Science: The Struggle for Survival, 1880 to 1894

Sally Gregory Kohlstedt

Summary. The first issue of *Science* was published on 3 July 1880 as a result of collaboration between journalist John Michels and inventor Thomas A. Edison. Although Edison withdrew his support after 18 months, Michels published three more issues and continued to seek support elsewhere. Earlier, Alexander Graham Bell expressed interest in the journal, but did not complete negotiations with Michels until after publication of *Science* had ceased in 1882. In February 1883 the first issue of another series of *Science* appeared, this time supported by Bell and his father-in-law, Gardiner G. Hubbard. Publication then continued, under the editorship of Samuel H. Scudder and, subsequently, N. D. C. Hodges, until 1894, when, after an interval of several months, *Science* became the property of James McKeen Cattell.

The early years of *Science: A Weekly Journal of Scientific Progress* are obscure today (*1*). Historical accounts typically ignore the first 3 years of publication and gloss over the rather difficult period before the affiliation of the journal with the American Association for the Advancement of Science. Yet it was in the first decade that *Science* established areas of coverage and an audience that remains surprisingly similar after 100 years.

The First Eighteen Months

The first issue of *Science* was published on 3 July 1880 as a result of collaboration between a little-known New York journalist, John Michels, and inventor Thomas A. Edison. Personal motives played a critical role in this collaboration. Michels' career, before he contacted Edison in early 1880, included service as a private secretary to the British consul general and work as a freelance reporter in England and the United States (*2*). He was about 40 years old and was seeking more stable employment. An amateur in microscopy and a journalist, he had reported on scientific meetings and events for the *New York Times* and had published in *Popular Science Monthly* and *Scientific American*. He was undoubtedly aware of contemporary discussions about a news journal when he sent Edison a prospectus for a weekly publication "comprehensive in its character and issued on a sound financial basis" (*3*).

Thomas A. Edison's motives appear similarly tied to personal ambition. During this period the inventor rather directly—and not altogether successfully—was trying to establish his image as a "scientific man" (*4*). He had joined the Draper astronomical expedition to Council Bluffs in 1878 to observe the eclipse and had at that time met J. Norman Lockyer, the editor of *Nature*. He also had attended meetings of the AAAS at St. Louis in 1878 and at Saratoga Springs in 1879 (*5*). Contacts made through these meetings were a backdrop, however. Edison in 1880 was at a high point in his career, working on the electric lamp and developing means to commercialize its use. He was anxious to publicize his ideas on electricity. The newspapers obliged and *Scientific American*, with its emphasis on invention and patents, regularly published details of his discoveries (*6*). Still, a journal under his influence would have certain advantages. It was not entirely fortuitous that, while his name was nowhere in evidence in the front matter, the first issue of *Science* devoted two and a half pages to electrical research and contained specific references to work being done at Edison laboratories (*7*); later issues continued this pattern. Perhaps equally significant, Edison had money to invest and Michels held out the probability of a paying enterprise: "When I see the unethical sheets with limited subjects and no editorial capacity *paying*, I can have no doubt of the commercial success of what I propose" (*8*). So, after a few months of negotiation, Edison agreed to back the journal financially while Michels served as editor, writer, and subscription agency at a fixed salary of $30 per week (*9*).

Michels' argument that there was a need for *Science* reflected not only previous efforts here and abroad but also discussions among scientists at various scientific meetings in the 1870's and 1880's. A significant influence in the formulation of the journal was the apparent success of *Nature*, which had been founded in London in 1869 and had attracted leading scientists into its "stable of writers" (*10*). In the years between the founding of *Nature* and *Science* there had been several short-lived efforts in the United States to create publications that would cover scientific research results as well as information on institutions and organizations, such as *Science News* (see box, page 34) (*11*). Keeping themselves informed across disciplinary boundaries and abreast of rapid institutional development was becoming very important to scientists at that time. Among the journals already publishing were Benjamin Silliman's *American Journal of Science* (established in 1818), which carried news of scientific societies; *Scientific American* (1845), which stressed primarily technological news and invention (about 20 percent of its content); and newer journals, such as the *American Naturalist* (1867) and Edward Youman's *Popular Science Monthly* (1872), which carried a high proportion of national and institutional information. But these were not enough.

By the 1870's many American scientists judged the news coverage in the older science journals and in the public press to be piecemeal and insufficient. As scientific activity increased, they sought more regular access to news of the scientific bureaucracy in Washington (including the U.S. Geological Survey and the Department of Agriculture), of universities such as Johns Hopkins and Harvard, which were initiating advanced degree programs and building research facilities, and of the research results being presented in journals dealing with astronomy, microscopy, entomology, and other fields (*12*). Thus the incentives to start a new journal, in addition to being related to the private purposes of the sponsors, were a perceived need for more thorough news coverage within the

The author is acting chairperson of the Department of History, Syracuse University, Syracuse, New York 13210.

0036-8075/80/0704-0033$02.00/0

scientific community and concern about the adequacy of public news coverage of science.

Edison and Michels were also conscious of a growing public interest in science. For years, broad-based journals of culture such as the *North American Review* (1815) included reviews of scientific books and articles, a tradition that continued in the last half of the century in such magazines as *Harpers' Monthly Magazine* (1850) and Frank Leslie's *Popular Monthly* (1876) (*13*). Audiences at the expanding natural history museums in Boston, New York, Chicago, and Washington, D.C., provided visible signs of this public interest, as had the Centennial Exhibition in Philadelphia (1876) with its features in technology and science. Newspapers regularly presented scientific news provided by journalists as well as by such leading scientists as Spencer S. Baird of the Smithsonian Institution. He served as a network center for the collection of news during this period and supplemented his salary and the salaries of his informants by distributing summaries of scientific activity to general periodicals (*14*). Although Whitelaw Reid, editor of the New York *Tribune*, cut back that newspaper's coverage of science in the late 1870's (*15*), the momentum toward specialized periodicals appeared on the increase. Michels stressed public interest as a justification for the new journal, and expected that a combination of scientists and amateurs as subscribers would attract advertisements from companies specializing in specimens, books, or equipment.

Many of *Science*'s predecessors had encountered serious difficulties that might have served as a warning to Michels and Edison. Nevertheless, the collaboration between the editor and inventor began in 1880 without much apparent discussion of the past. Both men were naïve about the real costs of establishing a magazine not subsidized by society membership and about the problems in establishing a regular group of contributors and subscribers. Edison rejected Michels' request for a capital investment and the proposal of multiple ownership through a stock company. He maintained tight fiscal control, leasing space in Manhattan for a time in the Tribune Building and paying Michels' salary and office expenses on a weekly basis when these (typically) overran income from subscriptions and advertising. Once the format of *Science* was established, Michels found limited opportunity to experiment with the size and content. He had almost no allocation for staff and completed much of the office work himself, while simultaneously soliciting news. Michels knew that promptness and attention to detail were important to his best contributors and noted with evident pride that *Popular Science Monthly* published Alexander Graham Bell's paper "The photophone" 3 weeks after *Science* and without drawings. He also observed that the *American Journal of Science* had similarly been late with Alexander Agassiz's AAAS address (*16*).

Michels intended to organize a well-recognized corps of associate editors, such as William Pickering, John Draper, and James Hall, in order to establish the reputation of the journal and to avoid any suggestion of "advocacy" of a single point of view (*17*). Nonetheless, given time and financial constraints, much of the content was derivative. A comparison with *Nature* in the same period reveals that the two journals had similar aspirations; but the quality of *Science* was uneven and its content was less predictable from one issue to the next. As an amateur Michels lacked contacts, and his financial backing was insufficient to attract contributors of the stature of those contributing to the English journal in the 1880's (*18*). News coverage in *Science* included straightforward announcements of national meetings and other public events without much editorial comment. Articles, lectures, and book reviews accounted for much of the rest of the content.

Edison, with one or two serious exceptions, did not interfere with editorial policy or help solicit materials (*19*). He paid the bills, sometimes belatedly (*20*). By December, 6 months after the journal had been founded, his investment was

Predecessors of *Science*

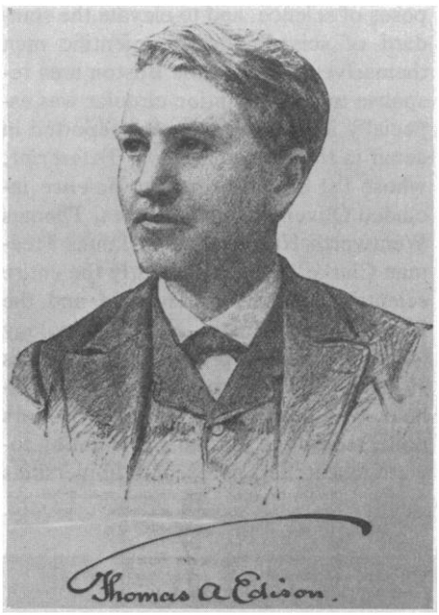
Science was neither the first nor the only response to the apparent need for a journal for the dissemination of scientific news in the last quarter of the 19th century. Many of the earlier periodicals, however, such as the short-lived *Science News* (not connected with the present journal of this name), encountered serious difficulties that might have warned of the risks involved in a journal dependent on individual subscriptions and advertising.

In the 1860's a group of Louis Agassiz's best students—including Frederic W. Putnam, Alpheus Hyatt, Alpheus S. Packard, and Edward S. Morse—"seceded" from Cambridge and established a scientific center in Salem, Massachusetts. There they organized a local society, a museum, a research center, and a journal, the *American Naturalist*. The publication, avowedly a "missionary effort" to encourage natural history, was sufficiently successful that its publisher, S. E. Cassino, operated a scientific book exchange for a national list of subscribers (represented in his irregularly published *Naturalist Directory*). In 1878 he agreed to launch a periodical, appropriately entitled *Science News*. With an established publisher and two editors with experience in science journalism, the effort seemed promising: Ernest Ingersoll was known for numerous popular books and articles on science and William C. Wyckoff had covered science meetings for the New York *Tribune*. Leading scientists indicated that the semimonthly would more generally advance the interests of science: "It is intended to be useful and attractive alike to those who are engaged in various branches of research and to that wider public which follows with avidity the record of modern discovery." The news presented was primarily that submitted by scientific organizations and individuals presenting papers at national meetings. Other content was unsigned and often derivative. Subscriptions never covered costs and personality conflicts on the editorial staff proved disruptive. On 15 October 1879 the last issue appeared and the journal ceased publication without public explanation.

Similar magazines stressing news (with approximate dates) included: *Science Record* (1872 to 1877, edited by the publishers of *Scientific American*); *Scientific Monthly* (1875 to 1876); *Science Record* (1884 to 1885, a revitalization of *Science News*); *Science Observer* (1877 to 1888); *Science Review* (1885 to 1886); and *Science and Education* (1886 to 1887). The perception that a journal attractive to scientific researchers as well as a public concerned about the implications of science could be successfully established was clearly widespread. The difficulties in undertaking such a project were apparently less understood.

about $3500; during 1881 he spent at least an additional $5700 for itemized expenses. The subscription list stabilized at about 600, which was not sufficient to meet costs. The constant drain of money and the lack of return made Edison restless (*21*). Michels remained determined to make the venture succeed but was too overworked to find ways either to recruit new subscribers or improve the weekly issues substantially.

As Edison hinted impatience with his "poor investment," Michels desperately sought other financial backers. His experience with Edison reinforced his belief that the magazine required a capital investment; weekly handouts might permit survival but would allow no opportunity for innovation. Thus, he readily accepted an offer to publish regular reports for the New York Academy of Sciences, believing this might provide a local base of support (*22*). With Frederick Shonnard of Yonkers he attempted to launch a scientific publishing company, whose 250 shares at $100 per share would be a secure foundation (*23*). The company's prospectus indicated that Michels was well aware of specific problems that needed attention and suggested such improvements as an increase in the number of pages, the assignment of specialists to head various sections of the journal, and more well-illustrated and general articles to attract a broader range of readers (*24*). Michels also contacted Alexander Graham Bell in late 1881, remembering that Bell had earlier complimented him on the journal and had offered support (*25*). In December of 1881 Edison formally ceased his sponsorship and apparently turned over to Michels all rights to the journal (*26*).



Thomas Alva Edison (1847–1931) was one of the most celebrated inventors of the 19th century, remembered particularly for his work on electricity and the telephone. Seeking recognition for his efforts among scientists, he became the first financial backer of *Science* in 1880. This support, however, was not mentioned in the article on him in the journal. [*Science* VI, 144 (21 August 1885)]

New Backers, and Reorganization

The contact with Bell eventually ensured the survival of *Science*, but it undermined Michels' own interests. For the next few months Bell contemplated becoming the financial backer of a newly constituted *Science*: "At the present time I am simply in consultation with scientific and business friends regarding the advisability of establishing an American weekly scientific journal covering the same ground as the English periodical 'Nature'—but nothing has yet been decided" (*27*). In the meantime, after three sporadically issued numbers in 1882, *Science* ceased publication (*28*).

By the 1880's Bell was sufficiently successful in his telephone interests to have money for investment and he enjoyed his contact with scientists. His father-in-law, Gardiner G. Hubbard, was a lawyer active in Boston philanthropic and literary circles (*29*). Together they planned carefully for the "new" journal and viewed their involvement as broader than financial. Thus they remained interested in the content and policies of *Science* even when they later withdrew most financial support.

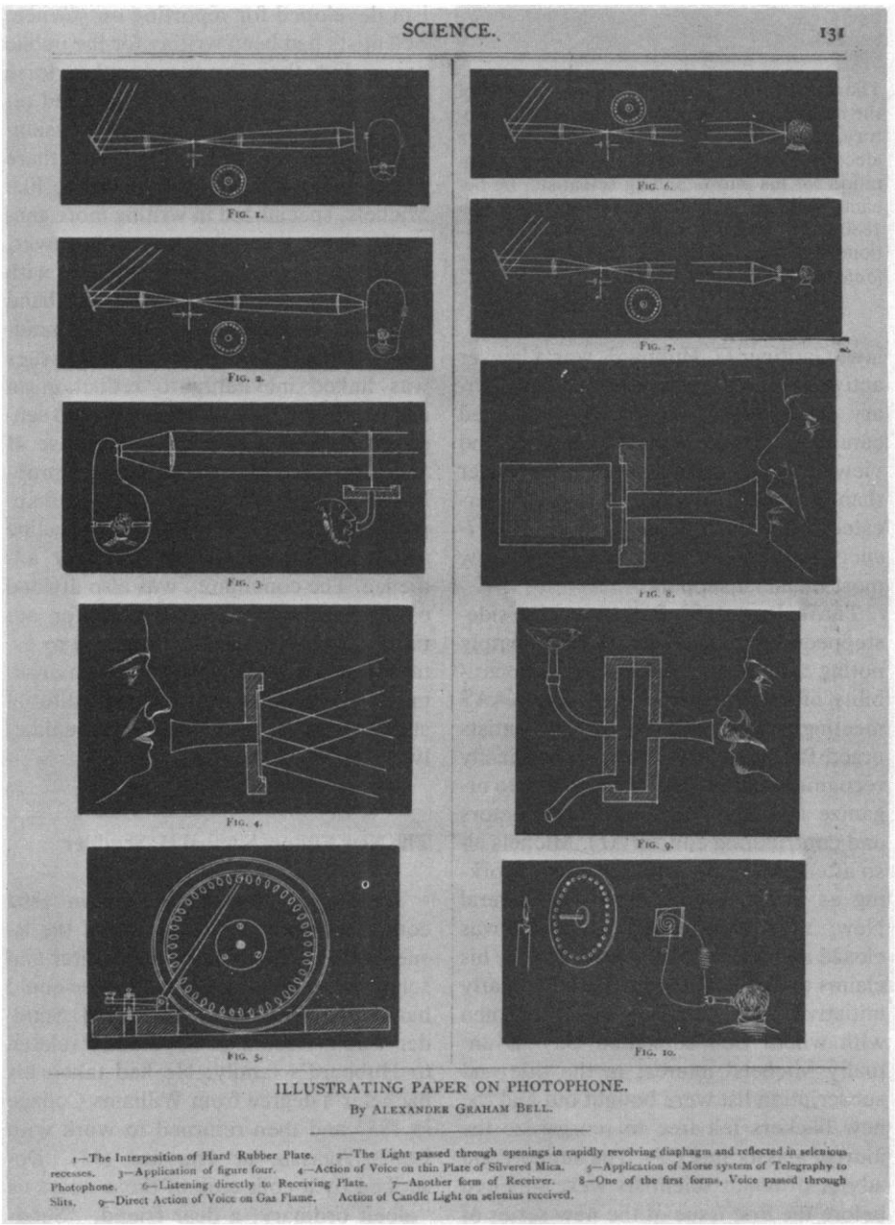
Throughout 1882 Bell shrewdly sidestepped commitment to Michels, simply noting that he was discussing the possibility of sponsorship (*30*). At the AAAS meeting in Montreal that year scientists urged Bell to select a more scientifically recognized editor than Michels and to organize a competent board of directors and contributing editors (*31*). Michels also attended the Montreal meeting, working as news correspondent for several New York newspapers, but he was closed out of key discussions because his claims to further support, based on early initiative, were dismissed by the men with whom Bell consulted (*32*). Eventually Michels' interest in the title and subscription list were bought out and the new backers felt free to reorganize the journal and its staff (*33*). The support and advice of major scientists were solicited before the first issue of the new series of *Science* was formulated, and the new editor and board of directors included educators and scientists of national reputation (*34*).

The break between the two series of *Science* was so complete that later editors and historians did not always know of or acknowledge the pre-1883 effort (*35*). The differences between the two series of *Science* were primarily in management and participation. The title, of course, remained the same and there were many similarities of intention, content, and even subscription list. Fundamental problems also persisted. Finances were the most frequently mentioned difficulty, but they were related to other fundamental issues. *Science* suffered from ambiguities that had undermined efforts to start similar journals in the 1870's and made the topic of science difficult for the daily press and literary magazines. There simply was no journalism developed for reporting on science. Scientists had been writing for the public press, but they produced either terse compilations of news or the detailed results of specialized research. Professional journalism was in its infancy and there were only a few individuals who, like Michels, specialized in writing more generally about scientific topics. Moreover, reporters were frequently viewed with the same skepticism as the growing band of popularizers by the scientific community. The problem of simplifying issues was linked inevitably to reductionism and was allied, in some estimates, to sensationalism as well (*36*). In the case of *Science*, there was the additional problem of deciding precisely what was appropriate for a science news magazine and who constituted the primary audience. The community was also divided over the question of payment for authors. Thus *Science* was required to establish its own standards in an environment where consensus among editorial staff, sponsors, and readers was unlikely.

The New Editor: Samuel H. Scudder

The new editor of *Science* in 1883 could not have been unaware of the issues, but his capabilities as a writer and scholar made him confident that he could handle the assignment. Samuel H. Scudder was a Bostonian apparently related to Hubbard's family. He had taken his bachelor's degree from Williams College in 1857 and then returned to work with Louis Agassiz at Harvard (*37*). Described by a colleague of those years as "albeit ordinary, a dear friend," Scudder worked hard and made a place for himself in the local scientific community (*38*). By 1880 he was the elected president of the Boston Society of Natural

History and a librarian at Harvard, where he devised a cataloguing system for scientific publications. In addition, his reputation as an entomologist was national and he edited *Psyche*, a Cambridge journal in entomology (*39*). His experience as administrator and his contacts augured well for *Science* and were demonstrated when Scudder wrote for and received letters of support from well-known scientists in a wide range of fields (*40*). His intentions were substantial: "The aim of the journal will be to increase the knowledge of our people, to show our transatlantic friends our real activity, to gain among intelligent people a knowledge of the true aims and purposes of science, and to elevate the standard of science among scientific men themselves" (*41*). In the Boston area response to a subscription circular was especially impressive and was reported in detail in the Boston *Evening Transcript*, whose list of subscribers to *Science* included Oliver Wendell Holmes, Thomas Wentworth Higginson, and James Freeman Clarke, along with nearly the entire scientific faculties of Harvard and the Massachusetts Institute of Technology (*42*). That the new president of the Johns Hopkins University, Daniel Coit Gilman, was head of the Board of Editors underscored the journal's orientation toward researchers at research universities and in government. Eventually named to the board were Othniel C. Marsh, paleontologist, and Simon Newcomb, astronomer (*43*). Curiously, Scudder resisted publicizing the fact of his editorship and the names of his board (*44*).



The prompt publication, with an illustrating set of figures, of Alexander Graham Bell's essay on "The photophone" persuaded the author that *Science* could provide special service to the scientific community. The illustration was intended to demonstrate for a general reader the technical steps involved in recording and then projecting a human voice. [*Science* I, 131 (1880)]

Forewarned by the problems of Michels and Edison, the new editor and backers sought to establish a network for soliciting news and for obtaining additional subscribers. On the issue of payment for publication, Scudder was determined to reimburse scientists for their efforts, convinced that a good journal would eventually attract enough subscribers to cover the costs (*45*). Scudder's own yearly salary, with a 3-year contract, was to be $4000 (*46*). After preliminary discussion with several established scientists such as Samuel P. Langley, then at Allegheny College, and William H. Pickering at Harvard, Scudder persuaded a young physicist, N. D. C. Hodges, to assist him with editorial work in January of 1883 (*47*). Order and efficiency were important to the former librarian, and he initiated form letters for routine correspondence and a new filing system.

Financial support seemed generous at the outset, especially in comparison with that of Edison, because Bell and Hubbard provided a capital base of $25,000 in stocks, toward an expected yearly budget of $40,000 (*48*). Publicity in the Washington *Post* suggested intentions were primarily philanthropic: "They [Bell and Hubbard] wished to make a contribution to science and have chosen this method as the one which seemed to them to open the way for the most beneficial results of the American people" (*49*). It is also evident that the new sponsors eventually expected to realize a profit on their venture. Like Scudder, they accepted the premise that American scientists needed such a news vehicle and that scientists should be in some way responsible for its content. They thus provided three essential requisites: editorial and contributing personnel of acknowledged competence, ample capital, and thoughtful management (*50*). Even Bell's and Hubbard's more substantial support, however, proved inadequate, given expanded aspirations, and a renewed struggle for survival began within a year. Again it would be the sacrifices and persistence of an editor who kept the journal alive. Hubbard, and to a lesser extent Bell, remained involved for nearly a decade, but after 2 years of conscientious backing they had to be goaded by the requests and sacrifices of the editors.

" 'Science' Will Help Science"

Nonetheless, the relaunch on 9 February 1883 was promising. The first issue considered "The future of American science" and found that "the scientific sky is clear and the outlook promising" for the liberal thinker (and corresponding journal) willing to acknowledge the value of applied science (*51*). The optimism apparently struck a responsive chord, and by 23 March a supplement to *Science* could list 1442 subscribers; within a year there were over 2000 on the circulation list (*52*). Scudder solicited current research news from friends, abstracted from detailed presentations and articles, and presented "intelligence" from such scientific stations as state and federal bureaus, college and other laboratories, museums and observatories (*53*). With somewhat less success he tried to persuade foreign correspondents to supply news from abroad. He intended to report on issues under debate within the scientific community but to avoid taking sides in controversy, if possible. Quite clearly, this version of *Science* was to be accessible to a wide audience but not "popular" in the increasingly derogatory sense of that term. As Gilman, chairman of the board, wrote somewhat sarcastically, "*Science* will never be easy reading & will never entertain the seeker of curiosities. They had better take their ten cents per issue to the Dime Museum—where they will 'get an equivalent' for their expenditure" (*54*). Yet public sensibility and national pride played a part as Gilman continued, "But 'Science' will help science & so help the country and 'mankind.' " Gilman, despite his other major responsibilities, was a persistent advisor, although he refused to let Hubbard make him financial manager of the journal.

Autonomy was a basic principle to Scudder and he believed an editor should be trusted to be responsible for both news content and presentation. The line between "popular" presentations, which connoted careless, even deliberately sensationalized and misleading versions of scientific activity, and general

In 1882 editor John Michels attempted to develop a broad-based stock company whose subscribers would provide the capital base on which to reestablish *Science* magazine. This "Prospectus" suggests the range of contributors and subscribers involved in the first 18 months of the weekly publication. Michels' effort was not successful and revival of the magazine occurred only when individual patrons were persuaded to underwrite costs. [Courtesy of the Eisenhower Library, Johns Hopkins University]

THE "SCIENCE" PUBLICATION COMPANY,
LIMITED.

CAPITAL, $25,000. IN 250 SHARES OF THE VALUE OF $100 EACH.

Payable half on Allotment. The remainder not earlier than Six months later.

OFFICERS:

Pending the Organization of the Board and Officers, checks in payment for Shares will be payable to the order of Frederic Shonnard, Esq, (Trustee), 521 West 24th Street, N. Y. City.

As the promoters of this Company are gentlemen of property, who desire the thorough success of this Journal as a means of advancing science, and as an aid to those engaged in scientific research, they claim the right to decline subscriptions from any person whose views are not in accord with such a purpose.

PROSPECTUS.

THE journal called "SCIENCE" having established a high reputation, and achieved a literary success, the "SCIENCE PUBLICATION COMPANY" is formed to secure the journal on a firm financial basis, and to take steps for placing it on the market, on the usual business principles.

A glance at the list of contributors and paid subscribers is evidence of the distinguished position achieved by this journal, and the favor with which it has been received in the United States and other parts of the world. "SCIENCE" stands alone as the only *weekly* scientific journal in the United States which covers *all* branches of scientific research, and unconnected with trade interests or business establishments.

The editorial conduct of this journal has been based on a policy to admit the widest discussion of all current scientific subjects, but no editorial bias has been given to any particular set of views. The Editor has not himself indulged in polemics nor permitted the discussion of religious questions, believing that the ground covered by investigations of all branches of the sciences, is sufficient for one journal to cultivate, and that pseudo-scientific discussions are foreign to the purpose of a real scientific journal.

This journal has now been published 18 months, but up to date no steps have been taken to make it known either by advertisements, canvassers, or by the distribution of sample copies; in fact, all the business steps for promoting the sale of the journal have yet to be taken. In spite of this, the nucleus of a good subscription list has been formed, comprising subscribers in every State of the Union, and also in Canada, Japan, India, and nearly all the European countries, and it may be concluded that when proper capital and business facilities are offered, "SCIENCE" will rank among the best paying periodicals on the market.

Many reasons for believing in the future prosperity of "SCIENCE" might be presented, as it describes the progress of every branch of the sciences, and deals in a subject of universal interest, not only associated with literature in its highest sense, but with the material interests of the multitude in almost every industry and branch of trade.

With the increased facilities afforded by capital, the editor proposes, after the 1st of January, when the Third Volume will commence, to make the following additions and improvements to the journal:

1. To increase the number of pages.
2. To place well known specialists in charge of the various departments of science.
3. To add a four-page supplement of applied or practical science, dealing with new inventions and discoveries in the various industries.
4. To bind the 4 weekly numbers in a paper cover, and issue as a monthly.
5. The introduction of more illustrations, and articles of a popular and instructive character, to widen the field of readers.
6. The issue of Vols. I. and II. as bound volumes—Vol. II. having 650 pages and index of 10,000 references, can be reprinted from the plates which have been preserved, for about $1.25 per volume, well bound in fancy cloth, and can be sold retail for $5; or it can be offered as a premiumfor new subscribers at cost price.

The "SCIENCE PUBLICATION COMPANY" will commence business under most favorable circumstances for success. The expenses incurred, up to date of transfer, will not be charged against the new company, but copyright, subscription lists, electrotype plates of all pages since the commencement (July, 1880), and all property acquired by the journal to date, will be handed over to "THE SCIENCE PUBLICATION COMPANY" without any cash payment. Thus the whole of the capital of the new company will be devoted to the future development of the journal.

There is no better property than a well established journal, which yearly increases in value as the circulation grows in extent. It is also a business in which no credit is given or debts incurred.

CONTRIBUTORS.

The Editor has received the generous support of the most-esteemed specialists of this country, and among those who have contributed original papers during the past 18 months may be named:

Professor ASAPH HALL....Naval Observatory, Washington, D.C.
Professor O. C. MARSH.....Yale College
Professor ED. S. HOLDEN.....Madison, Wis.
Professor E. C. PICKERING.....Harvard College, Mass.
Professor ORMOND STONE.....Cincinnati, O.
Professor H. L. SMITH.....Hobart College, N. Y.
Dr. ED. C. SPITZKA .....New York City.
Professor BURT G. WILDER.....Cornell University, N. Y.
Dr. J. B. HOLDEN .....Am. Museum of Nat. Hist., N. Y
Professor C. A. YOUNG.....Princeton, N. J.
Professor HENRY DRAPER.....New York City
Professor DANIEL DRAPER..... .....New York City
Professor F. W. PUTNAM, Peabody Museum, Cambridge, Mass.
Professor ALEX. GRAHAM BELL.....Washington, C. D.
Professor LOUIS ELSBERG, M. D..... .....New York City.
Major J. W. POWELL ..Geographical Survey, Washington, D. C.
Professor ED. S. MORSE..... .....Salem, Mass.
Mr. S. W. BURNHAM..... ..Washburn Obs., Madison, Wis.
Professor T. J. BURNETT.....Illinois Industrial University, Ill.
Lieut-Col. W. A. ROSS, R. A..... .....London, Eng
Dr. HENRY R. ROGERS.....Dunkirk, N. Y.
Mr. E. L. LARKIN .....New Windsor, Ill.
Dr. T. STERRY HUNT.....Montreal, Canada
Professor J. S. NEWBERY.....Columbia College, N. Y.
Professor ALEX. JULIEN .....Columbia College, N. Y.
Professor A. E. DOLBEAR.....Tufts College, Mass.

Professor A. WINCHELL.....University of Michigan
Countess CLARA LANZA.....New York City
(most valuable translations from the French, Italian & German.)
Prof. D. P. TODD, Nautical Almanac Office, Washington, D. C.
Mr. E. E. BARNARD.....Nashville, Tenn.
Dr. GEORGE W. RACHEL.....New York City
Professor W. A. BUCKHOUT.....Penn. State Univ., Pa.
Professor L. TROUVELOT.....Cambridge, Mass.
Dr. S. V. CLEVENGER..... Chicago, Ill.
Mr. H. F. OSBORN, S. D.....Princeton, N. J.
Professor H. W. WILEY.....Lafayette, Ind.
Professor J. E. HILGARD.....Washington, D. C.
Mr. CHARLES MORRIS.....Philadelphia, Pa.
Dr. G. M. HAMMOND.....New York City
Dr. H. J. DETMERS..... ..... Champagne, Ill.
Professor S. W. ROBINSON.....Ohio State University
Professor THEODORE GILL .Smithsonian Inst, Washington, D. C.
Professor RICHARD OWEN..... .....New Harmony, Ind.
Professor J. E. HENDRICKS.....Editor of the "Analyst"
Professor W. J. MCGEE..... ..Farley, Iowa
Professor W. LE CONTE STEVENS .....New York City
Professor PLINY EARLE CHASE.....Haverford College Pa.
Professor GEORGE B. MERRIMAN.....Rutgers College, N. Y.
Professor C. V. RILEY.....U. S. Entomologist, Wash'n, D. C.
Professor SHARPLESS.....Haverford College, Pa.
And others.

SELECTION FROM THE PAID SUBSCRIPTION LIST.

DEPARTMENT OF THE INTERIOR.....Washington, D. C.
SURGEON GENERAL'S DEPARTMENT ..... " "
CHIEF SIGNAL OFFICER..... " "
THE NAUTICAL ALMANAC OFFICE..... " "
COAST AND GEODETIC SURVEY..... " "
THE NAVAL OBSERVATORY..... " "
THE SMITHSONIAN INSTITUTE..... " "
THE UNIVERSITY OF TOKIO.....Japan
THE ROYAL OBSERVATORY.....Brussels, Belgium
THE ROYAL OBSERVATORY.....Lisbon, Portugal
THE COLLEGE OF ROME.....Italy
Professor HEDERSTEDT.....Lucknow, India
JOHNS HOPKINS UNIVERSITY.....Baltimore

Professor H. M. PAUL.....Tokio, Japan
MARUYA & CO..... " "
Professor CHAPLIN..... " "
Professor CILORIA.....Observatory of Milan, Italy
HARVARD COLLEGE..... .....Cambridge, Mass.
DR. STERRY HUNT.....Montreal, Canada
PUBLIC LIBRARY..... .....Chicago, Ill.
AMERICAN ELECTRIC COMPANY .....Connecticut
NEW YORK CITY..... .....Department of Parks
H. L. JONES.....Victoria, British Columbia
THE REVEREND J. M. PERRY.....Northumberland, England
LIEUT. COL. ROSS.....London, England
WIDDISON & SON..... .....Sheffield, England

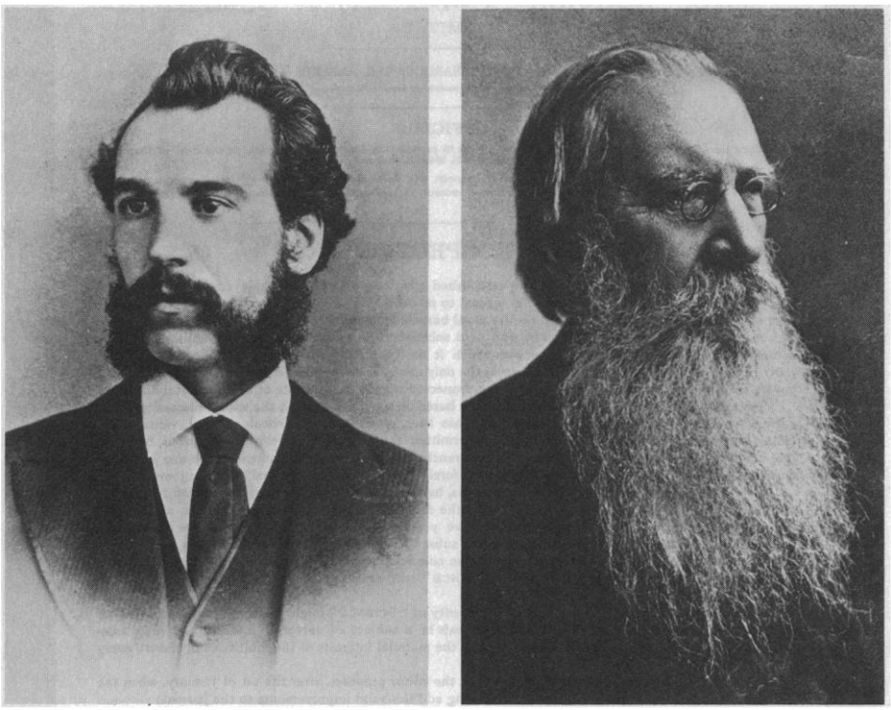
In the United States subscribers are represented in every State of the Union, including Heads of Schools, Libraries of Colleges, Professors in Universities, Business Houses, Pastors, Physicians and private persons.

188

To FREDERIC SHONNARD, Esq.,
521 W. 24th Street, N. Y. City:

Please allot to me.....Shares in "THE SCIENCE PUBLICATION COMPANY," *for which I now enclose a Check for.....Dollars.*

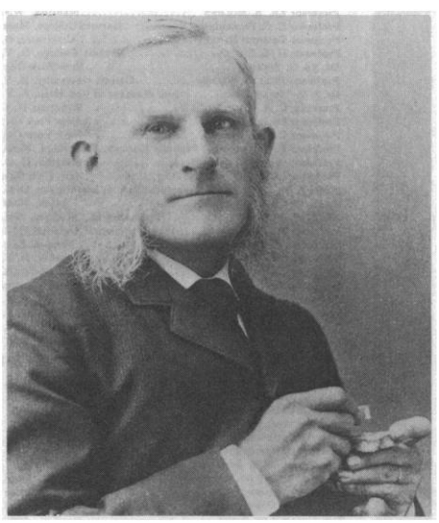
$.....



Alexander Graham Bell (1847–1922) (left) and his father-in-law Gardiner Greene Hubbard (1822–1897) (right) sponsored *Science* financially for several years in the 1880's. They were convinced that the advancement of science required a news journal with interdisciplinary coverage and regarded their $80,000 in support as a philanthropic activity. [Photos courtesy of A.T. & T.G.]

rather simplified summaries was not always clear. Scudder outlined the problem in early 1884 when he admitted that while popular science was too often produced by the "lay element" in the community, yet the increasing specialization and distance between natural and physical sciences required some compromise: "Science must be almost as much popularized to be made accessible to all scientific readers, as to be readable by the educated public who were never in a laboratory" (*55*). His decision to drop the rather terse Weekly Summary of new discoveries and pieces of data and to replace these by somewhat longer, signed articles detailing in more general terms work in particular fields was an effort to transcend specialization while maintaining expertise (*56*). Identifying qualified persons ready to take the time required to broaden their own perspective proved difficult, however, and scientific contributors were not always capable of "good form" in scientific writing (*57*). Scudder found it cumbersome to confer with his board and backers and believed that he should be independent in making decisions. His board should provide basic financial overview, but give advice only when asked. His position accounts, in part, for his reluctance to move closer to his sponsors. Hubbard, and presumably Bell, however, viewed the board as a "critic" of the journal and Hubbard wrote with some irritation to Gilman, "Mr. Scudder thinks we have nothing to do with the paper, while I consider that he is the organ of the Directors" (*58*).

In fact, the typical content caused little reason for discussion. The intention of *Science* was to cover news of societies and agencies as they produced or presented research results and as they developed facilities for scientific investigation. Certain features were standard. The American Association for the Advancement of Science's annual meetings, for example, were covered in detail. A summary of sessions and reprints of important addresses, especially that of the president of the AAAS, were accorded prominent place in the issues following each meeting (*59*). There were two featured series in 1883: Weekly Summary of the Progress of Science and Intelligence from American Scientific Stations. Although the titles changed and materials were rearranged, coverage persisted in these two major areas. Of course, progress was not easy to define and Scudder found he had to reject much "simply descriptive" material—such as the discovery of a petrel in Alaska—to search out scientists willing to present more general discussion of scientific activity (*60*). Information on institutional activities was somewhat easier to acquire from those who wanted publicity, particularly when they also reported to other organizations or authorities. Thus there were regular items from the U.S. Naval Observatory (with which board member Simon Newcomb was affiliated) as well as from agricultural experiment stations, universities, and a range of state agencies. Despite considerable effort, Scudder was never able to solicit much "foreign commentary" on scientific activities in Europe or the Far East (*61*). Occasionally the journal did take a stand with regard to the politics of science. One example was editorial support for the proposal in the mid-1880's to establish an autonomous and independent federal department for science in order to provide coordination among government agencies (*62*). The proposal of the Allison Commission failed, but not without considerable attention from the scientific community as well as Congress.



Samuel H. Scudder (1837–1911), noted for his work in entomology and paleontology, was selected as the second editor of *Science* in 1883. With rather generous support from Alexander Graham Bell and Gardiner G. Hubbard, he established a solid reputation for the journal among scientists before leaving his post in early 1885. [Courtesy of the Museum of Comparative Zoology, Harvard University]

The headings of sections in *Science* varied, and thus the content must be evaluated on the basis of individual items. The attention paid to topics varied considerably from issue to issue and the results of a limited sample are suggestive, not definitive. Nonetheless, it is possible to determine some relative commitment of space between 1880 and about 1955. On average, scientific news constituted about 40 percent of an issue, articles (including reviews) about 25 percent, reports and speeches about 10 percent, and science society news just less than 10 percent; the remainder of the space was normally taken by letters, discussion, and front matter. The scientific

fields covered emphasized the areas with which the editor and board were most familiar. Under Edison and Michels the journal stressed electricity, microscopy, and the physical sciences, whereas under Scudder more attention was paid to natural history and under his successor to the social sciences. There was no stated policy, however, and to a large extent the content reflected interests of contributors as much as editorial intention.

Scudder found many aspects of management taxing, despite the efficient assistance of Hodges. The original printer, Moses King of Cambridge, handled matters poorly and before very long, the Science Publishing Company was embroiled in bad debts and financial controversy (*63*). Bell and Hubbard increasingly urged Scudder to move the publishing operation to New York. Board meetings were often held in Washington at Bell's home or at the AAAS meetings, making coordination between the backers and editor in Cambridge difficult (*64*). In late 1884 Scudder was pressured by a recommendation of the board to move to Washington (*65*). Instead, he resigned. The constant demands of editing and the lack of time to devote to research were contributing factors to his decision, as were the attitudes of his backers. His determination was explicit: "Worry and contest are not to my taste. They disorder my mind and my efficiency; they warp my judgment" (*66*). In his own view, and that of others, Scudder had succeeded in creating a working corps of associate editors and had avoided making the journal the advocate of any particular interest. But he felt thwarted by financial constraints and outside advice regarding "improvements." He continued to assist the magazine throughout 1885 but resisted the ongoing suggestion that he return to his post (*67*).

Advertising for patent (or self-help) medicines was introduced into *Science* in the late 1880's as the editor tried desperately to keep the magazine afloat. These advertisements were disapproved by former sponsors and by some of the readers. [*Science* XVII, 12 (2 January 1891)]

Scudder's Successor: N. D. C. Hodges

Scudder's successor was the young man he had hired as an assistant 2 years earlier. N. D. C. Hodges had studied mathematics and physics at Harvard, traveled in Europe for study and leisure, and taught as an assistant at Harvard. Without other permanent employment, he had eagerly taken on the editorial tasks assigned by Scudder. Classmates described him as "reticent, reserved, very modest . . . generous in his valuation of others' characteristics and attainments" (*68*). The Board of Directors was not immediately enthusiastic about Hodges, relatively young and unknown, as a replacement for Scudder but finally conceded that his experience with the journal outweighed his lack of reputation as a scientist (*69*). Compromise was made easier by Hodges' willingness to move the offices of *Science* to New York City and to reduce staff. The new editor sought someone to assist him in the natural sciences and apparently planned to take on Franz Boaz to handle geography and anthropology; eventually he was forced to continue without much help (*70*).

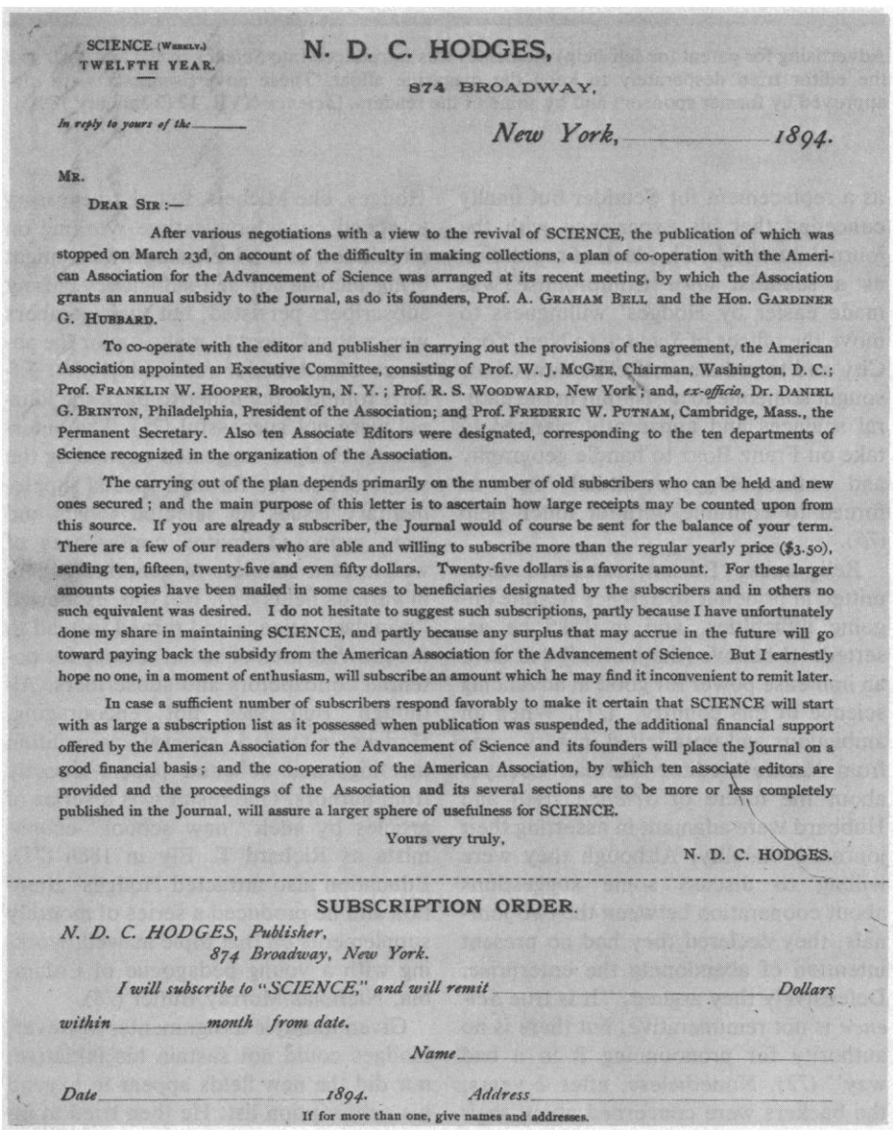
Bell, unlike Edison, remained committed in principle to *Science* despite ongoing difficulties, and in 1885 he asserted: "I believe [the journal] will have an immense power for good in advancing science in this country" (*71*). When an ambiguous and unsolicited inquiry came from *Nature*'s editor Norman Lockyer about the future of *Science*, Bell and Hubbard were adamant in asserting their journal's viability. Although they were willing to discuss some suggestions about cooperation between the two journals, they declared they had no present intention of abandoning the enterprise. Defensively they argued, "It is true *Science* is not remunerative; but there is no authority for pronouncing it in a bad way" (*72*). Nonetheless, after 2 years, the backers were concerned about their ongoing losses. They looked for ways to limit costs through policy or publishing changes; they also reduced their subsidy (*73*).

As a result of financial stringency, Hodges, like Michels, found it necessary to spend considerable time working on circulation and advertising which might bring income for self-sufficiency. Many subscribers persisted, but their numbers were not sufficient to make up for the absence of a broader readership (*74*). Efforts to find a publisher to back the journal were not successful (*75*). The enterprising Hodges suggested expanding the scope of *Science* through special supplementary issues on selected topics and even proposed invited conferences of well-known scholars to generate papers in various fields (*76*). He, too, eschewed "popular" science and turned instead to the growing area of social science for potential contributors and subscribers. Although Bell was not encouraging, Hodges attended several association meetings and solicited papers directly from authors. One result was a series of articles by such "new school" economists as Richard T. Ely in 1886 (*77*). Education also attracted Hodges' attention and he produced a series of monthly supplements on that topic as well, working with a young pedagogue of Columbia, Nicholas Murray Butler (*78*).

Given multiple assignments, however, Hodges could not sustain his initiative, nor did the new fields appear to expand his subscription list. He then tried to increase revenue through advertising, moving beyond the traditional notices of book dealers and instrument makers to such questionable health products as Scott's Emulsion, a cod-liver oil cream

intended to cover "the holes in your lungs . . . the homes of consumption germs." Although Gilman, Bell, and Hubbard were worried about costs and reducing their financial backing, they disapproved of Hodges' plans for supplementary issues, "sensational" advertising, and even his reduction of the annual subscription price from $5.00 to $3.50 in 1887 as an effort to attract new subscribers (*79*). They believed that if the journal was sufficiently attractive, the scientific community would provide a large enough readership to support it.

Bell suggested that a central problem was the source and presentation of news. Hodges, following his predecessors, relied heavily on scientists for news. Bell had initially supported this practice but began to think that expertise on scientific matters might not translate readily into general presentations. Thus he urged the use of professional journalists. He argued, negatively, that scientists did not make much money at reporting and that the best would not spend their time with this task. Positively, a reporter, liberally educated, would offer an objective viewpoint and would make his business "the collection of news." The best current information on science would be obtained from great thinkers who "will not write—but properly approached . . . will talk" (*80*). Hodges' reply to Bell's advice has not been uncovered, but either cost or personal preference kept him from implementing Bell's suggestion that he hire professional journalists. The quality of content in the journal began to slip and the excellent engravings of the mid-1880's disappeared entirely in the 1890's. Articles were increasingly derivative, including more abstracts of presentations and excerpts from American and British journals (*81*). In a further effort to cut his own costs and, not incidentally, to increase his circulation figures, Hodges instituted a category of "contributing subscribers" who sent in items in return for a free subscription (*82*). Often this information was published as "letters from a scientific correspondent" and contained outdated news from local newspapers (*83*). The scientists themselves were demonstrating Bell's contention that, while they might be very good at reporting on research, few had the inclination or ability to supply useful and timely news of a more general nature.



SCIENCE (Weekly.)
TWELFTH YEAR.

N. D. C. HODGES,
874 BROADWAY,

*In reply to yours of the*_____

*New York,*_____ *1894.*

MR.

DEAR SIR:—

After various negotiations with a view to the revival of SCIENCE, the publication of which was stopped on March 23d, on account of the difficulty in making collections, a plan of co-operation with the American Association for the Advancement of Science was arranged at its recent meeting, by which the Association grants an annual subsidy to the Journal, as do its founders, Prof. A. GRAHAM BELL and the Hon. GARDINER G. HUBBARD.

To co-operate with the editor and publisher in carrying out the provisions of the agreement, the American Association appointed an Executive Committee, consisting of Prof. W. J. MCGEE, Chairman, Washington, D. C.; Prof. FRANKLIN W. HOOPER, Brooklyn, N. Y.; Prof. R. S. WOODWARD, New York; and, *ex-officio*, Dr. DANIEL G. BRINTON, Philadelphia, President of the Association; and Prof. FREDERIC W. PUTNAM, Cambridge, Mass., the Permanent Secretary. Also ten Associate Editors were designated, corresponding to the ten departments of Science recognized in the organization of the Association.

The carrying out of the plan depends primarily on the number of old subscribers who can be held and new ones secured; and the main purpose of this letter is to ascertain how large receipts may be counted upon from this source. If you are already a subscriber, the Journal would of course be sent for the balance of your term. There are a few of our readers who are able and willing to subscribe more than the regular yearly price ($3.50), sending ten, fifteen, twenty-five and even fifty dollars. Twenty-five dollars is a favorite amount. For these larger amounts copies have been mailed in some cases to beneficiaries designated by the subscribers and in others no such equivalent was desired. I do not hesitate to suggest such subscriptions, partly because I have unfortunately done my share in maintaining SCIENCE, and partly because any surplus that may accrue in the future will go toward paying back the subsidy from the American Association for the Advancement of Science. But I earnestly hope no one, in a moment of enthusiasm, will subscribe an amount which he may find it inconvenient to remit later.

In case a sufficient number of subscribers respond favorably to make it certain that SCIENCE will start with as large a subscription list as it possessed when publication was suspended, the additional financial support offered by the American Association for the Advancement of Science and its founders will place the Journal on a good financial basis; and the co-operation of the American Association, by which ten associate editors are provided and the proceedings of the Association and its several sections are to be more or less completely published in the Journal, will assure a larger sphere of usefulness for SCIENCE.

Yours very truly,

N. D. C. HODGES.

SUBSCRIPTION ORDER.

N. D. C. HODGES, Publisher,
874 Broadway, New York.

I will subscribe to "SCIENCE," and will remit _____ *Dollars*

within _____ *month from date.*

Name _____

Date _____ *1894.* *Address* _____

If for more than one, give names and addresses.

In late August 1894, editor N. D. C. Hodges made a final effort to solicit support from previous and potential subscribers to *Science*. His proposed collaboration with the American Association for the Advancement of Science was not realized while he remained affiliated with the journal, but James McKeen Cattell was eventually able to take advantage of the opportunity discussed in the above circular. [From Bell papers, Library of Congress]

The years from 1886 to 1893 are a repetition of financial trouble and disillusionment on all sides. Hodges persisted doggedly, even as Bell and Hubbard reduced and then withdrew financial support (*84*), and he was forced to work without a salary and take on other employment to assist the family income (*85*). The board resigned in 1888 and by 1891 Hodges was entirely on his own (*86*). Bell wrote to Hubbard with evident relief, "Now that *Science* is off our hands—we should be able to do very well—if we could only avoid making investments for the benefit of friends" (*87*). Hodges did receive occasional loans from the softer-hearted Hubbard, who was increasingly occupied with his new and successful *National Geographic Magazine*. Hodges established a publishing service, The Science Press, to gain more work and to underwrite the costs of the journal (*88*). His various efforts managed to reduce his deficit to $3000. He claimed nearly 3000 subscribers by 1891—a substantial proportion of the scientific community (*89*)—but still the journal did not pay. By 1893 he was desperate and circularized the scientific community about his problems; in March of 1894 he suspended publication (*90*). Hodges remained loyal to the journal, however, and attended the AAAS meeting in Brooklyn that year to explore collaboration between the association and *Science*.

Nearly five decades old by 1894, the AAAS, with its annual meeting and published proceedings, was a highly visible national organization, but it made contact with its membership only once each year. A regular publication in addition to the annual report might tighten the linkage. *Science*, like the AAAS, was interdisciplinary and national in scope and had, from the outset, covered association meetings in detail and typically re-

printed the presidential addresses. In some ways the AAAS had helped give birth to the journal: Bell had used association meetings, albeit privately, to foster interest in the second launching of *Science* in 1883, and had held his editorial board meetings in conjunction with the AAAS annual meetings.

The association agreed to a $750 contribution and Hodges issued yet another circular to solicit support (*91*). Hodges knew he could not revive the journal with the subsidy alone and with some opposition on the AAAS council. In November he agreed to transfer responsibility to James McKeen Cattell (*92*). As subsequent history demonstrated, Hodges' suggestion of collaboration with the AAAS was a fruitful one.

Overview

The early years of *Science* demonstrate ongoing tensions in the definition and implementation of scientific journalism. Compounding the problem of defining the role and scope of a scientific news journal were the ambiguous attitudes of a research community in the process of professionalization. The dual intention of providing news for scientists and information to a broader public seemed reasonable, but the mechanism was not straightforward. The lack of professional science writers—journalists or scientists—was another serious problem. Scientists and professionals wanted to retain responsibility for the coverage of news but lacked the skills and time to produce comprehensive and timely content. In retrospect, it is perhaps ironic that the journal strived to retain its fundamental contact with basic research even as its primary backers, Edison and Bell, provided financial support based on applications of science.

Science survived competition and internal turbulence during its first decade for three basic reasons. First, the journal, using the British *Nature* as its model, deferred to the interests and priorities of leading scientists. Thus, among its competitors, *Science* was best able to take advantage of a readership whose needs had been identified but not satisfied by other news services. Second, the journal floundered but never failed because it secured the backing of prominent patrons, initially Thomas A. Edison and then Alexander Graham Bell with his father-in-law Gardiner Hubbard, who brought a marginal degree of financial stability during the first decade of publication. Third, the efforts of editors John Michels, Samuel H. Scudder, and N. D. C. Hodges produced basic characteristics of format and content that were sufficiently attractive to persist well into the 20th century. Given a backdrop of confused definition and marginal commitment, the struggles of *Science*, 1880 to 1894, become less an account of administrative failure than a tribute to survival.

References and Notes

1. The pre-1883 years were omitted in F. R. Moulton's account, "The editing of science" [*Science* **101**, 8 (1945)], but corrected in "Thomas A. Edison and the funding of *Science:* 1880" [*ibid.* **105**, 142 (1947)]. The early history is misrepresented in F. L. Mott, *A History of American Magazines* [(Belknap, Cambridge, Mass., 1957), vol. 4, p. 307] which acknowledges Edison's involvement but claims support by Alexander Graham Bell in 1881.
2. J. Michels to T. A. Edison, 17 April 1880. Little is known of Michels, except from his own accounts. Most of his work was apparently without byline, although his essay "Misinterpretations of the microscope" was published under his name in *Popular Science Monthly* **7**, 177 (1875). He first contacted Edison (10 July 1878) to ask about employment and at that point he claimed consular service and publications in a range of journals and newspapers (Thomas A. Edison Archives, West Orange, N.J.).
3. The prospectus made clear Michels' intention to edit and manage the weekly journal and requested a capital stock investment of $12,000. Edison apparently preferred that he be the exclusive backer and decided to cover costs rather than purchase stock. The origin of the title *Science* is unclear. Michels' four-page prospectus indicated only that the title should suggest "that the whole Scientific Field will be covered—perhaps 'Nature' (American)—'Popular Science Weekly'—'The Intellectual Observer'—&c. &c." with the name to be finally selected by the promoters (Edison papers).
4. D. A. Hounshell, "Edison and the pure science ideal in nineteenth century America," *Science* **207**, 612 (1980).
5. Francis R. Upton to his father, 24 August 1879. A summary of this letter (not found) is in the catalog of the Upton papers, Edison Archives.
6. For a bibliography of articles relating to Edison's work, see the Edison Archives. See also, R. Conot, *A Streak of Luck* (Seaview Books, New York, 1979).
7. F. Upton's "Electricity as power" [*Science* **1**, 5 (1880)] is a report on Edison's experimental railroad at Menlo Park; also see *ibid.*, p. 11.
8. J. Michels to T. A. Edison, 17 April 1880 (Edison papers). Michels argued, "There could not be a better time for literally the field is open, for with the exception of Patent Office organs and journals limited to particular . . . interests, there is nothing in the market and English journals are establishing good subscriptions lists here in the United States in consequence."
9. A nearly complete list of weekly financial statements (27 memoranda for 1880; 47 for 1881) indicate relatively little income from subscriptions and advertising. A copy of the lease for space in the Hamilton Building is in the Edison papers.
10. For a discussion of the founding and early history of *Nature* see R. MacLeod *et. al.*, "Centenary review, 1869-1969" [*Nature (London)* **224**, 417 (1969)].
11. For papers on *Science News* see the Peabody Museum of Science and the Essex Institute, both in Salem. Also see F. W. Putnam to H. Holt, 5 July 1875 (Putnam papers, Harvard University Archives) and W. Wyckoff to S. F. Baird, 16 June 1879, 13 November 1879, and 25 October 1882 (Spencer F. Baird Papers Smithsonian Institution Archives, Washington, D.C.). An account of the young scientists is included in D. W. Waymar, *Edward Sylvester Morse* (Harvard Univ. Press, Cambridge, Mass., 1942) and R. Dexter, "The 'Salem Secession' of Agassiz zoologists," *Essex Institute Historical Collections* **101**, 27 (1965).
12. A general discussion is found in R. S. Bates, *Scientific Societies in the United States* (MIT Press, Cambridge, Mass., 1945). Also see D. J. Kevles, J. L. Sturchio, P. T. Carroll, *Science* **208**, 27 (1980).
13. For other periodicals started around this time see *Union List of Serials in the Libraries of the United States and Canada* (Wilson, New York, ed. 3, 1965).
14. In 1868, S. F. Baird initiated a news collection service and served as a network center, paying various colleagues for information and, in turn, receiving payment from various periodicals. His "Editor's scientific record" for *Harper's Monthly* earned about $2000 each year in the 1870's and Baird also contributed regularly to the New York *Tribune*. His offer of similar paid service to *Nature* (letter to N. Lockyer, 27 January 1871) was apparently not accepted (Baird Papers and William H. Dall papers, Smithsonian Institution Archives, Washington, D.C.).
15. Whitelaw Reid, editor of the *Tribune*, cut back his own coverage of science in the late 1870's even though the momentum toward science journalism was on the increase. (W. Reid to S. F. Baird, 8 November 1875, and W. Wyckoff to S. F. Baird, 16 June 1879) (Baird Papers). E. R. Chadbourne's efforts to start a science news service are described in a letter to S. H. Scudder, 11 March 1889 (Scudder Papers, Boston Museum of Science Library). Baird's columns were dropped from *Harper's Monthly* in 1879.
16. See *Science* **1**, 130 (1880). J. Michels to T. A. Edison, 6 October 1880 (Edison papers), and J. D. Dana to A. G. Bell, 25 April, 3 May, and 2 June 1881 (Alexander Graham Bell papers, Library of Congress, Washington, D.C.).
17. J. Michels to A. G. Bell, 18 July 1881 (Bell papers).
18. Michels' amateur status was a handicap in this period where the term amateur became derogatory among emerging professionals. For comment on the local New York context, see D. Sloan, "Science in New York City, 1867-1907," *Isis* **71**, 35 (1980).
19. After *Science* [**1**, 170 (1880)] published "An improved electro-motor" by Weisandaiyer, an irate Edison dismissed the author as "an idiot" and asked that Michels send him proofs before publication in the future "to avoid as much as possible that which would be detrimental" to *Science*'s interest. Michels defended himself as having a problem with reviewers (T. A. Edison to J. Michels, 5 October 1880 and J. Michels to T. A. Edison, 6 October 1880) (Edison papers).
20. Much of the correspondence between Michels and Edison's assistants such as S. L. Griffin and S. Insull, involved routine business: "It is a mystery to me how Mr. Edison can expect me to run the Journal successfully without cash on hand and without capital to invest in enlarging subscriptions" (J. Michels to S. Insull, 4 October 1881) (Edison papers).
21. The *Science* episode persuaded Edison "never to waste time and energy on a thing not commercially needed" according to N. R. Speiden, "Thomas A. Edison, a sketch of activities, 1874—1881," *Science* **105**, 141 (1947).
22. J. Michels to S. Insull, 18 November 1881 (Edison papers).
23. On 12 February 1881, Edison gave Michels permission to seek other backers. Frederick Shonnard was a shadowy figure often cited by Michels as interested in supporting *Science* but there is no evidence of actual contributions [J. Michels to T. A. Edison, 6 May 1880 (Edison Papers); J. Michels to A. G. Bell, 9 June 1882 (copy, Bell papers)].
24. An undated prospectus entitled "The Science Publication Company," late 1881 (Edison papers).
25. J. Michels to T. A. Edison, 2 November 1881 (Edison papers); J. Michels to A. G. Bell, 18 July 1881 and 28 July 1882 (Bell papers).
26. Michels argued (2 November 1881) that Edison had given him 3 years to establish the journal, but Edison gave notice (25 October 1881) that his support would end at the end of December 1881. The decision was basically financial, as indicated by S. Insull to J. Michels (19, 21, and 24 December 1881). Edison continued to make payment for back bills into 1882 with a "final" payment in July. In January of 1882 Edison began to produce his own bulletin, *The Edison Electric Light Company*, intended primarily for stockholders but whose contents often appeared in newspapers as well (Edison papers).
27. A. G. Bell to S. Kneeland, 18 July 1882 (Bell papers).
28. Three issues appeared in 1882: No. 80 (14 January), No. 81 (21 January), and No. 82 (4 March).
29. A. G. Bell to J. Michels (copy), 3 and 12 August 1882 (Bell papers).
30. A. G. Bell to J. Michels, 10 September 1882 (Bell papers).
31. See (*29*), and Michels' letter to Bell, 24 August 1882, which mentions discussions with John Dawson, Thomas Sterry Hunt, George Frederick Barker, John Strong Newberry, and Otis T. Mason (Bell papers). Almost nothing has

been found to indicate Michels' subsequent career, although he continued to write free-lance articles on electricity for the New York *Tribune*.

32. Michels insisted he would not abandon *Science* quietly without any financial recovery (J. Michels to G. G. Hubbard, 5 and 7 September 1882) (Bell papers). A series of letters indicates that Michels was authorized $5000 but that he eventually settled for $1000 in cash and $4000 worth of stock which he surrendered for $1666.66. Out of the latter he repaid a loan of $500 to Bell. For this Michels signed a receipt (24 March 1883) "for transfer of good will and all rights and title in the Science Newspaper." Bell also acquired the list of subscribers (see A. G. Bell to J. Michels, 12 August 1882). (Bell papers).
33. R. V. Bruce, *Alexander Graham Bell and the Conquest of Solitude* (Little, Brown, Boston, 1973), pp. 376–378.
34. S. H. Scudder to D. C. Gilman, 27 December 1882 (see heading "Weekly Journal of Science" in the Daniel Coit Gilman Papers, Special Collections, Johns Hopkins University, Baltimore).
35. J. M. Cattell to A. G. Bell, 4 August 1903. Cattell admitted, "I did not know until you told me last winter that the journal was originally supported by Dr. Edison" (Bell papers).
36. For early evidence of the difficulties see S. G. Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1848–1860* (Univ. of Illinois Press, Urbana, 1976), pp. 90–91.
37. C. A. Elliott, *Biographical Dictionary of 19th Century American Scientists* (Greenwood Press, Westport, Conn., 1979), p. 232. Most of the information here is based on the Scudder correspondence in the Boston Society of Natural History Collections at the Boston Museum of Science Library.
38. F. W. Putnam, manuscript autobiography, January 1862 (Putnam papers).
39. D. C. Gilman wrote (1 April 1883), "You have a first rate standing in the scientific world" (Scudder papers).
40. Letters of support (see the Boston Museum of Science Library) came from such prominent contemporaries as John Comstock, Ferdinand V. Hayden, Joseph Leidy, John L. LeConte, John Strong Newberry, Charles Peirce, Frederic W. Putnam, James Dwight Dana, and Spencer F. Baird. The editorial staff of both the *American Journal of Science* (J. D. Dana, 24 November 1882) and the *American Naturalist* (F. W. Putnam, 9 November 1882) expressed some concern over the potential competition offered by *Science*.
41. S. H. Scudder to J. L. LeConte, 19 December 1882 (typescript in Bell papers).
42. A copy of the *Boston Advertiser* (1 December 1882) was sent out with a promotional circular for *Science* (Gilman papers).
43. Gilman became friendly with Bell after he urged the inventor to lecture at Johns Hopkins (A. G. Bell to D. C. Gilman, 3 March 1880). Marsh was elected 23 December 1883 and Newcomb on 21 January 1884 (Gilman papers).
44. This position of Scudder baffled his backers and was never fully explained (G. G. Hubbard to D. C. Gilman, 3 April 1884) (Gilman papers).
45. Scudder was determined to pay for contributions, which he felt would make *Science* "a reflex of the *best* American thought and hope for it a secure future in the high standard we mean to obtain" (S. H. Scudder and J. L. LeConte, 19 November 1882) (typescript in Bell papers).
46. A "Memorandum of Agreement" signed by Scudder and witnessed by N. D. C. Hodges stated the $4000 salary with $12,750 allowed for an assistant editor and to "pay for leading and other articles, home and foreign correspondence, reports of societies, illustrations, and all other office and general expenses" (Gilman papers).
47. Information on Hodges is derived from the alumni files and occasional reports for his Harvard graduating class. For his subsequent and more gratifying career as librarian at the New York Public Library and then as head of the Cincinnati Public Library see sketch by J. Richard Abell in the *Dictionary of American Library Biography* (Libraries Unlimited, Littleton, Colorado, 1978), pp. 247–48. Scudder dismissed Gilman's recommendation of J. Willard Gibbs with the observation that Gibbs "would not do at all—he is too awkward with his pen and too slow." For discussion of the effort to hire an assistant see S. H. Scudder to D. C. Gilman, 19, 25, and 27 January and 18 February 1883 (Gilman papers).
48. The stocks were not to be sold, however, so that the two sponsors covered real costs with cash in a manner similar to that of Edison [A. G. Bell to S. H. Scudder, 24 July 1883 (letterpress) and G. G. Hubbard to A. G. Bell, 22 January 1884] (Bell papers).
49. Washington *Post*, 7 January 1883 (clipping in Bell papers).
50. Careful contracts were drawn up and the new company was formally incorporated in Massachusetts (G. G. Hubbard to D. C. Gilman, 1 March 1883). On 10 March 1883 a transfer of $21,250 was made to Scudder via Gilman (Gilman papers).
51. See *Science* **1**, 3 (1883).
52. G. G. Hubbard to D. C. Gilman, 14 July 1884 (Gilman papers). In April 1884 the board sent circulars to *Science* subscribers to ask opinions of the journal (Bell papers). An estimated 6000 subscribers were needed to make the journal self-sufficient.
53. See A. Oleson and J. Voss, Eds., *The Organization of Knowledge in Modern America, 1860–1920* (Johns Hopkins Press, Baltimore, 1978).
54. D. C. Gilman to S. H. Scudder, 1 April 1883 (Scudder papers).
55. See *Science* **2**, 5 (1884).
56. "Circular," 7 November 1883 (Gilman papers and Baird papers).
57. S. H. Scudder to D. C. Gilman, 18 May 1883 (Gilman papers).
58. G. G. Hubbard to D. C. Gilman, 9 March 1884 (Gilman papers).
59. A transcript of a *Science* board meeting, 18 December 1884, recommended that 88-pages be allocated to the annual AAAS meetings (Gilman papers).
60. S. H. Scudder to S. F. Baird, 15 January 1883 (Baird papers).
61. S. H. Scudder to E. W. Morse, 18 January 1883 (Morse papers, Peabody Museum of Science, Salem, Mass.).
62. See *Science* **5**, 41 (1885). The fact that *Science* board member O. C. Marsh was a proponent may have been significant. See A. H. Dupree, *Science in the Federal Government* (Belknap Press, Cambridge, Mass., 1957), pp. 215–231.
63. A. G. Bell to S. H. Scudder, 26 July 1883 and 18 August 1883 (Bell papers); S. H. Scudder to D. C. Gilman, 25 April and 7 May 1883; and an undated resignation of King (Gilman papers). Charles L. Condit subsequently served as business manager (C. L. Condit to D. C. Gilman, 12 November 1883) (Bell papers).
64. S. H. Scudder to D. C. Gilman, 2 December 1883 and 1 February 1884 (Gilman papers).
65. G. G. Hubbard to D. C. Gilman, 22 December 1884 and 9 January 1885 (Gilman papers). There has been considerable discussion about a move to New York or Washington, although Bell had been skeptical about bringing the magazine too close to the Washington establishment (G. G. Hubbard to D. C. Gilman, 3 April 1884) (Gilman papers).
66. S. H. Scudder to G. G. Hubbard, 11 January 1885. Bell's plea to Scudder on 8 February not to resign or to add to the embarrassments of the journal went unheeded and there was a long period of estrangement between the two men (Bell papers).
67. A. G. Bell to S. H. Scudder, 8 February 1885 (Scudder papers).
68. *Report of the Class of 1874* (Harvard University, 1928).
69. S. H. Scudder to A. G. Bell, 11 January 1883 (Bell papers).
70. N. D. C. Hodges to D. C. Gilman, 14 December 1885 and 20 and 31 January 1887 (Gilman papers).
71. A. G. Bell to S. H. Scudder, 8 February 1885 (Scudder papers).
72. N. Lockyer to D. C. Gilman, 17 May 1886, and S. Newcomb to D. C. Gilman, 31 May 1886 (Gilman papers).
73. G. G. Hubbard to D. C. Gilman, 1 August 1885 and D. C. Gilman to A. G. Bell and G. G. Hubbard (letterpress), 19 January 1886 (Gilman papers).
74. In part the limitations were imposed by the size of the community of scientific practitioners. For some estimate of groups interested in science, see N. Reingold, in *The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from the Colonial Times to the Civil War*, A. Oleson and S. C. Brown, Eds. (Johns Hopkins University Press, Baltimore, 1976), pp. 55–64.
75. Apparently the major New York publishers were contacted. Scribner and Appleton declined any involvement, although Houghton was interested and Putnam showed some enthusiasm (G. G. Hubbard to D. C. Gilman, 14 February 1885). (Gilman papers).
76. N. D. C. Hodges to A. G. Bell, 22 December 1885 (Bell papers).
77. His plan is outlined in letters to Bell, 14 January and 10 March 1886 (Bell papers).
78. See, for example, *Science* (Suppl.) **8**, 591 ff. (1886). Scudder defended Hodges' practice to a skeptical Gilman, noting that the scientific content remained substantial and the educational content "strictly extra" and concluded, "I presume that Mr. Hodges would be glad to drop the education, if he believed Science could get on by itself; but by this means he gets hold of an excellent clientele which will care for both parts—We must not forget that the journal is still struggling into life and that its expenses are below [sic] its receipts." (S. H. Scudder to D. C. Gilman, 6 January 1887) (Gilman papers); N. D. C. Hodges to S. H. Scudder, 8 October 1886 and D. C. Gilman to S. H. Scudder, 5 December 1886 (Scudder papers). A similar effort was made to work with the Agassiz Association for scientific education and to produce a supplement entitled *The Swiss Cross* (H. H. Ballard to S. H. Scudder, 17 November and 13 December 1886) (Scudder papers).
79. N. D. C. Hodges to S. H. Scudder, 14 December 1887 (Scudder papers).
80. A. G. Bell to N. D. C. Hodges (letterpress), 15 January 1886 (Bell papers).
81. The range was broad, from Dr. Mary Putnam Jacobi's article on "Higher education of women" [*Science* **18**, 295 (1891)] that had first been published in the *Evening Post* to John M. Coulter's "The future of systematic botany" [*Science* **18**, 127 (1891)], an abstract of an address at the AAAS meeting.
82. Advertised in subscription circulars, this practice was not approved by the Board of Editors.
83. N. D. C. Hodges to A. G. Bell, 18 October 1892 (Bell papers).
84. Hodges in 1886 offered a proposition for disestablishment, suggesting 5 years of support with a subsidy of $8500 for the first year, $6000 for the second year, $4000 for the third year, and $2500 for the fourth and fifth years [G. G. Hubbard to D. C. Gilman, 11 June 1886 (Gilman papers); G. G. Hubbard to S. H. Scudder, 26 December 1888 (Scudder papers)].
85. Hodges claimed he had no salary after 1886 and he toyed with inventions as well as publications in his effort to earn a living. See his advertisements for use of a patent on lightning rods (sometimes under the heading of the American Lightning Protection Company) in *Science* throughout 1891.
86. N. D. C. Hodges to S. H. Scudder, 12 November 1888 (Scudder papers).
87. By implication, Hodges was the owner and publisher (G. G. Hubbard to A. G. Bell, 22 April 1888, and A. G. Bell to G. G. Hubbard, 20 December 1891) (Bell papers). Various papers in the Bell correspondence indicate that Bell provided about $60,000 and Hubbard about $20,000 to *Science* over their years of sponsorship.
88. Hodges continued to solicit help from Bell and Hubbard through the early 1890's and wrote a simple truth when he stated "I am getting very tired" [see letters of 21 March and 4 April 1892 (Bell papers)].
89. See N. Reingold (*74*).
90. A circular of September 1894 clearly indicates that, despite the suspension of the journal in that year, Hodges still assumed he might be editor if *Science* was revived. See also N. D. C. Hodges to S. H. Scudder, 3 August 1894 (Scudder papers).
91. Several dozen replies to the circular were eventually turned over to James McKeen Cattell, indicating a broad-based readership ("Science," Cattell papers, Library of Congress, Washington, D.C.).
92. J. M. Cattell to A. G. Bell, 6 November 1894 (Bell papers).
93. I especially thank graduate students D. Sloane of Syracuse University, for his work on the content of *Science* and related magazines, and T. D. Cornell of Johns Hopkins University, for his preliminary survey of the Daniel Coit Gilman papers. Colleagues and friends were generous in their comments, particularly C. Covert, M. Sokal, R. V. Bruce, and C. Elliott. Staff members of the Edison Historical Site in West Orange were helpful beyond their responsibilities.