One of the physicists at the APS meeting, whose husband is a dentist, wondered whether she should ask for a second badge saying "dentist's spouse", to enhance her status. Not that the APS badges were impeccable. In a heretofore never perpetrated and imperfectly mastered imitation of the *bonhomie* at other conventions of displaying the bearers' preferred versions of their first names or their nicknames, J. Robert Schrieffer sported a big "J" under his name; W.W. Havens, Jr, who is universally known as 'Bill", was to be addressed as "W.W."; and there was no clue that Venkatesh Narayanamurti is called "Venkie".

209. In a striking rally for unity, all divisions, topical groups and forums participated in the Centennial meeting, although some only in a token way. In particular, the Division of the Physics of Beams did not convince its partners in the organization of the biennial "Particle Accelerator Conference" (the Division's annual meeting every other year), that this year's conference should be held in conjunction with the APS Centennial, rather than, almost simultaneously, in a different part of the country.

210. Some of the divisional symposia presented the history of their area of physics in the twentieth century or speculated on its future in the twenty-first, and featured such luminaries - merely to give a sample - as T.D. Lee, Burton Richter, Leon Lederman, Edward Witten, Pierre de Gennes, Ben Mottelson, Dudley Herschbach, Stuart Rice, Harry Swinney, Pierre Hohenberg, Norman Ramsey, Michael Turner, David Wineland, Clifford Will, Kip Thorne, Klaus von Klitzing, Paul Lauterbur, Sherwood Rowland, William Brinkman, Charles Townes, Nicolaas Bloembergen, Theodor Haensch, Carl Wieman, Simon Foner, Werner Wolf, Michael Fisher, Ernest Courant, Andrew Sessler, Mitchell Feigenbaum, and Douglas Osheroff. There were panels on "Science policy for the new millennium" (with speakers, among others, from the executive and legislative branches of the government); on "Breakthroughs of women in physics" (with, again among others, the pioneer Esther Conwell and current notables Mary K. Gaillard and Gail Hanson); a similar symposium on the contribution of minority physicists under the title "From particles to atoms and galaxies: physics in all sizes, by all peoples" (with scheduled speakers Shirley Jackson, Michael Nieto, Arthur Walker, and J.D. Garcia); and a session on "Research and innovation in physics education" (with Sheila Tobias, Charles Holbrow, Donald Holcomb, Edward (Joe) Redish

and Lillian McDermott). An interesting symposium on the "Impact of immigration on U.S. physics" featured Hans Frauenfelder, Steven Chu, and Boris Altshuler; one on "The history of physics in the national defense" had excellent presentations by Hans Bethe (on the Manhattan Project), Sidney Drell, Charles Townes and others. The indomitable Bethe, at ninety-two, gave another splendid talk in a session on "I.I. Rabi: physicist and citizen", which also featured contributions by Norman Ramsey, Dudley Herschbach, Daniel Kleppner, Martin Perl and Gerald Holton. The latter, in turn, was the lead-off speaker at a symposium on "Physicists as concerned citizens", where he was followed by Philip Morrison and Joseph Rotblat (of Pugwash fame). Joseph Birman, David Pines, Yakov Alpert (a senior *refusenik*), Ngee-Pong Chang, and Guo-Zhen Yang (of the Chinese Academy of Sciences and a participant in the APS China program) shared a session on "Physics cooperation in cold war and post cold war eras". At a panel discussion by presidential science advisers, every living person who had occupied this role was there to give his insights and reminiscences, except the incumbent Neal Lane, who was detained in Washington, but sent a tape. The line-up was D.Allan Bromley, Edward E. David, John H. Gibbons, William Graham, Donald F. Hornig, George Keyworth, Frank Press, and H.Guyford Stever.

211. "Richardson Vows to Keep Labs Open in Keynote Address", APS News **8** (5) p.1 (1999).

212. http://www.aps.org/ APS News.

213. The "black tie optional" invitations would have delighted K.K. Darrow; the physics chanteuse (Lynda Williams, a former go-go dancer turned physics lecturer at San Francisco State, who sang songs like "Carbon is a Girl's Best Friend" and "Solid State of Mind") probably would not - but then who knows? The *Chronicle of Higher Education,* in a page-and-a-half story (Kim A. McDonald "A Centennial Celebration of Physics Brings Out the Discipline's Human Side - Abandoning their somewhat stodgy image, physical-society's scientists show they also want to have some fun", The Chronicle of Higher Education, April 2, 1999, pp. 22, 24) was much taken not only with Ms. Williams performance, but also with her sociological findings. "Based on her experience at various scientific banquets, the *Chronicle* reported, "Ms. Williams rates geologists as the true party animals, followed by astronomers, then physicists". " 'Physicists are the toughest audience', she said. 'They tend to be very conservative. But you know, physics is a serious business. Astronomers are a lot easier'." Although the gala formed the centerpiece of the *Chronicle's* report, the scientific and socio-political program of the Centennial meeting was given fair coverage by that weekly. Not so for the rest of the press. To the best of the Society officers' knowledge, the Centennial meeting was mentioned in none of the popular media, or even the not so popular ones, like National Public Radio, and this in spite of the fact that the Society had paid a lot of money to a public relations firm to assure publicity for the Centennial and for physics.

214. "To Advance & Diffuse the Knowledge of Physics : 100 Years of the American Physical Society"; Sara Schechner, curator; Barrett Ripin, exhibit director.

215. "A Century of Physics"; Brian B. Schwartz, project director; Hans von Baeyer and Sidney Perkowitz, writers; Albert Gregory, designer. The American Physical Society, 1999. Copies of the Wall Chart are being distributed to thousands of high schools.

216. Benjamin Bederson, ed., with an Introduction by Hans Bethe (who also wrote two of the articles); XIX + 841 pages, Springer and The American Physical Society (1999); also published as a special issue of Reviews of Modern Physics (**99**, 1999).

217. Written by Curt Suplee; edited by Judy R. Franz and John S. Rigden, 233 pages. Harry N. Abrams in association with the American Physical Society and the American Institute of Physics, 1999.

218. Christopher Lehmann-Haupt, The New York Times, April 29, 1999. In his mixed evaluation, the reviewer says that "Mr. Suplee [the author] makes a lot of difficult abstract ideas a little clearer, particularly superconductivity, chaos theory and Einstein's theory of special relativity". But Lehmann-Haupt faults some of the photographs for showing impressive machinery while "they tell you little". And he notices a "faintly disconcerting pattern. As each new discovery is explained, the discussion ends with some practical application...you sometimes get a sense that the whole point of 20th-century physics was not simply to extend the frontiers of knowledge but, like Du Pont in the old commercial, to produce things for better living through chemistry." With a redaction of the word "simply" and , perhaps, the insertion of "only" before "to produce", many of the participants in the Centennial and the other members of the American Physical Society would resonate with the reviewer's discomfort.

219. and which for the first time challenges the Society's and the professions's long held conviction that "physicists are necessary so that physics gets done, and not that physics is necessary so that physicists have something to do" (Halsted, op. cit.).

220. Representative George E. Brown , until his death in July of 1999, the ranking Democrat on the House Committee on Science , the former chairman of the Committee on Science, Space and Technology, and unarguably, until the election of Vernon Ehlers, science's greatest friend and supporter in Congress, said this in a recent interview: "...[scientists], generally speaking, have too great a faith in the power of common sense and reason. That's not what drives most political figures, who are concerned about emotions...You have to talk to them realistically. It does very little good to talk to them on high principle..." (Claudia Dreifus, "The Congressman Who Loved Science", *The New York Times*, Science Section, March 9, 1999).

221. There were exceptions to arguing for programs and projects on the basis of their anticipated contributions to the cold war. When Robert R. Wilson, the director of the Fermi National Accelerator Laboratory (and President of the APS in 1985) was asked at a Senate hearing what the Lab would contribute to the national defense, he was reported to have answered, nothing at all, but it will make the country worth defending (Kevles, op. cit., p. XXXVI).

222. George Brown (Claudia Dreifus, "The Congressman Who Loved Science", *The New York Times*, Science Section, March 9, 1999), in response to a question about whether it was a mistake for scientists to have asked for funding as a part of the cold war: "Well, I wouldn't describe it as a big mistake. But to build the funding of science for the next generation on the basis of the cold war was not well advised. That implied that science was not important enough to survive without a cold war."

223. The earlier belief, by Rowland (Ref. 20) and by some more contemporary physicists that it is *more* important and *more* worthy of support is no longer held or at least no longer voiced. In a post-SSC article on the problems facing science, Steven Weinberg now says, with disarming modesty: "The problem is that some people, including some scientists, deny that the search for the final laws of nature has its own special sort of value, a value that *also* should be taken into account in deciding how to fund research ("Reductionism Redux", *The New York Review of Books*, 5 October 1995, 39-42).

224. albeit at the cost of having money and effort spent on a manned space station and other diversions of little scientific interest and even dubious practical benefit. The success of the astronomers is, in good part, due to the superb and sustained work by their gifted communicators in explaining their fascinating science and its findings to the media and the public.

225. as quoted by Charles M. Vest in "A wondrous and poetic spectrum" (a review of the book "Unwinding the Rainbow - Science, Delusion, and the Appetite for Wonder", by the biologist Richard Dawkins), Science **283** (5398), 38-39 (1999).

226. Phys. Today, **52** (3), 25 (1999).

227. and is still recognized by contemporary statesmen of science, albeit expressed in more modern language: Charles M. Vest, the president of MIT, in *Science* (op. cit.): **"**... the patrons of modern science, primarily governments, appropriately feel an obligation to show that public investment in science produces improvements in economics and quality of life. So, as we discuss science with the public and our patrons, we face an inherent dilemma: We must demonstrate science's utilitarian returns, but we know that science often thrives while advancing along circuitous pathways toward unpredictable destinations, propelled by human curiosity". Vest also approvingly cites Dawkins' warning of the danger, in selling science to the public, of 'dumbing [it] down, and of the trend to present it as 'fun, fun, fun'.

228. Harry Lustig, Phys. Today **52** (3) 27-33 (1999).

229. Center for the History of Physics, Niels Bohr Library of the American Institute of Physics.

FIGURE CAPTIONS

Fig. 1. Arthur Gordon Webster, the "father" of the American Physical Society. (Courtesy of Clark University Archives.)

Fig. 2. Henry A. Rowland, the first president, (1899-1900), of the American Physical Society. His inaugural address sounded many philosophical and political themes that resonate with physicists to this day. (Courtesy of the AIP Emilio Segré Visual Archives, hereafter abbreviated AIP ESVA.)

Fig. 3. Edward L. Nichols, Ernest Merritt and Frederick Bedell, first editors of *The Physical Review*, founded at Cornell University in 1893. (AIP ESVA.)

Fig. 4. Henry Rowland, William Thomson (Lord Kelvin) and T.C. Mendenhall, shown with Éleuthère Mascart (extreme left) and W.E. Ayrton (extreme right) at the 1893 International Electrical Congress in Chicago. Some credit the Congress, by dint of its pointing to the importance of physics for industry, with having been a major influence in the formation of the American Physical Society. (AIP ESVA.)

Fig. 5. Growth in the numbers of manuscripts received since 1950, and in the
numbers of articles and pages published since 1963 by the *Physical Review* .Data for *Physical Review Letters* are included from its founding in 1958. (Courtesy, APS Editorial Office.)

Fig. 6. Growing international prestige of APS journals is reflected in the increase in manuscripts submitted from abroad since 1981 to the *Physical Review* and *Physical Review Letters.* (Courtesy, APS Editorial Office.)

Fig. 7. In recent years (1966 is shown), the major source of income for the APS journals have been library subscriptions and the major expense editorial and composition costs. (Courtesy APS Treasurer's office, hereafter abbreviated APS T.)

Fig. 8. Making room for public affairs*:* net income from journals helped to finance education and outreach programs of the Society. Membership and meetings operations broke even. Data for 1996. (APS T.)

Fig. 9. How in 1996 investment income was able to help build up the reserves. (APS T.)

Fig. 10. Revenues and expenses for the journal operations since 1967. Both have gone up by close to a factor of ten, and a surplus has been achieved for most years
since 1983. (APS T.)

Fig. 11. APS's overall finances since 1967. Surpluses have permitted the accumulation of a reserve fund. (APS T.)

Fig. 12. Martin Perl, activist, founding member of the Forum on Physics and Society and Nobel Laureate, shown here with Richard Lapidus and David Wolfe at a Penn State conference, 1974. (AIP ESVA.)

Fig. 13. Membership growth in the APS (Courtesy, APS Associate Executive Officer.)

Fig. 14. George Pegram, APS treasurer (1918 -1957*),* helped found AIP and served as AIP secretary (1931-1945) and treasurer

(1938-1956). He is shown delivering a report to APS president R.W. Wood in 1935. (AIP ESVA.)

Fig. 15. K.K. Darrow, “Mr. American Physical Society” to many older members, served as secretary of the Society from 1941 until 1966. According to his successor, W.W. Havens, Jr., “the manner in which he ran the American Physical Society will never be duplicated.” Darrow (on left) with Henry A. Barton, director emeritus of AIP, at a Washington APS meeting, 1960. (AIP ESVA.)

Fig. 16. As APS’s Executive Secretary from 1967 until 1990, W.W. (Bill) Havens, Jr. did much to shape the modern *Gestalt* of the Society. He is shown with Robert Marshak, who was to become APS’s (arguably most activist and outspoken president in 1983.(Courtesy, City College of New York and Bill Havens.)

Fig. 17. Participants in the fiftieth anniversary meeting of the APS at Harvard University, 1949. (AIP ESVA.)

Fig. 18. Charles Townes, Hans Bethe and Norman Ramsey (former APS presidents), at a luncheon for Nobel laureates, high school teachers and students, held during the APS centennial celebration in Atlanta in March 1999. Altogether twenty-one of APS’ eighty-five presidents have been Nobel laureates. (Courtesy, *APS News*.)