# JAMES BRYANT CONANT: THE MAKING OF AN ICONOCLASTIC CHEMIST

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James Bryant Conant was a truly unique figure in the history of American chemistry as he was one of the first American trained chemists to break the total domination by European chemists in the field of organic chemistry (1). He was the leader in the United States of a movement to go beyond the traditional domination by structural chemistry, as exemplified by German organic chemistry prior to 1920, to an integration of all the various branches of chemistry in order to understand chemical phenomena. Conant, along with persons like Howard Lucas in the United States and Arthur Lapworth, K. J. P. Orton, Robert Robinson, and C.K. Ingold in Great Britain, would establish the discipline of physical organic chemistry in the period between the two world wars. Conant was also a visionary in that he saw the future of chemistry inextricably bound to the development of the biological sciences. Conant considered his work on chlorophyll as his most significant contribution to chemical knowledge; others would stress his work in physical organic chemistry as his greatest chemical legacy (1, 2, 3). He was in the forefront of a new generation of American academicians who favored the idea of merit and accomplishment as the prime criteria for professional advancement rather then one's familial background and connections. This zeal for reform of higher education would cause him to have to abandon almost completely his chemical work when he was offered the presidency of Harvard University in 1933.

How Conant became this leading figure during his brief career as a chemist has received far less attention than have his other careers as president of Harvard, scientific adviser, diplomat, and critic of the American education system. One can argue that his chemical training and the research that he performed laid the foundation for his future achievements. Biographical notices appearing on behalf of the Royal Society (London) by Kistiakowsky and Westheimer (2) and for the US National Academy of Sciences by Bartlett (3) provide very brief sketches of his life and emphasize his research output. Conant's own 1970 autobiography (4) has only 76 out of 647 pages devoted to his life before his assumption of the presidency of Harvard University in 1933. James Hershberg devotes only 75 out of 755 pages to this part of Conant's life in his biography (5).

Conant's autobiography was described by many reviewers as revealing little of the man and had the quality of being an obituary, rather then an examination of an exceptional life. How much of this was a natural Yankee reticence or a conscious attempt to conceal matters that might diminish his standing for posterity is difficult to assess. Conant has been described as dogmatic and unimaginative, incurably cold, without radiation, but also as warm, brilliant, innovative, considerate, and unpretentious. His granddaughter Jennet Conant has recently written of her grandfather (6):

> James Conant was a very private, proud, and tidy man and placed a premium on appearances.

Conant family roots, both maternal (Bryant) and paternal can be traced back to the founding of the Massachusetts Bay Colony in the early 17$^{th}$ century. These two families had lived for almost two hundred years in southeastern Massachusetts near the town of Bridgewater. At various times they were farmers, shopkeepers, and shoe manufacturers. His father James Scott moved to

Dorchester, then a growing suburb of Boston, in 1880. By hard work and effort, James Scott Bryant prospered by building houses, speculating on real estate, and establishing a photoengraving business (7). James Bryant, born on March 26, 1893 was the last of three children and the only son.

Conant made a point of his humble beginnings to reinforce his achievements as the result of his efforts rather than family position and contacts. Conant felt initially an outsider when he entered Harvard in 1910, and this sparked his ambition to succeed and be accepted (8).

Herschberg has summarized Conant's childhood as follows (5):

> ….avid curiosity and breadth of interest, skepticism toward religious or political dogma, admiration for intellectual excellence, rigorous self-discipline, and devotion to duty, awareness of and desire to participate in an epoch of accelerating technical change.

Conant in his laboratory in Boylston Hall, 1921

As a young child Conant was fascinated by chemistry; and, sensing his son's interest, the elder Conant built a home laboratory where James was able to conduct experiments. In 1903 Conant was admitted to the highly competitive Roxbury Latin School, a private school founded in 1645 by James Eliot (7). Roxbury Latin had achieved an outstanding reputation as a college preparatory school particularly strong in both the sciences and the classics. Roxbury Latin was the only high school in Greater Boston that had laboratories for the teaching of chemistry and physics. More important than the laboratories was the instructor Newton Henry Black (1874-1961) (8). He was to be an important influence on Conant's future (9).

Black, an 1896 Harvard graduate arrived at the Roxbury Latin School in 1900 after having taught at the St. George's School, Newport, RI and Concord, NH High School. Black was an exceptional teacher and totally devoted to his students. He spent many summers in Europe, where he toured laboratories and classrooms in order to improve the level of secondary education in the sciences in the United States. Black continued his own professional development by obtaining a master's degree at Harvard in 1906 (10):

> ...his students, as individuals, were his main concern, and especially those who responded to his own enthusiasm for science. He spotted them early. At Roxbury Latin boys from several grades brought their sandwiches to his laboratory at lunch time for talk about chemistry experiments, home-made wireless sets, and the like. The students were encouraged to go as fast as far as they could, and many left his courses with advanced preparation that anticipated much of college physics and chemistry.

Conant thrived under the mentorship of Black, rising from a student with mediocre grades in all his subjects except science to becoming first in his class. Black firmly believed that Conant had the most potential to achieve scientific greatness of any of the many students he had ever taught in the past ten years. Conant's father had been successful in his business ventures, but he was not in a position to be able to support his son's further education at Harvard.

Through the efforts of Black and his fellow instructors at Roxbury Latin, Conant was awarded a scholarship of $300 and he entered Harvard in the fall of 1910. Black had arranged with Theodore Richards, chair of the chemistry department, for Conant to receive advanced standing in chemistry since he had done the equivalent of two years of college chemistry and a year of college physics. To obtain advanced standing Conant had to pass the same final examination in the introductory chemistry course given in June, 1910 to the Harvard students. This was easily accomplished, and Conant was thus able to begin his studies with Chemistry 2, the half-year course in organic chemistry.

Theodore William Richards (1868-1928) (11) was to play a crucial role in Conant's life as mentor, colleague, and father-in-law over the next two decades. Richards, the first American to win the Nobel Prize in

Chemistry (1914) was in some respects the equal intellectually of Conant but his opposite in many ways. Richards was one of the first American physical chemists in the Ostwald tradition (12). He had worked with Nernst in Göttingen and Ostwald in Leipzig and spent part of 1901 as a visiting Professor of Physical Chemistry at Göttingen. Richards had many of the same personality traits as Conant: cool rationality and reserve, prudence, skepticism, and thoroughness. Conant was so taken by Richards as an undergraduate that he resolved to do his Ph.D. research with him. This had been Black's intention when he had so highly recommended Conant to Richards.

Conant was eligible in his third year (1912-1913) to undertake undergraduate research. In 1912 Emil Peter Kohler (1865-1938) (13) arrived at Harvard, having previously taught at Bryn Mawr College for twenty years. Kohler, an organic chemist, had obtained his Ph.D. with Remsen at Johns Hopkins in 1892. He was consumed with a deep passion for his subject that he instilled in all his students. He was familiar with the latest developments in organic chemistry and shared these with students in his advanced courses. Kohler was keenly interested in the mechanisms of organic reactions, an unusual interest in a period in which structural chemistry predominated.

Fellow students had advised Conant that it would be a good idea for him to do research in another field before he began his doctoral work with Theodore Richards. Conant described this turning point in his life (4):

> What was intended as an exploration of a neighboring field turned out to be an introduction to my lifework as a chemist. Kohler in his first year at Harvard had few research students; therefore he gave a disproportionate amount of time to me. I was enormously impressed by him as a man and a scientist. The attractions of experimentation with carbon compounds began to make me wonder whether I wanted to be a physical chemist after all.

Conant finished his undergraduate work in three years and formally graduated *magna cum laude* with the class of 1914 and was elected to Phi Beta Kappa.

Torn between physical and organic chemistry, Conant decided to present a double thesis for the Ph.D. involving problems in physical and organic chemistry. Kohler had offered him a position as the assistant in charge of the undergraduate organic laboratory work, which provided Conant the means to pursue his studies.

With Richards, Conant undertook a study of "The Electrochemical Behavior of Liquid Sodium Amalgams," which constituted Part I of his dissertation (44 pages) (14). Part II under Kohler's supervision was "A Study of Certain Cyclopropane Derivatives" (234 pages) (15). Part II contained a comprehensive literature review of cyclopropane chemistry through 1915 and included some novel speculations on the bonding in cyclopropanes to account for their unusual properties. Conant took stock of his situation (4):

> With a Ph.D. awarded for a two-part thesis, I would be theoretically prepared to undertake research in organic and physical chemistry. Actually, by the time commencement 1916 came around, I was a committed organic chemist. By a series of accidents, Mr. Black's scheme of having his favorite pupil become a physical chemist had been thwarted. I had deserted the path of chemical science, which he had laid out for me so long ago.

However, Conant was to make good use of this dual training as one of the pioneers in the discipline of physical organic chemistry in the 1920s and early 1930s (16).

During the summer of 1915 Conant had the opportunity to work in the laboratory of the Midvale Steel Company in Philadelphia. George L. Kelley, who had received his Ph.D. in organic chemistry at Harvard in 1911, and then had been appointed an instructor for the following academic year, was the head of the laboratory. Kelley had hired a friend of Conant, Richard Patch (Ph.D. 1914); this connection led to the summer job and to Conant's first three publications. These papers, jointly authored with Kelley, involved techniques for the analysis of vanadium, chromium, and nickel in steel.

The outbreak of World War I in August, 1914 had a profound impact on Conant's plans for the future. It had been Conant's intention to do post-doctoral work in Germany, but by 1916 this had become impossible. Conant's admiration of German achievements in chemistry led him at the beginning of the war to express pro-German sentiments even in light of the reports of German atrocities in Belgium. By 1916 anti-German feeling had become so intense on the Harvard campus that Conant was less than popular in many circles. He toyed briefly with the idea of studying at the Institute of Technology (ETH) in Zürich and also volunteering as an ambulance driver on the Western Front. This too proved to be impossible, since one could not enlist as a driver for a short term, as Conant had intended. In 1916 Conant, age 23 with his Ph.D., had few prospects for the immediate future.

Two fellow chemistry students, Chauncey Loomis and Stanley Pennock, considered starting an organic chemical manufacturing business and approached Conant in the spring of 1916. Germany had been the principal source of organic chemicals in America, and with the British blockade these were now scarce and expensive. The partners believed they could manufacture small batches of simple organic chemicals, such as benzyl chloride and benzoic acid, and sell them for a considerable profit (17). This venture was to be limited to the length of the war and it seemed to the young and naive Conant to be a get-rich-quick scheme. His years at Harvard as a scholarship student and then as a graduate assistant had convinced him that having independent means was important.

Manufacturing started in the summer of 1916 in Queens, New York, and Conant and Loomis proceeded to burn the building down in August 1916. Undeterred, they moved to Newark, New Jersey and changed the name of the partnership to the Aromatic Chemical Company. Conant developed a more efficient process for making benzyl chloride, which did not require using gaseous chlorine. He took out a patent (1,233,986: July 17, 1917), which was later sold to the Semet-Solvay Company (18).

In September 1916 Roger Adams (1889-1971) gave notice that he was leaving Harvard for a position at the University of Illinois (19). Adams was about to begin his fourth year as an instructor at Harvard, when he succumbed to the persistent inducements offered by W. A. Noyes to move to Illinois. Conant and Adams were on very friendly terms, and Adams had been one of Conant's examiners for the organic portion of his dissertation. Conant was asked to take over Adams' courses for the 1916-17 academic year. He was formally released from any obligations to the Aromatic Chemical Company on September 18, 1916 so he could return to Cambridge.

Shortly after Conant returned to Harvard, on November 27, 1916, there was an accident in Newark when his two former partners Pennock and Loomis began their first full-scale production of benzoic acid. An explosion occurred that killed Pennock and two employees, and Loomis sustained serious acid burns. An investigation into the accident revealed flaws in the procedures developed by Conant for the manufacturing process. Although he was no longer officially associated with the company, Conant certainly felt a degree of guilt over the loss of his friend Pennock.

A crucial event for Conant was the entry of the United States into World War I on April 2, 1917. Conant was less than enthusiastic about entering the war and indicated in his memoirs that he had voted for Wilson in the 1916 election because of his neutrality position. By early 1917 Conant, realizing that war was inevitable, mulled over what he should do. Volunteer for combat? Volunteer his chemical skills, which were considerable? On March 26, 1917 he wrote for advice from George Kelley, with whom he had worked at Midvale Steel (20):

> I have been wondering personally whether if war comes (it seems inevitable now) I should enlist myself in the army or navy. There seems to be a strong opinion among those who should know best that the trained chemists will be more useful in connection with the industrial military work than by fighting themselves. There is, consequently, both in my mind and in the minds of several of my friends, a great deal of uncertainty as regards what course we had best pursue.

Conant joined the Bureau of Chemistry of the US Department of Agriculture in Washington, DC as his contribution to the war effort. However, Conant's association with the Bureau was short-lived because he was recruited by James F. Norris of MIT to become a group leader at the Bureau of Mines division of American University in Washington, where research on offensive poison gas was being carried out. His work in Washington concerned an improved synthesis of mustard gas. Conant was inducted into the Chemical Warfare Service of the Army in 1917 as a First Lieutenant and rose to the rank of Major by the time he was released.

The Allies had developed a more potent poison gas then mustard gas: namely, dicholoro (2-chlorovinyl) arsine, or lewisite, named after its developer W. L. Lewis of Northwestern University. In May, 1918 Conant was given the assignment of producing lewisite on a large scale at a plant to be set up in Cleveland, Ohio. Lewisite was never used offensively, but the feat Conant accomplished in converting a product of laboratory research to full-scale production drew praise from his superiors. Upon being discharged on January 11, 1919, Conant returned to Harvard and was appointed an instructor for the balance of the 1918-1919 academic year.

World War I had demonstrated the importance of chemistry and how ill prepared the United States and the other allies were in this new, more sophisticated technological age. As a result of a major expansion of the American chemical industry, Conant received several offers prior to and shortly after his discharge because of his outstanding work while in the Army.

The offer from W. C. Greer, Second Vice President in charge of development at B. F. Goodrich, on December 23, 1918, illustrates the great promise of Conant as a scientist (21):

> The Goodrich Company is desirous of adding to its staff several experienced, well educated research chemists. The line of work to be done is most interesting to one who had a good training in either organic or physical chemistry or both. From the description of you and your work made to me by Dr. Jones and others in the Chemical Warfare Service in Washington, I believe you would find the investigations which I have in mind exceedingly interesting and the situation one to your liking. The possibilities for the future to you personally, I assure you, would be excellent.

The University of Chicago also tried to hire Conant. Julius B. Stieglitz wrote to Conant on February 19, 1919 (22):

> I have received word from Dr. Richards that he would have no objection to my trying to secure you for our staff in spite of the fact that you have been offered an Assistant Professorship on the Harvard staff....Would you be willing to consider a call as Assistant Professor of Chemistry with a salary of $2,500?
>
> I do not know, of course, whether you would be at all interested in coming to us, but I hope you will consider the invitation with an open mind. A few years here, with advancement to a permanent appointment as Associate Professor, and ultimately as Professor, together with a prospect that Harvard might wish to call you back to its own staff would, it seems to me, be mutually profitable.
>
> Frankly, it is our intention to strengthen the organic work at all costs, but we prefer to do so with a view to the future, rather with a promising young man like yourself, than with an older man of fully established standing.

Roger Adams, instrumental in suggesting Conant to Stieglitz, communicated with Conant in a letter dated February 3, 1919, about two weeks prior to the formal offer (23):

> I suggest that you may have a letter concerning the possibility about coming out West. You had better consider it carefully because I think it is a good position and I have never regretted coming here three years ago in spite of the fact that I miss a great many of the things that I was able to have when in Cambridge.

Conant turned down the offer in favor of an appointment as an Assistant Professor of Chemistry at Harvard. He set about developing a research program, in which he initially concentrated on extending some of the work he had done at the Chemical Warfare Service and then branched out into other fields. He was consumed by his research, probably to the detriment of his teaching and other duties. He was a frequent guest at the Richards home and this led to his eventual marriage to Grace (Patty) Thayer Richards, daughter of Theodore and Miriam Thayer Richards, on April 21, 1921 in the Appleton Chapel at Harvard University. Their marriage lasted for his lifetime and produced two sons, James Richards (b.1923) and Theodore Richards (b. 1926). Although Conant was cremated, his ashes are buried with his wife in the Richards family plot in the Mount Auburn Cemetery in Cambridge.

As a honeymoon gift T .W. Richards made it possible for the newlyweds to visit Britain in the summer of 1921. Armed with letters of introduction from his father-in-law, Conant called upon Jocelyn Thorpe in London and met a very young Christopher Ingold and Norman Collie. At Oxford he talked to William Henry Perkin, Jr,; in Manchester Arthur Lapworth, and in Newcastle Norman Haworth. Many of these were pioneers in physical organic and bioorganic chemistry, fields in which Conant would become interested. He also attended a Solvay conference in Brussels, where he met William Pope and Thomas Lowry (24).

From 1919-1925 Conant and his co-workers published 36 papers, 31 in the *Journal of American Chemical Society* and several others in the *Journal of Biological Chemistry*. In a major undertaking, reported in a series of papers beginning in 1922, Conant applied his knowledge of electrochemistry to the mechanism of oxidation-reduction in organic compounds with an eye towards its relevance to biological systems. With Louis Fieser and a number of other co-workers over many years, the mechanisms of oxidation- reduction were elucidated (25). The reduction reactions were of both the reversible and the irreversible types. Many of the studies involved reversible reduction with quinones (benzoquinone, napthoquinone, and anthroquinone) as model systems. The relation of structure as well as solvent system to redox potential was studied in detail in these investigations. These studies characterize the new insights that Conant brought to the study of organic systems: the importance of the application of the methods of physical chemistry to understand more fully what was happening in organic reactions and the importance of an interdisciplinary approach (26).

In a similar vein, kinetic studies on "The Relation Between the Structure of Organic Halides and the Speeds

of their Reaction with Inorganic Iodides"(27) began in 1924. This research anticipated to some degree the work that would be done by Ingold on nucleophilic substitution in the 1930s. Conant was able to show that the reaction was bimolecular and that the most reactive substrate, ethyl chloride, was twice as reactive as any other compound studied. Secondary and tertiary halides were less reactive and cyclohexyl chloride did not react at all. Studies with lithium, sodium, or potassium iodide showed that the cation had no effect and that it was the iodide ion that was involved in the displacement reaction.

In 1923 Conant published the first of a major series of investigations in which he applied his mastery of both physical and organic chemistry to the study of biological systems. He was an early proponent of the proposition that the most significant work that would be done by organic chemists in future decades would be in the area of biological chemistry. His initial work in this new area was an electrochemical study of hemoglobin (28). With Fieser he performed a quantitative reduction of methemoglobin to hemoglobin by electrometric titration with sodium hyposulfite. This investigation offered additional evidence that reduction involved a one-electron transfer that converted ferric to ferrous ion. As a by-product of this work, Conant and Fieser developed an electrometric method for the determination of methemoglobin in the presence of its cleavage products, one that was more reliable then the spectrometric method then in use (29).

Patty Richards with sons James Richards (l) and Theodore Richards, 1930

A significant event during this period was the founding of *Organic Synthesis*. On January 17, 1919, Roger Adams wrote to Conant concerning the idea of producing an annual publication devoted to new or better methods for the synthesis of specific organic compounds. In another letter on February 3, 1919, Adams, in reply to Conant, gave further details of his ideas about the organization of this venture (30):

> In regard to making this international, I feel we are under no obligation to such people as Stieglitz, Emmet Reid, Bogart, etc. In the first place, they never would do any work and would degrade the whole affair even in my mind if they become any such thing as honorary members. I would prefer simply to tell these men that such a thing was being carried out and was being actually done by the younger organic chemists....It is better to have only four or five men and this would work out more satisfactorily I am sure....Of course, it was my intention to write to some of the bigger men in France or England and ask them for the names of some of the prominent younger men who might be willing to cooperate....I think it might be well for you to speak to Kohler and see what he thinks of the whole thing.

*Organic Synthesis* was a direct response to the difficulty that American chemists were having in obtaining organic chemicals during World War I, as well as to the post-war problems of cost and supply. John Wiley agreed to publish *Organic Synthesis*, and the first volume appeared in 1921 with Adams as Editor-in-Chief and Conant as a member of the editorial board. Conant was the editor of Volume 2, which appeared in 1922, and continued to serve on the editorial board for many years.

In 1925 Conant, promoted to Associate Professor with tenure, was finally able to make his long postponed visit to Germany. With his wife and young son Theodore, Conant took up residence in Munich in April, 1925. Over the next eight months Conant made the grand tour of German universities and met with many of the leading figures in academia and industry. These trips were meticulously documented in a diary, which contained comments on the places and persons he met. He visited the universities at Tübingen, Karlsruhe, Heidelberg, Darmstadt, Würzburg, Göttingen, Dresden, Halle, Leipzig, Berlin, Jena, and Erlangen. Among those he had discussions with were Casimar Fajans, Hans Fischer, Kurt Meyer, Theodore Wieland, Jacob Meisenhemier, Karl Ziegler, Theodore Curtius, Hermann Staudinger, Adolf Windaus, and Arthur Hantzsch. He toured

Ostwald's laboratory in Leipzig and spent time in the library of the Hofmann House in Berlin. From September 1-6, 1925 he attended the meeting of the German Chemical Society in Nürnberg and met Hans Meerwein and Paul Walden (31).

Returning to Harvard, Conant resumed his program of research with even greater vigor. He was confident that he would quickly be promoted to the rank of Professor of Chemistry. He felt that his progress was being held back as a junior member of the department by the disproportionately heavier teaching load he bore, as well as the lack of sufficient students and financial support to carry out the many avenues of research he wished to pursue.

A. A. Noyes (32) of the California Institute of Technology had been making overtures to Conant about joining the faculty as a full professor with a reduced teaching load and institutional funding for his work. In late 1926 Conant was enticed by Noyes to take unpaid leave form Harvard, with Caltech paying his salary and expenses for a period from February-April, 1927. This was not Conant's first trip to California, as he had spent the summer of 1924 at the invitation of G. N. Lewis (a student of Richards) at the University of California, Berkeley, teaching undergraduate organic chemistry. The visit was combined with a month's vacation spent at Carmel, which the Conant family thoroughly enjoyed (33). Thus Conant was predisposed to making a break with his past.

Noyes was eager to have a chemist of Conant's ability, ambition, and blossoming reputation join his department. He offered Conant a salary and working conditions that were beyond anything he had or would normally have expected at Harvard. In a report Conant made to the Carnegie Corporation in 1969, he wrote the following (34):

> Here I might record my impressions as a member of the department of chemistry at Harvard and my own response to a call to the Cal. Inst. Of Tech. Some of the older members of the department, when it came to enlarging the department by the addition of one or two people, were always inclined to look to their own graduate students and be suspicious of outsiders. This seemed to me a bit of parochialism, which was not in the interest of either chemistry or the university.

We have a good idea of what Conant expected to do in his trial period at Caltech from a letter he wrote to A. A. Noyes on January 3, 1927, in which he stated what he intended to teach and what his research plans were (35):

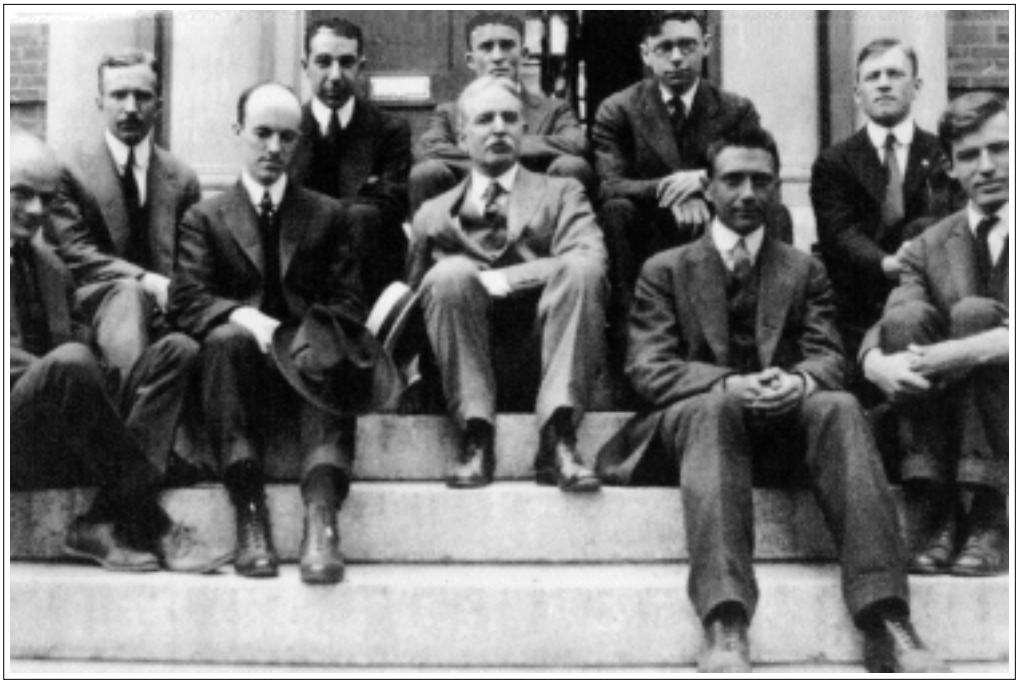
> In regard to lecture work, I should be delighted to take over the three hours a week course in advanced organic chemistry. I would plan to discuss in particular some aspects of the recent work on oxidation and reduction and on the constitution of complex natural products. In regard to research, I have decided that it would be best to concentrate my efforts on some aspect of the oxidation-reduction work while I am with you....I should perhaps apologize for planning such a physical-chemical investigation in a new organic laboratory but, considering the present state of my problems and the short time available, it would seem to me the wisest line of research to undertake

When Conant stated his intention to resign to President Lowell of Harvard, a counter-offer was made. In a letter to Conant dated May 13, 1927, the Dean of the College of Arts and Sciences, Clifford H. Moore, enumerated the conditions of the offer. First, Conant would be promoted to the rank of professor, effective September 1, 1927, with a salary of $7,000. Specific stipulations about teaching and committee work and financial support for research were also included (36):

> ...you will not be asked to give more then one lecture course running through the year.…you will not be asked to serve on standing committees….a grant of $4,000 for the year 1927-28, followed by a yearly grant of $9,000 for the next five years, these sums of money to be expended by you in furthering your research in such a manner as seems wisest to you.

With this guarantee of research funding Conant was now in a position to hire post-doctoral associates. Although not a common practice in the United States at this time, it had been one of the aspects of the Germanic system that Conant so admired. Conant's research output increased markedly over the next few years (37). In looking at the leading works published in physical organic chemistry in the 1940s and 1950s, the citations to Conant's body of work are almost exclusively from this period (38). This is the period in which Conant had many students who would become the future leaders of physical organic chemistry, such as Paul Bartlett, George Wheland, and Frank Westheimer. From 1928-1933 Conant was able to publish 55 papers in a variety of research areas (39). This equaled his entire output from his first papers in 1916 through 1927.

One year after being promoted to professor, Conant, now only 35 years of age, was awarded the Sheldon Emory Professorship in Organic Chemistry. This was also coupled with the move to the new Mallinckrodt Laboratory from the cramped confines of Boylston Hall. He was also able to purchase his first house on the same



T. W. Richards with students and colleagues on the steps of Gibbs Hall; Conant in top row, second from right, ca 1921

street as the new laboratory. This year also coincided with the publication of the first edition of his undergraduate textbook, *Organic Chemistry: A Brief Introduction*, which went through several editions (41). A more detailed text, *The Chemistry of Organic Compounds: a Year's Course in Organic Chemistry*, was published in 1933. In 1931 Conant was appointed chairman of the chemistry department, a position that had also been held by his father-in law T. W. Richards.

Conant's comfortable world was irrevocably changed when President Abbot Lawrence Lowell announced his resignation on November 21, 1932, effective at the end of the academic year. Lowell, president since 1909, was a man of a deeply conservative nature. According to younger faculty such as Conant, Lowell had presided over the gradual decay of Harvard as a first class institution devoted to learning and research in favor of preserving Harvard as a bastion for the elite of America. The naming of a new president was the province of the six members of the Harvard Corporation, all considered being very much in favor of the *status quo*. It was generally believed that the choice would be someone with the breeding and refinement of Lowell and his predecessor, Charles William Eliot (42).

The Corporation proceeded to solicit names of candidates and discuss these with members of the faculty and among themselves for several months. Conant was well known as a first rate organic chemist and a man of forward thinking ideas of reform on campus; but he was completely unknown to the world outside of Harvard Yard. Having no interest in the office and having achieved his position based upon merit, he was quite blunt and direct as to the problems he saw at Harvard when interviewed by the members of the Corporation. As the selection process continued and many names were dropped from consideration, Conant began to appear on the lists of the Corporation members. The final choices were narrowed to two: Conant and Elihu Root, Jr., a New York lawyer, whose father had been both Secretary of State (T. Roosevelt) and War (McKinley). The need for reform was felt to outweigh any other considerations and Conant was offered the presidency on April 24, 1933. Conant was torn between his desire to remain in chemistry and to accept this new challenge. He felt that if he declined and Root were made president, a nonscholar would be in charge; and the chance to reverse the decline in Harvard's fortunes would be lost.

Conant was not a popular choice to many inside and outside of Harvard. Typical is this conversation between Alfred North Whitehead and a colleague (5):

> "The Corporation should have not elected a chemist to the Presidency"…."But Elliot was a chemist and our best president," his colleague replied…"I know," replied Whitehead, "but Eliot (41) was a bad chemist."

Whitehead was certainly proven wrong, for Conant was not only a very good chemist but was an outstanding president.

James Bryant Conant's brief career as a research chemist lasted only from 1919-1933. In view of the level of his accomplishments, this is truly remarkable. He was instrumental in the development of American physical organic chemistry, making contributions in such diverse fields as superacidity, the quantitative measurement of very weak acidity, the theory of nonaqueous solutions, kinetic versus thermodynamic control of reactions, free radicals, reaction mechanisms, and effect of high pressure on organic reactions. His pioneering work in the biochemical area involving hemoglobin and chlorophyll showed that an important function of organic chemistry in the future would lie in its application in the biochemical arena. Although Conant's active chemical career ended in 1933 (his last research publications date from 1934), his influence remained alive through his many students and admirers, who expanded upon the work he had begun.

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6. J. B. Conant, *Tuxedo Park: A Wall Street Tycoon and the Secret Palace of Science That Changed the Course of World War II*, Simon & Schuster, New York, 2002.
7. JBC was the trustee for his father's estate and in the Conant archives exists a financial statement dated October 3, 1927, which shows the value of the estate to be $116,900. Of this 71% was invested in stocks and the balance in bonds. Conant Archives, Harvard University, Box 138.
8. One of the hallmarks of Conant's presidency was the attempt on his part to open the admissions process to a much broader group of students from various ethnic, geographical, and socio-economic levels. Admission should be on the basis of merit rather then family background and connections. Conant was instrumental in the establishment of the Scholastic Aptitude Test as a means of achieving his goal of a meritocracy in higher education. He also instituted strict rules on the granting of tenure based upon scholarly achievements rather then on having the right background.
9. F. W. Jarvis, *Scola Illustris, The Roxbury Latin School 1645-1995*, Godine, Boston, 1995.
10. For a brief biography of Black see: R. W. Hickman, E. C. Kemble, and E.M. Purcell, "Newton Henry Black," *Harvard University Gazette*, December 1, 1962, 73-74.
11. For a biography of Richards see: S. J. Kopperl, "Theodore Richards," *Dictionary of Scientific Biography*, Charles Scribner's Sons, New York, **1975**, 11, 416-418. For a discussion of Richard's chemical philosophy see: H. Gay, "The Chemical Philosophy of Theodore Richards," *Ambix*, **1997**, *44*, 19-37.
12. For a study of the development of physical chemistry in the United States see J. W. Servos, *Physical Chemistry from Ostwald to Pauling, The Making of a Science in America*, Princeton University Press, Princeton, NJ, 1990.
13. For a biography of Kohler see: J. B. Conant, "Elmer Peter Kohler," *Biog. Mem. Natl. Acad. Sci. USA*, **1952**, *27*, 264-291.
14. T. W. Richards and J. B. Conant, "The Electrochemical Behavior of Liquid Metal Amalgams," *J. Am. Chem. Soc.*, **1922**, *44*, 601-11.
15. E. P. Kohler and J. B. Conant, "Studies in the Cyclopropane Series," *J. Am. Chem. Soc.*, **1917**, *39*, 1404-20, 1699-1715.
16. M. D. Saltzman, "The Development of Physical Organic Chemistry in the United States and the United Kingdom: 1919-1939, Parallels and Contrasts," *J. Chem. Educ.*, **1986**, *63*, 588-593.
17. J. B. Conant, *25th Anniversary Report, Harvard University*, Cambridge, MA, **1939,** 164-166.
18. Details concerning the chemical ventures of Conant and his partners can be found in Box 137 of the Conant papers.
19. D. S. Tarbell and A. T. Tarbell, *Roger Adams: Scientist and Statesman*, American Chemical Society, Washington, D.C., **1981**.
20. J. B. Conant to G. Kelley, March 26, 1917, Conant Archives, Box 121.
21. W. C. Greer to J. B. Conant, December 23, 1918, Conant Archives, Box 121.
22. J. B. Stieglitz to J. B. Conant, February 19, 1919, Conant Archives, Box 121.
23. R. Adams to J. B. Conant, February 3, 1919, Conant Archives, Box 121.
24. A notebook containing Conant's observations during this trip can be found in the Conant Archives, Box 19. There is an interesting comment that when JBC spoke to Lowry, the latter had spoken very highly of K .J. P. Orton "..in South Wales as being the foremost organic chemist interested in such problems as the speed of reactions." Orton was relatively unknown at this time but would play an important role in the development of British

physical organic chemistry. There is also a brief mention of having met with Ingold in Thorpe's laboratory at Imperial College.

25. J. B. Conant and L. F. Fieser, "Free and Total Energy Changes in the Reduction of Quinones," *J. Am. Chem. Soc.*, **1922**, 44, 2480-2493; J. B. Conant and L.F. Fieser, "Reduction Potentials of Quinones. I," *J. Am. Chem. Soc.*, **1923,** *45*, 2194-2218; II, **1924,** *4*6, 1858-1881**.**
26. This new approach to the integration of physical and organic chemistry, especially to biological chemistry, would lead to the major awards to Conant, including the Chandler Medal(1931), Nichols Medal (1932), American Institute of Chemists Award (1934), and the Priestley Medal (1944).
27. J. B. Conant *et al.*, "Relation Between Structure of Organic Halides and the Speed of Their Reaction with Inorganic Iodides. I," *J. Am. Chem. Soc.*,**1924**, *46*, 232-252; II, **1925**, *47*, 476-478; III, 488-501.
28. J. B. Conant and L. F. Fieser, "Methemoglobin," *J. Biol. Chem.*, **1925**, *62*, 595-622.
29. J. B. Conant and L. F. Fieser, "A Method for Determining Methemoglobin in the Presence of its Cleavage Products," *J. Biol. Chem.*, **1925**, *62*, 623-631.
30. R. Adams to J. B. Conant, February 3, 1919, Conant Archives, Box 122.
31. Conant Archives, Box 17. It is interesting to note that both Conant and his wife were surprised by the depth of resentment and anger in Germany resulting from the Treaty of Versailles and the reparations demanded in the postwar period. It was evident to Conant that already scapegoats were being sought: *i.e*. Jews, Socialists, and Communists, for Germany's loss and humiliation. JBC arrived in Munich in 1925, only two years after Hitler's failed beer hall Putsch of 1923.
32. For a biography of Noyes see L. Pauling, "Arthur Amos Noyes," *Biog. Mem. Natl. Acad. Sci. USA*, **1958**, *31*, 322-346. For Noyes and Caltech see: J. Servos, "The Knowledge Corporation: Chemistry at Caltech," *Ambix*, **1976**, 186-203.
33. J. B. Conant to G. N. Lewis, March 31, 1924, November 19, 1924, April 8, 1925, Lewis Archives, Bancroft Library, University of California, Berkeley, CA. Conant thought so highly of Lewis that he wrote on May 10, 1928 asking him whether he would accept the position as Richard's successor. "We all feel that Harvard needs you, that the east coast as well as the west should have the benefit of your influence…"
34. J. B. Conant, "Notes on Writing an Autobiography, Memorandum I, Teaching and Research in the 1920s," May 22, 1969, ConantArchives, Box 11.
35. J. B. Conant to A. A. Noyes, January 3, 1927, Conant Archives, Box 122
36. C. H. Moore to J. B. Conant, May 27, 1927, Conant Archives, Box 140
37. Conant usually had three to four post-doctorals in the years 1928-1933, and we have an idea of the conditions of employment from an offer he made in 1931 to Fritz Dersch, a student of Ziegler at Heidelberg. "The position I am offering you is that of a research assistant, and has no official title or status in the University. The period of work is from October 1 until August 20: that is, for one year less six weeks vacation. Except for a few days at Christmas time, the assistant is expected to work continuously for 5 1/2 days per week." The salary offered was $2,500; Conant Archives, Box 138.
38. The following texts were consulted and the number of citations to Conant's papers prior to 1927 and after 1927 is shown in parenthesis. E. R. Alexander, *Ionic Organic Reactions*, **1950** (0,3); G. W. Wheland, *Theory of Resonance*, **1944** (0,6); G. W. Wheland, *Advanced Organic Chemistry*, **1960** (1,5); W. A. Waters and T. M. Lowry, *Physical Aspects of Organic Chemistry*, **1937** (1,3); L. P. Hammett, *Physical Organic Chemistry*, **1940** (2,2).
39. For a discussion of the scope of the research from this period see Ref. 1, 3, and 4.
40. In 1920 Conant was the co-author with his former mentor Newton Black of a text for high school students: N. H. Black and J. B. Conant, *Practical Chemistry, Fundamental Facts and Applications to Modern Life*, Macmillan, New York, 1920. The two organic texts are: J. B. Conant, *Organic Chemistry: A Brief Course*, Macmillan, New York, 1928, and J. B. Conant, *The Chemistry of Organic Compounds; a Year's Course in Organic Chemistry*, Macmillan, New York, 1933. The latter organic textbook remained in print for several decades, the 1959 edition being the last. When Conant became president of Harvard in 1933, he left the revisions to two of his former post-doctoral students, A. H. Blatt and Max Tischler. Blatt remained a continual collaborator whereas Tischler, who had gone to work at Merck, dropped out. Blatt's name appears as a co-author in the 1947, 1950, and 1959 editions. The 1928 text was extremely popular and adopted by 75 colleges and universities. The royalties from this one book alone accruing to Conant were $3,335.18 in 1929, $4,425.56 in 1930, $3,368.58 in 1931, and $2,989.90 in 1932. These royalty statements from Macmillan can be found in Box 140 of the Conant Archives. Conant also held a consulting position with DuPont that he began in 1929 with a fee of $300 per month. The contract for his services can be found in Box 138.
41. Charles William Eliot (1834-1924) entered Harvard in 1849 and studied chemistry and mineralogy with Josiah Parsons Cooke. He became intrigued by the scientific method and used it as the basis for all his future endeavors. In 1854 he was appointed to the position of tutor in mathematics, and in 1858 he became an assistant professor of mathematics and chemistry in the Lawrence Scientific School. He early showed abilities in both teaching and administration and did some original research with fellow chemist Frank Storer. When he failed to be promoted to the rank of professor in 1863,

he left Harvard and went to study in France and Germany. In 1865 he returned to America and accepted a position at the newly opened Massachusetts Institute of Technology, where he stayed until elected president of Harvard in 1869. For a biography of Eliot see P. A. Hutcheson, "Charles William Eliot," *American National Biography*, Oxford University Press, New York and Oxford, 1999**,** Vol. 7, 394-397.

## ABOUT THE AUTHOR

Martin D. Saltzman is Professor of Natural Science at Providence College, Providence, RI 02918.

## FUTURE ACS MEETINGS

**March 28-April 1,** 2004**—Anaheim, CA**

**August 22-26,** 2004**—Philadelphia, PA**

**March 13-17,** 2005**—San Diego, CA**

**August 28-September 1,** 2005**—Washington, DC**

**March 26-30,** 2006**—Atlanta, GA**

**September 10-14, 2006—San Francisco, CA**

**March 25-29,** 2007**—Chicago, IL**

**August 19-23,** 2007**—Boston, MA**

**April 6-10,** 2008**—San Antonio, TX**

**August 17-22,** 2008**—Philadelphia, PA**

**March 22-26,** 2009**—Salt Lake City, UT**

**August 16-21,** 2009**—Washington, DC**

**March 21-26,** 2010**—San Francisco, CA**

**August 22-27,** 2010**—New York, NY**

**March 27-31,** 2011**—Anaheim, CA**

**August 28-September 1,** 2011**—Chicago, IL**

**March 25-29,** 2012**—San Diego, CA**

**August 19-23,** 2012**—Boston, MA**