

The Early History of *Chemical Reviews*: “Established To Fill a Definite Want”

Mary Ellen Bowden*

Senior Research Historian, Chemical Heritage Foundation, 315 Chestnut Street, Philadelphia, Pennsylvania 19106-2702

Received October 13, 1999

Contents

I. Introduction	13
II. Origins	13
A. Founding of <i>Chemical Reviews</i>	13
B. Historical Antecedents	16
III. <i>Chemical Reviews</i> , 1924–1949	16
A. Changing Editors	16
B. Content of <i>Chemical Reviews</i> in Its First Decades	17
IV. Crisis of the Information Explosion, the 1950s and after	19
A. The Review Journal as an Answer	19
B. Proliferation of Review Journals	19
C. <i>Chemical Reviews</i> in the New Environment, Post-1950	19
V. References	21

I. Introduction

As *Chemical Reviews* celebrates its 100th volume and 75 years of service to the chemical community, it is timely to revisit its early days and the broader history of review articles and review journals in the chemical literature.

Reviews have long been recognized as among the most important forms of scientific communication. Reviews benefit the busy scientist who must keep up with the primary literature in a given field while remaining literate in broader aspects of scientific research. Reviews point out the most significant and worthwhile papers in a field and collate and compact research from different sources. They serve to identify emerging specialties and indicate fruitful directions for future research.¹ It was the need for a review journal, a place to publish “comprehensive, analytical reviews and summaries on topics of interest to chemists”, that led to the slogan emblazoned inside the covers of early issues of *Chemical Reviews*: “Established to Fill a Definite Want”.

Historically there has been a wide range of styles and approaches used in reviews, which other analysts have attempted to categorize.^{2–5} Several of these variants enter into the discussion below of *Chemical Reviews*' content and the context in which it emerged and the changing context in which it has operated since the 1950s. In the long view, *Chemical Reviews*



Mary Ellen Bowden received her B.A. degree in History from Smith College and her Ph.D. in the History of Science and Medicine from Yale University under the direction of Derek J. deSolla Price. She is Senior Research Historian at the Chemical Heritage Foundation, an organization with which she has been associated for the past 10 years. The foundation was established by joint action of the American Chemical Society and the American Institute of Chemical Engineers to preserve and make known the achievements of chemical scientists and the chemical process industries. Dr. Bowden has on many occasions investigated the means by which scientists communicate. Most recently, in collaboration with Robert V. Williams, she completed an illustrated chronology detailing the history of chemical information systems and she served as co-editor with Williams and Trudi Hahn of the proceedings of the First International Conference on the History and Heritage of Science Information Systems.

has remained remarkably true to its original conception—with certain well-considered modifications: providing balanced reviews on current chemical topics covering several years of developments in articles averaging 50 pages each provided on a regular basis to chemical scientists. Picking up the very first volume, however, a modern reader might well recognize the names of the authors of the articles but sense a distinct difference in their content and presentation from the reviews published in today's journal. However, that is because, as in any start-up enterprise, there is a unique and intriguing story to be told about the actual birth of *Chemical Reviews*.

II. Origins

A. Founding of *Chemical Reviews*

Following World War I, the American chemical community was experiencing a new-found confidence. Before the war, the United States was dependent on Germany as the sole supplier of certain critical chemical products, principally pharmaceuticals and dyestuffs. At that time American chemists, many of

* To whom correspondence should be addressed. E-mail: mebowden@chemheritage.org.

whom had benefited from graduate work at German universities, revered German chemists, chemical institutions, and journals (although Americans frequently subscribed to British journals too). During the war American chemical scientists had struggled but ultimately succeeded in most areas in recreating German chemical achievements, meanwhile providing munitions and the highly controversial poison gas to the Allied armed forces. The numbers of young people entering the chemical profession grew dramatically after the war because of the heroic role that chemists were portrayed as taking in the "Chemists' War" and because of the availability of chemical jobs in the economic boom that soon ensued.

In this exhilarating context, the American Chemical Society founded in a few short years its Chemical Monograph Series (1920), the *News Edition of Industrial and Engineering Chemistry* (1923), which was eventually to become *Chemical and Engineering News*, the *Journal of Chemical Education* (1924), and *Chemical Reviews* (1924).⁶

In many ways *Chemical Reviews* was the offspring of the monograph series, and challenging German hegemony in the chemical world figured in the background of both publications. By arrangement with the Interallied Conference of Pure and Applied Chemistry (the predecessor of the International Union of Pure and Applied Chemistry, organized at a time when representatives of the former Central Powers were still *personae non gratae*⁷), the ACS agreed to undertake the publication of scientific and technologic monographs as well as to prepare critical tables of chemical and physical constants in cooperation with the American Physical Society. The ACS and the Division of Chemistry and Chemical Technology of the National Research Council, itself a product of World War I, mutually agreed to oversee these two projects.⁶

In the early days, ACS maintained two monograph series: scientific monographs edited by William A. Noyes, Sr.,⁸ head of the Chemistry Department at the University of Illinois, and technologic monographs edited by Harrison E. Howe, an industrial chemist. Both men were well-respected chemist-editors. In 1902, Noyes Sr. (his son, William A. Noyes, Jr., also figures in this history) had taken over from Arthur A. Noyes,⁹ a distant cousin, the editorship of the *Review of American Chemical Research*. This "review" was actually an abstract journal carrying notices of papers written by Americans whose work was then receiving scant coverage in German and British abstract journals. In 1907, under Noyes Sr.'s leadership the *Review of American Chemical Research* became *Chemical Abstracts*, which he edited until 1910. Meanwhile, he served as editor of the venerable (founded 1879) *Journal of the American Chemical Society* from 1902 to 1917. Soon after being tapped to be the editor of the technologic series, Howe was chosen to be editor of ACS's *Industrial and Engineering Chemistry*, a position that he held from 1922 to 1942.⁶

The earliest evidence that a new journal was being contemplated appears in an exchange of letters between Howe and Noyes Sr., who both recognized

the need for more journals to accommodate the many manuscripts, especially survey articles, that did not fit the criteria of the extant journals. Noyes rhetorically remarked

Despite the dreadful financial situation in which Germany finds herself at the present time the *Berichte* [*Berichte der Deutschen Chemischen Gesellschaft*] has published during the past year about 4000 pages of original papers, and this in addition to a large volume of publication in the *Annalen* [*Justus Liebigs Annalen der Chemie*], *J. pr. chem.* [*Journal für praktische Chemie*]; *Z. phys. Chem.* [*Zeitschrift für physikalische Chemie*] and other journals. Are we willing to admit that here in America, now the richest country in the World, we can not do as much for our scientific publication as is done by Germany?¹⁰

The real impetus for founding a review journal came out of a meeting of the NRC's Chemistry and Chemical Technology Division held in conjunction with ACS's spring 1923 meeting in New Haven, CT, where the Sterling Chemistry Laboratory at Yale University was just being dedicated. One of the prime movers of the journal project was A. A. Noyes, then helping shape the California Institute of Technology.¹¹ The Division instructed its Executive Committee, under the chairmanship of Columbia University's J. Enrique Zanetti, "to investigate the possibility of publishing critical reviews on chemical topics and to secure, if possible, the cooperation of the American Chemical Society in establishing such a series to supplement its present monograph series".¹² Zanetti (Figure 1) worked energetically to put together a proposal complete in nearly every detail that would stand the best chance of being accepted by fellow members of the Division, other chemists around the country, and ACS's Executive Committee.

From Zanetti's correspondence it is clear that the chief problem to be solved by a new journal was the challenge posed by the growth of the chemical literature itself. One version of oft-repeated words appears in a letter to Noyes Sr., who was out of the country during the planning stages. Zanetti began the rationale, "The subject matter of chemistry is developing so fast and is becoming so specialized that we all need from time to time to have a specialist summarize for us the things that have been going on in his own field". Lectures often fulfilled this need, but by their nature they were evanescent unless they could be published someplace.¹³

Editorial dilemmas were discussed on several occasions in Zanetti's correspondence. In the context of journals extant in 1923, papers that did not consist primarily of original research but were worthwhile surveys were often deemed too short to be monographs, insufficiently original for the *Journal of the American Chemical Society*, and because of their theoretical content, inappropriate for *Industrial and Engineering Chemistry*. For example, Harvard's Arthur Lamb, then the *Journal of the American Chemical Society's* Editor, and MIT's James F. Norris, member of its Editorial Board, were faced with two long papers on the relation between color and chemical composition by Julius Stieglitz of the Uni-



Figure 1. J. Enrique Zanetti. Photograph courtesy of the American Chemical Society.

versity of Chicago,^{14,15,16} who was meanwhile also being asked his opinion on the prospects for a review journal.^{17,18} Norris wrote, "On account of his position in the chemical world we hesitate to refuse to publish his papers, but if we break the rule in his case there is no reason why we should not in other cases".¹⁴ Lamb importuned Zanetti to let him know as soon as possible if the proposed journal received a go-ahead so that he could recommend that the papers in question be submitted to it.¹⁵ (In the end these papers did not appear in *Chemical Reviews*. Stieglitz papers on this topic were published around this time in the *Proceedings of the National Academy of Sciences* and the *Journal of the Franklin Institute*. The former promised critical discussions of the work of other authors in the *Journal of the American Chemical Society*—an empty promise; the latter is not a review article, and Stieglitz published nothing further on the topic.^{19,20})

The plan, as Zanetti put it together, involved taking over the organization of ACS's two monograph series but with Noyes Sr. as Editor-in-Chief of the review journal. Howe, who had offered the pages of *Industrial and Engineering Chemistry* as a place to publish a few review articles to test the appeal of a review journal,²¹ a plan that was dismissed, was placed on the Editorial Board of *Chemical Reviews* along with the combined boards of the scientific and technologic monograph series. Thus, from the very beginning, *Chemical Reviews* carried on its Editorial

Board such industrial figures as Arthur D. Little (who happened to be one of Howe's former bosses) as well as academic chemists.

Zanetti explored the willingness of various publishers to take on such a new journal. One requirement was that all financial risk was to be assumed by the publisher while editorial control would rest with the ACS. The financial decisions were taken in part on the projection that 1500–2000 subscribers would receive four issues per year making up 500 pages per volume, which would sell for \$4.00 per year to ACS members, \$5.00 to nonmembers.²² At first it seemed that the Chemical Catalog Company located in New York City, publishers of the monograph series, would take the job, but then they began requesting a market survey of 5000 chemists.²³ (No evidence has surfaced that such a survey was ever undertaken.) They bowed out in the end on the grounds that they were book publishers without the staff needed to operate a subscription service.²⁴ The Williams and Wilkins Company in Baltimore, which already published all kinds of medical and biological journals, eventually signed on as publisher, expressing concerns, though, that the ACS would soon want to take on the role of publisher itself²²—an event that was not to happen for another 30 years.

Zanetti also lined up the contents for the first volume of *Chemical Reviews*: the papers that had been presented in New Haven at the dedication of Yale's Sterling Chemistry Laboratory. He exulted, "Having such a rattling good first volume to advertise our enterprise, I believe the thing will go through".²⁵ Twelve world-class chemists had contributed papers: Theodore William Richards, Moses Gomberg, Gilbert N. Lewis, Arthur A. Noyes, and William C. Bray from the United States; W. Lash Miller from Canada; James Colquhoun Irvine from Scotland; Frederick G. Donnan from England; Georges Urbain from France; Arnold F. Holleman from The Netherlands; Thé Svedberg from Sweden; and Giuseppe Bruni from Italy. Originally there were plans for Yale University Press to publish the papers as a separate volume,²⁶ but there had been a shortfall in funds¹³ and Yale chemist John Johnstone was able to negotiate their release to the new journal.²⁷

Soliciting papers for one purpose and then using them for another has its pitfalls, although capturing in print those lectures and symposia that provided up-to-date treatments of topics of general interest was a part of the program of *Chemical Reviews* from its inception. G. N. Lewis's response to Zanetti's request to use his paper on "magnetochemical theory" is revealing in this regard.

They [the papers delivered at Yale] were not, for the most part, the sort of thing that you have in mind, but were intended rather as extremely individualistic expressions of the authors' own latest ideas, and my own paper, I am sure, would not be quite the same thing you should want.²⁸

Still Lewis was willing to have his paper used. His and the papers of several other of the stars make the first volume of *Chemical Reviews* distinct from subsequent volumes: in it state-of-the-art accounts, with little or no review of the work of others, predominate.

B. Historical Antecedents

The founders of *Chemical Reviews* had two very clear precedents in mind for the new journal.^{13,18,22,24,29} One was *Physiological Reviews*, founded in 1921 by the American Physiological Society. The reasoning went if the physiologists can publish successful reviews of their literature, then the far larger ACS should be able to succeed with a similar publication.¹⁷ *Physiological Reviews* already boasted 1500 subscribers by 1923, as Zanetti enthusiastically reported.¹⁶ Lafayette Mendel, a physiological chemist at Yale, however, supplied the inside information that the journal was in fact having difficulties maintaining a steady flow of good manuscripts after the "cream" of the topics in his field had been skimmed off. He therefore recommended intermittent publication to the chemists.³⁰

The other model was the *Sammlung chemischer und chemisch-technischer Vorträge*, which was founded in 1896 by Felix B. Ahrens, a professor in Stuttgart. It was in reality not a journal but a series of monographs on topics in chemistry and chemical technology of varying lengths. In many ways, it was comparable to ACS's monographs but some numbers were just 20 or 30 pages long, like J. H. Van't Hoff's essay on the theory of solutions, *Über die Theorie der Lösungen* (Bd. V, Hefte 1, 1900). Over time, and the series lasted until 1969 with a slightly changed title (from 1956, *Beiträge* instead of *Vorträge*), the numbers tended to thicken to treatises of several hundred pages and become increasingly oriented toward industrial chemistry.

When Charles L. Parsons, Secretary of the ACS, was first introduced to the plan for a review journal, he pointed out that American chemists could already avail themselves of the annual reviews of chemistry published by the two biggest British chemical societies, the Chemical Society of London and the Society of Chemical Industry. According to Parsons, these publications were cheaper than anything of this type that could be produced in the United States.³¹ The Chemical Society had published its *Annual Reports of the Progress of Chemistry* since 1904, and the Society of Chemical Industry had published its *Annual Reports* since 1917. Zanetti quickly pointed out that such annual reviews differed from the kind of reviews that *Chemical Reviews* would carry: Annual reviews cover in a very brief manner the whole of chemistry or chemical technology, whereas an entire volume of *Chemical Reviews* would include rather thorough coverage by specialists of only 20 or so topics.²⁹

In the history of periodicals and serials, annual reviews of scientific subjects had roots that extended at least back to the 18th century, especially in medically related fields.³² Often what appeared in early scientific journals were summaries or abstracts with little or no attempt at critical or integrative presentation. Such, for example, was Sigismund Friedrich Hermbstädt's *Bibliothek der neuesten physisch-chemischen, metallurgischen, technologischen und pharmaceutischen Literatur* (Berlin, 1788–1795).³³

In chemistry, some of the earliest and best reviews were written by Thomas Thomson, Professor of

Chemistry at the University of Glasgow, for his *Annals of Philosophy, or Magazine of chemistry, mineralogy, mechanics, natural history, agriculture, and the arts*. Beginning in 1814 he added annual reviews of progress in a number of fields to the original articles, news of learned academies, and meteorological records that made up the rest of his journal. By the 20th century, the *Annals of Philosophy* had become the *Philosophical Magazine*, a physics journal. However, when Thomson was Editor, the focus was on chemistry: "This [chemistry] is the science which has made by far the greatest progress during the course of the year. It will consequently occupy a greater space than any of the preceding [subjects]".³⁴ In a few years, his chemical reviews had progressed from short disjointed summaries to nicely integrated critical essays in which he clearly indicated research opportunities.

Not too long after the appearance in 1778 of the first journal entirely devoted to chemistry, Lorenz von Crell's *Chemisches Journal*, in 1795 the first chemical journal almost entirely devoted to reviews appeared: the *Berlinisches Jahrbuch der Pharmacie und für die damit verbundenen Wissenschaften*.³⁵ In 1822, a far more influential journal commenced publication: *Svenska vetenskaps kademien arsberättelser*, Jöns Jakob Berzelius's reports to the Swedish Academy about chemical activities in the rest of Europe. They proved so informative and so useful that Berzelius's former student Friedrich Wöhler, who was then back in Germany at the center of chemical research activity, obtained permission to translate Berzelius's reports annually from Swedish into German as the *Jahresbericht über die Fortschritte der Chemie und Mineralogie*. Following Berzelius's death, the system of annually reviewing the progress of chemistry was carried on in the German-speaking world by Justus Liebig and others.³⁶

Monographs, that is, surveys of present knowledge, each on a chosen topic, existed in the chemical world at least since the days of Robert Boyle in the 17th century. Chemical monograph series seem to have been a more recent development. Ahrens' *Sammlung* may well have been the earliest of these.³⁵

It was a proud tradition involving some of history's best chemists that Noyes Sr. was to join when the ACS gave the go-ahead to *Chemical Reviews* in early 1924. As it happened, Noyes was still abroad; ironically the first steps in actually putting the journal together had to be taken by Mendel,³⁷ one of Zanetti's most cautious advisers, who was at Yale, where the original papers still lay in a drawer.

III. Chemical Reviews, 1924–1949

A. Changing Editors

Noyes Sr. (Figure 3) was Editor of *Chemical Reviews* for only three years, the shortest editorship ever. Apparently his editorial duties had become too burdensome and he was looking for some financial recompense. James Norris, then President of the ACS, hastened to assure Noyes that the latter issue had not figured in the decision to accept his resignation.³⁸ Noyes was replaced by Gerald Wendt (Figure



Figure 2. Louise Kelley. Photograph by Cecelia Norfolk, courtesy of the American Chemical Society.

4), Dean of the School of Chemistry and Physics at Pennsylvania State University. While retaining his editorship, Wendt was to leave Penn State in 1929 to become president of Coffee Products Inc. in New York City and then director of research at General Printing Ink Company.³⁹

In 1927 it was clearly stated inside the front cover of *Chemical Reviews* that most contributions to the journal were received by invitation; other submissions were refereed by the Editorial Board. It is difficult to tell from the evidence available when additional referees were brought into the process, although their role is implied in the first set of instructions to authors published in the journal (1951).⁴⁰

In 1930, Louise Kelley (Figure 2),⁴¹ Professor of Chemistry at Goucher College, Baltimore, MD, joined the staff as Assistant to the Editor, perhaps because of the propinquity of Williams and Wilkins. In 1931 she began her service as Assistant Editor, a position that she held until her death in 1961. Her job was to edit all manuscripts once they were accepted by the editor. Meanwhile she was a beloved mentor at Goucher (where a lecture hall now bears her name) as well as Assistant Editor of the *Journal of Physical and Colloid Chemistry* from 1937 to 1959.

In 1931 *Chemical Reviews* became bimonthly, perhaps explaining the need for an Assistant Editor. The six issues were divided into two volumes per year, which not only increased the number of pages,



Figure 3. William A. Noyes, Sr. Photograph courtesy of the University of Illinois at Urbana–Champaign.

but also the cost of a subscription, which was quoted in terms of volumes. (Only in 1955, when the volume numbers could be made to agree with years, was the two-volume-per-year organization of the issues discontinued.)

In 1936 the Editorial Board of *Chemical Reviews* was separated from the boards of the monograph series. The new board was constituted of six members, each of whom represented a chemical specialty.

William A. Noyes, Jr. (Figure 5), a chemistry professor at the University of Rochester, was chosen to be Editor of *Chemical Reviews* in 1939 when Wendt became Director of Science for the New York World's Fair, the platform from which he constructed a globally successful career as a writer and spokesman for science. Noyes Jr. remained at *Chemical Reviews* until 1949 when he became Editor of the *Journal of the American Chemical Society*, thus equaling if not bettering his father's record.

B. Content of *Chemical Reviews* in Its First Decades

In the period through the end of World War II, the precedent of publishing lectures, set in the first volume of *Chemical Reviews*, continued, especially symposia sponsored by ACS's Division of Physical and Inorganic Chemistry. In the introduction to a symposium on the kinetics of homogeneous reactions, Farrington Daniels remarked on the public service



Figure 4. Gerald Wendt. Photograph courtesy of the American Chemical Society.

this division was performing for the rest of the chemical community.

In order to correlate the advances of research in special fields, it is necessary for investigators in related subjects to summarize their findings for the benefit of other scientists who are not familiar with the technicalities involved. For a number of years the Division of Physical and Inorganic Chemistry of the American Chemical Society has endeavored to meet this recognized obligation. It has transmuted its frontier work into more usable form by the organization of symposia and their publication in *Chemical Reviews* and elsewhere.⁴²

Although there was definitely an emphasis on physical chemistry in the first 25 years of the journal, other specialties in chemistry were represented as in W. R. Bloor's article on the biochemistry of fats (1925)⁴³ and George Beadle's magisterial survey of biochemical genetics (1945).⁴⁴ Industrially related topics also appeared, as in the symposium on coal and oil chemistry held at Penn State in 1927, with talks by Hans Tropsch⁴⁵ and Gustav Egloff,⁴⁶ the article by Sharp and Dohme's Walter Hartung on the influence of molecular structure on the physiological activity of epinephrine and related compounds (1931),⁴⁷ and the contribution by Paul Flory, then at Goodyear Tire and Rubber Company, on the network structure and elastic properties of vulcanized rubber (1944).⁴⁸



Figure 5. William A. Noyes, Jr. Photograph courtesy of the American Chemical Society.

Authors continued to deal with the work of other scientists variously. Thé Svedberg, for example, wrote only about his own work on the sedimentation of molecules in centrifugal fields (1934).⁴⁹ Likewise, the article by Leonor Michaelis and M. P. Schubert on the theory of two-step oxidation involving free radicals was advertised as a "consolidation" of their own work (1938).⁵⁰

Many authors, however, took their responsibility to survey the literature very seriously. When Wallace Carothers wrote about polymerization in 1931, he remarked on "the profuse, contradictory, and confused literature" on the subject and therefore his decision to make his discussion "rather selective and critical", but he came up with over 250 references.⁵¹ Glenn Seaborg's 1940 article on artificial radioactivity concluded with an enormous list of nearly 600 references.⁵²

The international character of the contributors that had been set in the first volume continued, although somewhat abated by World War II. Even in the depths of war, papers arrived from England like R. L. M. Synge's paper written at the Wool Industries Research Association in Leeds and received at *Chemical Reviews* in November 1941,⁵³ as well as Brynmor Jones's from Sheffield University, received in July 1944;⁵⁴ others came from faraway India.^{55,56}

Leading-edge information technology was visible in the 1940 *Chemical Reviews* volume in the offer of microfilming services made by the Committee on

Scientific Aids to Learning. This committee was founded in 1937 by the National Academy of Sciences with support from the Carnegie Foundation. Under the plan the American Documentation Institute, the predecessor of the American Society for Information Science, was to estimate the cost of microfilming which would be carried out by the nonprofit Bibliofilm Service at 1 cent per page or 0.5 cent per page for 10 or more consecutive volumes.⁵⁷

Another example of the early deployment of information technology in the service of scientific communication appeared in the 1947 review of organosilicon chemistry by C. A. Burkhard and E. G. Rochow of the General Electric Research Laboratory and H. S. Booth and J. Hartt of Western Reserve University. They proudly reported that they had used McBee Keysort punched cards in the assembly of their paper.⁵⁸ For most of the rest of the world, scissors-and-paste methods prevailed for years to come, as the often-reiterated 1951 Instructions to Prospective Authors indicated with its tips on how to keep footnotes straight.⁴⁰

IV. Crisis of the Information Explosion, the 1950s and after

A. The Review Journal as an Answer

An explosion in scientific information occurred shortly after World War II, fueled by the flood of war-related research that had recently been declassified and later accelerated by the increased production of scientific research funded by government agencies during the Cold War. Landmark conferences and committees organized to make recommendations to deal with this crisis quickly identified the scientific review journal as part of the solution.

J. D. Bernal, a prime mover in setting up the Royal Society Information Conference in 1948, administered a pilot questionnaire to 208 scientists to provide background for the conference. Of the scientists surveyed, 76% read and appreciated reviews but many wished for more reviews only on the condition that they were better and more critically edited.⁵⁹ At the International Conference on Scientific Information held in 1958 in Washington, DC, and sponsored by the National Academy of Sciences and the National Research Council, Dennis Brunning, a British scientist, reported on a questionnaire to which 65 presumably British chemists responded with their views on the current state of the review literature. In this study, the ACS's *Chemical Reviews* was one of the three most frequently read review journals, along with the *Annual Reports* and the *Quarterly Reviews* of the Chemical Society (today's Royal Chemical Society). These respondents also looked for high-quality reviews where a critical approach was employed, not unduly favoring the author's own work, and the references were relatively comprehensive.⁶⁰ The so-called Weinberg Report, giving advice to President John F. Kennedy in 1963 on how to improve science and technical communication within and outside government, recommended the establishment of critical review journals by government agencies and other groups to deal especially with the

morass of unrefereed technical reports as well as the related open literature.⁶¹

B. Proliferation of Review Journals

A partial answer to the information crisis was the proliferation of review journals and serials with similar purposes. The American Chemical Society itself founded its *Advances in Chemistry Series* (1950), *Accounts of Chemical Research* (1968), and its *Symposium Series* (1974). In Britain the Chemical Society began publishing its *Quarterly Reviews* in 1947 (now the *Royal Society of Chemistry Reviews*).

In the post-World-War-II period, the professional societies were joined in the publication of review journals by a number of commercial ventures aimed at capturing the audiences for review literature focused on chemical subdisciplines. In the United States, in the chemical sciences this trend actually began before the war with J. Murray Luck's establishment of the *Annual Review of Biochemistry* in 1932. (Annual Reviews Inc. now publishes some 29 different editions.) Other publishers that chose to enter the apparently lucrative market for chemical review literature include Academic Press, CRC Press, Marcel Dekker Inc., Elsevier Science Publishing, Pergamon Press, Springer-Verlag, and John Wiley and Sons.²

Another product of this era is the *Index to Scientific Reviews* annually published by the Institute for Scientific Information since 1974. Through the *Index's* search mechanisms, reviews not published in review journals or series are also identified. In all the sciences only 19% of the review articles cited in the 1986 *Index*, for example, came from review-type publications. The remaining 81% appeared in other journals and serials, albeit widely scattered.²

C. *Chemical Reviews* in the New Environment, Post-1950

Ralph L. Shriner (Figure 6), Harold Hart (Figure 7), Anthony M. Trozzolo (Figure 8), and Josef Michl (Figure 9) led *Chemical Reviews* in this new competitive environment, Table 1. They provided the journal's readers with a broad perspective not available in the more recent specialized review journals: in-depth reviews of topics chosen from the whole spectrum of chemical subdisciplines, whatever was showing the most interesting progress and gave promise for future growth. Readers understood that being exposed to such diversity increased their chances of being truly creative in their own research, enhanced their appreciation of the work of their colleagues, and made them more informed citizens of the chemical world.

In the years 1959–60, for example, one could read essays as different as Calvin Fuller's on the interactions between solutes in germanium and silicon⁶² and state-of-the-art natural products chemistry in "Gossypol, A Pigment of Cottonseed" by Roger Adams, T. A. Geissman, and J. D. Edwards.⁶³ In the long run, though, chemistry's ever-multiplying subspecialties and the reflection of this centrifugal tendency in *Chemical Reviews* called for integration of some areas. In 1985 special thematic issues were inaugu-



Figure 6. Ralph L. Shriner. Photograph courtesy of the Western Historical Manuscript Collection, University of Missouri.



Figure 8. Anthony M. Trozzolo.

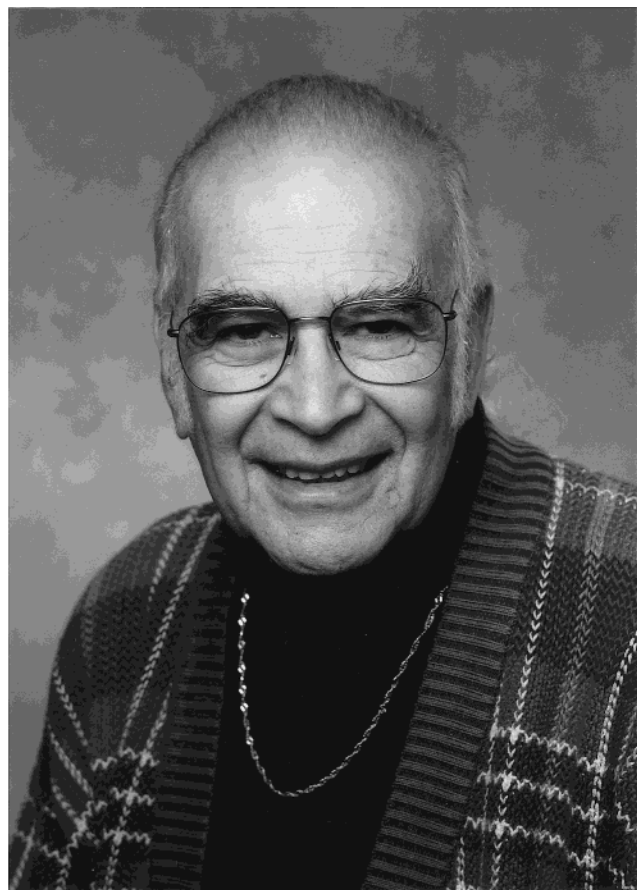


Figure 7. Harold Hart.



Figure 9. Josef Michl.

Table 1. Editors of *Chemical Reviews*

William A. Noyes, Sr.	1924–26
Gerald Wendt	1927–39
William A. Noyes, Jr.	1939–49
Ralph L. Shriner	1950–67
Harold Hart	1967–76
Anthony M. Trozzolo	1977–84
Josef Michl	1984–current

rated for this purpose; one-half of the issues of the journal now continue to provide their usual stimulating variety of topics.

Chemical Reviews displayed other aspects of the growth of the chemical sciences in the post-World-War-II era. Among these signs was the rise of articles written by scientific teams. Because a high degree of intellectual integration is expected in review articles, they are to this day generally written by one or two authors. Nevertheless, from the 1960s onward, some reviews bear the names of four or more authors. Long operating with a relatively small Editorial Advisory Board of 6–8 members, the board similarly more than doubled in size in the 1980s. A larger board could survey better the vastly expanded and more complicated territory of the chemical sciences and represent its truly international character in the modern world.

From its earliest days designed to be a manageable length so as not to swamp readers with too much information, *Chemical Reviews* underwent controlled growth over the years. In 1960 when the ACS took over publishing the journal, the size of pages increased appreciably. In 1987, *Chemical Reviews* began publishing eight issues per year instead of six; in 1999, it went to 12 issues per year, thus providing more frequent updates on areas experiencing high research activity. Since 1997, *Chemical Reviews* has offered a Web edition of the journal and since 1998 made available articles on-line as soon as they are publishable (ASAP) and before they appear in hard-copy.

Prices have also increased since 1924; *Chemical Reviews* no longer costs \$4.00 a year to ACS members. Still, 75 years of salary increases make today's (1999) \$49.00 (inside the United States) for the print edition and \$68.00 (inside the United States) for print plus Web editions (and \$30.00 for a single thematic issue) seem like real bargains.

Looking to the future based on our knowledge of the past, we can expect that *Chemical Reviews* will continue in its next 100 volumes to “fill a definite want” in the chemical community and will evolve as those “wants” change.

V. References

- Woodward, A. M. The Role of Reviews in Information Transfer. *J. Am. Soc. Inf. Sci.* **1977**, *28*, 175–180.
- Garfield, E. Reviewing Review Literature. Part 1. Definitions and Uses of Reviews. Part 2. The Place of Reviews in Scientific Literature. *Essays of an Information Scientist*; ISI Press: Philadelphia, 1989; Vol. 10, pp 113–122.
- Adams, S. The Review Literature in Medicine. *Bibliography of Medical Reviews*; National Library of Medicine: Washington, DC, 1961; Vol. 6.
- Woodward, A. M. The Review Literature: Characteristics, Sources and Output in 1972. *Aslib Proc.* **1974**, *26*, 367–76.
- Manten, A. A. Scientific Review Literature. *Scholarly Publ.* **1973**, *5*, 75–89.
- Brown, C. A.; Weeks, M. E. Publications. In *A History of the American Chemical Society: Seventy-Five Eventful Years*; American Chemical Society: Washington, DC, 1952; pp 296–426.
- Fennell, R. *History of IUPAC, 1919–1987*; Blackwell Science: Oxford, 1994; pp 14–17.
- Van Hecke, G. R. William Albert Noyes. In *Dictionary of Scientific Biography*; Gillispie, C. C., Ed.; Charles Scribner's: New York, 1970–1981; Vol. 10, pp 157–158.
- Pauling, L. Arthur Amos Noyes. In *Dictionary of Scientific Biography*; Gillispie, C. C., Ed.; Charles Scribner's: New York, 1970–1981; Vol. 10, pp 156–157.
- Noyes Sr. to Howe, Jan. 5, 1923, Central Policy File, Divisions of the National Research Council, Chemistry and Chemical Technology, Projects, Publication of Chemical Reviews Proposed, 1923, National Academy of Sciences–National Research Council Archives (hereafter cited as *Chemical Reviews* Proposed).
- Zanetti to Noyes Sr., Dec. 1, 1923, *Chemical Reviews* Proposed.
- Minutes of April 7, 1923. Central Policy File, Divisions of the National Research Council, Chemistry and Chemical Technology, Meetings, 1923, National Academy of Sciences–National Research Council Archives.
- Zanetti to Noyes Sr., Nov. 6, 1923, *Chemical Reviews* Proposed.
- Norris to Zanetti, Nov. 8, 1923, *Chemical Reviews* Proposed.
- Lamb to Zanetti, Nov. 9, 1923, *Chemical Reviews* Proposed.
- Zanetti to Norris, Nov. 9, 1923, *Chemical Reviews* Proposed.
- Zanetti to Stieglitz, Nov. 9, 1923, *Chemical Reviews* Proposed.
- Stieglitz to Zanetti, Nov. 14, 1923, *Chemical Reviews* Proposed.
- Stieglitz, J. A Theory of Color Production I; II. Inorganic Compounds. *Proc. Natl. Acad. Sci. U.S.A.* **1923**, *9*, 303–312.
- Stieglitz, J. A Theory of Color Production. *J. Franklin Inst.* **1925**, *200*, 35–49.
- Howe to Zanetti, Oct. 16, 1923, *Chemical Reviews* Proposed.
- Zanetti to Parsons, Feb. 2, 1924, Central Policy File, Divisions of the National Research Council, Chemistry and Chemical Technology, Projects, Publication of Chemical Reviews Joint with ACS, 1924, National Academy of Sciences–National Research Council Archives (hereafter cited as Publication of *Chemical Reviews*).
- F. W. Robinson to Zanetti, Nov. 16, 1923, *Chemical Reviews* proposed.
- C. C. Thomas to Zanetti, Jan. 17, 1924, Publication of *Chemical Reviews*.
- Zanetti to Johnstone, Nov. 30, 1923, *Chemical Reviews* Proposed.
- Ind. Eng. Chem., News Ed.* **1923**, *1*, 2.
- Johnstone to Zanetti, Nov. 28, 1923, *Chemical Reviews* Proposed.
- Lewis to Zanetti, Feb. 11, 1924, Publication of *Chemical Reviews*.
- Zanetti to Parsons, Oct. 16, 1923, *Chemical Reviews* Proposed.
- Mendel to Zanetti, Dec. 11, 1923, *Chemical Reviews* Proposed.
- Parsons to Zanetti, Oct. 13, 1923, *Chemical Reviews* Proposed.
- Kronick, D. A. Derivative Publication: The Review Journal. *A History of Scientific and Technical Periodicals: the Origins and Development of the Scientific and Technological Press*; Scarecrow Press: New York, 1962; pp 159–178.
- Kronick, D. A. *Scientific and Technical Periodicals of the Seventeenth and Eighteenth Centuries: A Guide*; Scarecrow Press: Metuchen, NJ, 1991; p 52.
- Ann. Philos.* **1814**, *3*, 10.
- Soule, B. A. Review and Monograph Series. *Library Guide for the Chemist*; McGraw-Hill: New York, 1938; pp 77–90.
- Brock, W. H. *The Norton History of Chemistry*; Norton: New York, 1993; p 452.
- Mendel to Zanetti, April 14, 1924, Publication of *Chemical Reviews*.
- Norris to Noyes, Dec. 31, 1926, William A. Noyes Papers, University of Illinois Archives, Urbana–Champaign.
- Jones, J. H. Gerald Louis Wendt. In *American Chemists and Chemical Engineers*; Miles, W. D., Gould, R. G., Eds.; Gould Books: Guilford, CT, 1994; Vol. 2, pp 287–288.
- Suggestions to Authors of Review Articles. *Chem. Rev.* **1951**, *48*, 1–5.
- Webb, J. L. A. Louise Kelley. In *American Chemists and Chemical Engineers*; Miles, W. D., Ed.; American Chemical Society: Washington, DC, 1976; Vol. 1, pp 269–270.
- Daniels, F. A Symposium on the Kinetics of Homogeneous Reactions, Introduction to the Symposium. *Chem. Rev.* **1932**, *10*, 1.
- Bloor, W. R. Biochemistry of the Fats. *Chem. Rev.* **1925**, *2*, 243–300.
- Beadle, G. W. Biochemical Genetics. *Chem. Rev.* **1945**, *37*, 15–96.
- Tropsch, H. Problems in the Chemistry of Coal. *Chem. Rev.* **1929**, *6*, 63–90.
- Egloff, G.; Schaad, R. E. The Oxidation of the Gaseous Paraffin Hydrocarbons. *Chem. Rev.* **1929**, *6*, 91–141.
- Hartung, W. Epinephrine and Related Compounds. *Chem. Rev.* **1931**, *9*, 389–465.
- Flory, P. J. Network Structure and the Elastic Properties of Vulcanized Rubber. *Chem. Rev.* **1944**, *35*, 51–75.
- Svedberg, T. Sedimentation of Molecules in Centrifugal Fields. *Chem. Rev.* **1934**, *14*, 1–16.

- (50) Michaelis, L.; Schubert, M. P. The Theory of Two-step Oxidation Involving Free Radicals. *Chem. Rev.* **1938**, *22*, 437–470.
- (51) Carothers, W. Polymerization. *Chem. Rev.* **1931**, *8*, 353–426.
- (52) Seaborg, G. Artificial Radioactivity. *Chem. Rev.* **1940**, *27*, 199–286.
- (53) Syngé, R. L. M. Partial Hydrolysis Products Derived from Proteins and their Significance for Protein Structure. *Chem. Rev.* **1943**, *32*, 135–172.
- (54) Jones, B. Kinetics and Mechanism of the Beckmann Rearrangement. *Chem. Rev.* **1944**, *35*, 335–350.
- (55) Anantakrishnan, S. V.; Venkatorama, R. The Reaction between Ethylene Derivatives and the Halogens. *Chem. Rev.* **1943**, *33*, 27–55.
- (56) Sethna, S. M.; Shah, N. R. The Chemistry of the Coumarins. *Chem. Rev.* **1945**, *36*, 1–62.
- (57) Microfilm Sets of Periodicals. *Chem. Rev.* **1940**, *26*, 472.
- (58) Burkhard, C. A.; Rochow, E. G.; Booth, H. S.; Hartt, J. The Present State of Organosilicon Chemistry. *Chem. Rev.* **1947**, *41*, 97–149.
- (59) Bernal, J. D. Preliminary Analysis of Pilot Questionnaire in the Use of Scientific Literature. In *The Royal Society Scientific Information Conference, June 21, to July 2, 1948*; Royal Society: London, 1948; pp 589–637.
- (60) Brunning, D. A. Review Literature and the Chemist. *Proceedings of the International Conference on Scientific Information, 1958*; National Academy of Sciences–National Research Council: Washington, DC 1958; Vol. 1, pp 545–570.
- (61) *Science, Government, and Information: the Responsibilities of the Technical Community and the Government in the Transfer of Information, A Report*; President's Science Advisory Committee, U.S. Government Printing Office: Washington, DC, 1963; pp 42–43.
- (62) Fuller, C. S. Interactions between Solutes in Germanium and Silicon. *Chem. Rev.* **1959**, *59*, 65–87.
- (63) Adams, R.; Geissman, T. A.; Edwards, J. D. Gossypol, A Pigment of Cottonseed. *Chem. Rev.* **1960**, *60*, 555–574.

CR980362D