EDWARD KREMERS (1865-1941)

REFORMER OF AMERICAN PHARMACEUTICAL EDUCATION

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I. THE PRELIMINARY STAGE

The word "reformer" has, objectively as well as subjectively, a disquieting connotation. It presupposes an individual dissatisfied with the status quo, who takes issue with conveniences and tacit allowances, who is moving faster than the majority of his contemporaries and sees realities which to them still seem to be dreams, fanciful or even dangerous.

To be a "reformer" means to ask for a fight. There are those who know this fact and try to circumvent it or at least to diminish its tempo and temper. To these born statesmen a compromise is a desirable success which may be used as a stepping stone for further accomplishment. To bribe people into their fold by flattery or persuasion is to them perfectly legitimate. There are others who, knowingly or otherwise, take pleasure in fighting. To these born fighters combat is wonderful and almost an end in itself and compromise, however promising, a despicable disgrace. Hesitant people are not to be persuaded but driven into the fold by thunderous reproach.

The statesmen present suggestions taking as little personal risk as possible. The fighters set an example taking every risk possible. The reformer Edward Kremers belonged to the second, the fighter category.

The last third of the nineteenth century saw a remarkable change in the educational ideas and methods in the United States of America. It was political (and politico-ideological) not intellectual independence from Great Britain that had been achieved as the fruit of the Revolutionary War at the end of the eighteenth century. There had been some sprinkling of French influence in letters as well as in science. On the whole, how-
ever, for more than a century the educational system, spirit and results, had been definitely Anglo-Saxon in character.

But now the great-grandchildren of the men of Bunker Hill and the grandchildren of the French refugees from 1789 to 1815 had been joined in great numbers by the children of the German liberals coming to this country about 1848 and after. Moreover, one of the miraculous constellations for which historians heap up reasons without ever finding a patent explanation had just now made Germany the leader in scientific education and research. Thus it was German trends and influence that played an important part in the educational renaissance taking place in the United States after the Civil War. “The leaders of American education in the post-Civil War period were for the most part German-trained; the universities of Göttingen, Jena and Berlin were particularly influential.”

Edward Kremers was as “German-trained” as a native American possibly could be. He was born on February 23, 1865 in the most German community within the United States, Milwaukee, as the scion of a German immigrant family that clung to the cultural traditions of the “fatherland” with all the tenacity of this idealistic generation of refugees who emphatically tried to create and set an example for a synthesis of what they esteemed most, both in the countries of their birth and their choice. About his Milwaukee schooltime Kremers reports: “there were in my class two or at the most three children who did not participate in the instruction in German, i.e., were of English descent.” His high-school training he received in the “Missionhouse” in Herman township, Wisconsin, a German theological institution devoted especially to the education of ministers of the Reformed faith.

Thus prepared, the young man entered in his home town a professional activity which in its specific form even in the old country has always belonged to the most typical German institutions, a pharmacy “equipped and conducted exclusively according to German concept” and even called by its German-born

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2 Badger Pharmacist, 1936. No. 8, 10.
3 Louis Lotz (1843–1923). Autobiographical notes in the manuscript files of the American Institute of the History of Pharmacy.
This picture of Dr. Edward Kremers was taken on the occasion of the Convention of the American Medical Association, held at Milwaukee in June, 1933. It shows him amidst an exhibition of pharmacopeias. The pictures on the wall, from left to right, represent Thomas F. Wood (1838-1892), C. Lewis Diehl (1840-1917), and Lyman Spalding (1775-1821).
owner, Louis Lotz, with its German name Apotheke. A former student of Liebig (chemistry), Jolly (physics), Radlikofer (botany) and Buchner (pharmacognosy), Lotz had passed his pharmaceutical examination at the University of Munich with the best possible marks. Besides, he was a man of high general culture quoting in his instructions to his apprentices not only scientific authors but also the great German poets.

The idea of pharmacy as applied science and not as a business requiring the more or less disconnected knowledge of some scientific details, was inculcated on young Edward by Louis Lotz. The aging German apothecary imbued the young American furthermore with the doctrine that there has to be an educational balance between science proper and the humanities which, without interfering with the necessary specialization in the one field or the other, marks the well-educated man and maintains the unity of the world of culture. The certificate which the apothecary Lotz in the city of Milwaukee handed Edward Kremers at the end of the latter’s apprenticeship (reduced from three to two years because of the special merits of the unusual apprentice) is written in German. It could have been a copy of the certificate which Lotz himself received in 1862 from the apothecary August Halberstadt in Camberg in the grandduchy Nassau.

It is significant that the only attempt ever made by Edward Kremers at staying for a longer period of time in another part of the United States than in the Middle West, in particular Wisconsin, proved to be a failure. After having attended the junior course in the Philadelphia College of Pharmacy during the fall and winter 1884–85, he returned to Wisconsin in order to continue his studies at the university of his home state where a Department of Pharmacy had been established scarcely two years previously.

There were three men who in the formative period of his life gave Edward Kremers the incentives and the opportunities which he needed. The one was the apothecary Louis Lotz mentioned above. The second was the Anglo-American Frederick B. Power, one of the great American scientists who came from

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*Owner of a professional pharmacy in Milwaukee for half a century, archeologist, and mineralogist.
*Frederick B. Power (1853–1927), organizer and first head of the Department of Pharmacy of the University of Wisconsin, member of the National Academy of Science. He attained international renown as director of the Wellcome Research Laboratories in London, especially by his studies of chaumooogric and hydnocarpic acids which proved to be of scientific as well as therapeutic importance.
the ranks of pharmacy and Kremers’ teacher as well as predecessor in the capacity as head of the Department of Pharmacy of the University of Wisconsin. The third was the pharmaceutical scientist, author and journalist Frederick Hoffmann who, like Lotz German-born and educated, not only was an excellent analytical chemist but wielded one of the most analytical pens ever employed in American pharmaceutical journalism. All three men had studied at German universities, at Munich (Lotz), at Strassburg—German from 1871–1918—(Power) and Berlin (Hoffmann).

Lotz was a German romanticist to whom, irrespective of his strong scientific ambitions, general cultural ideas and ideals were of first importance. Power was an Anglo-American pragmatical classicist to whom, irrespective of his strong cultural ambitions, science and scientific achievements were of first importance. Hoffmann was a German intellectualist of the militant preceptor type using as his yardstick the cultural German situation as it was when he left his home country in 1862, guided by distance and his need of justification for his assumed role of praeceptor pharmaciae Americanae. It was in Hoffmann’s Pharmaceutische Rundscha that Kremers, in 1887, published his first scientific report to appear in a periodical. Although it was a German-language paper and Kremers mastered German with the same perfection as English, the article was written in the latter in spite of or perhaps even because of the editor’s persuasive invitation to write in German. To whatever extent the young man may have felt proud of his descent and what he may have thought to be its cultural advantages, he apparently refused to be regarded (and to regard himself) as anything else but American.

Already one year earlier, in 1886, the name Edward Kremers had appeared before the pharmaceutical world. It was in the Contributions from the Department of Pharmacy of the University of Wisconsin No. II that Kremers’ Pharmaceutical Graduate (Ph. G.) thesis on Fraxinus Americanus was published. After his graduation the young man continued work at the School and acted as Professor Power’s assistant during the col-

*Frederick Hoffmann (1832–1904), owner of a New York pharmacy, editor of a New York pharmaceutical German-language journal, analytical chemist. His “Manual of Chemical Analysis as Applied to the Examination of Medical Chemicals” lived to see several editions.
leggiate year 1886–87. In this year he published the results of not less than four different investigations. With two of them he entered the field in which he was to become an internationally recognized authority, that of the examination of volatile oils. They brought him simultaneously his first public distinction, the Ebert prize of the American Pharmaceutical Association for the year 1887.

In the fall of 1887 Kremers matriculated again as an undergraduate, this time in the General Science Course of the University of Wisconsin, and in 1888 he graduated as Bachelor of Science. As he states in one of his many autobiographical notes, it was his "self esteem" which caused the young pharmacist to make himself "the equal" of the non-pharmaceutical students on the campus who looked down on the "pharmics" with practically no entrance requirements and with only four terms out of twelve of the undergraduate quadrennium. This confession is of highest psychological importance. It offers the cue to the special direction of the later activities of the reformer Kremers, to the missionary zeal with which he tried to make pharmacy, first and above all, the "equal" of the other professions requiring an academic study.

In the late summer of 1888 the young man made his great trip over the ocean, and in the fall of that year he matriculated at the University of Bonn, Germany. It was, however, not a certain university, it was a certain man to whom his pilgrimage was directed. This man was Otto Wallach,7 the so-called "Messiah of the Terpenes." "I was drawn to the master," writes Kremers, "by his earliest contributions in the Annalen [Liebig's Annalen der Chemie] of the early eighties while I was working in the laboratory of Professor Power on the volatile oils of pennyroyal and citronella. Though a mere tyro in the field, I recognized instinctively the accomplishments of the master."8 Naturally, Kremers also took advantage of the presence of other famous scientists on the teaching staff of the University of Bonn and attended with special pleasure and profit the lectures of the theoretical chemist Kekulé.9 When, however, his master Wallach in 1889 accepted a call to Göttingen as successor to Victor

7 Otto Wallach (1847–1931). His experimental work and the theoretical conclusions drawn from it opened a new era in the chemistry of terpenes and essential oils and influenced general structural chemistry.
9 F. A. Kekulé von Stradenitz (1829–1896), creator of the benzene ring theory.
Meyer,¹⁰ Kremers followed him. He was rewarded not only by his unusually successful work with Wallach, but by the unexpected opportunity of being introduced into a then new branch of science, physical chemistry, by a young man who was to become one of the great physicists of our time, Walter Nernst.¹¹

It is a remarkable proof of the ability of the young American student, as well as of the knowledge acquired by him previous to his study in Europe, that after scarcely two years of work with Wallach, Kremers, in 1890, took the degree of Doctor of Philosophy at the University of Göttingen. His dissertation dealt with “The Isomerism within the Terpene Group” and laid the ground for many later investigations. Kremers’ work was based on limonene nitrosochloride, limonene monohydrochloride and limonene hydrochloro-nitrosochloride and their derivatives from both dextro and laevo limonene. According to Kremers’ own statement “out of some forty odd compounds fully two-thirds were new.”

When the young American returned to his home country in the late summer of 1890, he came back with the holy zeal of a missionary. He had been an active and efficient part of a well-organized and highly esteemed world of science in which his own profession, pharmacy, had its place and was given its opportunity, and he had seen professional pharmacy practiced as a rule and not as an exception. Even there he had found much that, in his opinion, was in need of reform. All the more reason to change the chaotic situation in American pharmaceutical education fundamentally, using the German pattern but by no means adopting it.

A quite unusual stroke of luck gave the young man his opportunity when all his irons still were hot. In the fall of 1890 he had become an instructor of pharmacy at the University of Wisconsin (and Assistant to Professor Power) with an annual salary of $600.00. Soon the laboratory instruction, the experimental as well as the theoretical, was turned over completely to Kremers—the University Catalogue for 1890–1891 lists him as “Instructor in Pharmacy and Director of the Pharmaceutical Laboratory”—and his salary was doubled. Hardly another year

¹⁰ Victor Meyer (1848–1897), known especially for his researches leading to the thiopene series.
¹¹ Walter Nernst (1864—__) became especially known for his studies on electricity (Nernst’s electric lamp).
later, in spring 1892, the unexpected happened. Professor Power decided to leave Madison in particular and teaching pharmacy in general for a position in industry, and it was with almost automatic self-evidence that Kremers succeeded him. At the age of twenty-seven years a young idealist found himself in a position offering unusual, almost dazzling potentialities. If he should decide to go farther than Professor Prescott at Ann Arbor,\(^\text{12}\) the man who had served in a considerable degree as a model to Professor Power, there was no precedent to be followed. His was the full sensation of the decision, the full sweetness of satisfaction if he succeeded, the full bitterness of disappointment if he failed. Sure, there was the administration of the University of Wisconsin, the President and the Regents whose permission had to be asked for. There were the druggists of Wisconsin on whose initiative the Department of Pharmacy was created and who, through their association, patronized as well as supervised it. But he, young Edward Kremers, was after all the only one on the campus and in the State and, may be, even in the nation, who had some definite idea about a reform in pharmaceutical education, its ways and aims. There was no doubt in his mind, he would be allowed to make a start for there was nobody except himself who really knew what he was after and what it would lead to. As a matter of fact, Kremers had already begun his work of reform during his instructorship.

II. A REFORMER AT WORK

a. The Background

What was the situation in American pharmaceutical education about 1890? It has to be borne in mind that it was not until 1904 that one state, New York, made graduation from a School of Pharmacy the legal prerequisite for the State Board examination which had to be passed by all applicants for registration as licensed pharmacists, and that this example was followed only very slowly.\(^\text{13}\) Until 1890 there were still fifteen states without a pharmacy law, hence without a pharmaceutical

\(^\text{12}\) Alfred B. Prescott (1832–1905). Without any drug store experience the physician Prescott became closely connected with American pharmacy and as the Dean of the University of Michigan School of Pharmacy one of the most progressive pharmaceutical teachers in this country. He was author of several textbooks.

\(^\text{13}\) At the time being there are still two states, Nevada and Vermont, and one Territory, Alaska, without the requirement of college graduation for pharmaceutical licensure.
licensing board and examination. It is understood that under such conditions the number of students of pharmacy was bound to be small. Of the 34,886 American drugstore owners counted in 1892 only about ten percent had attended a School of Pharmacy, and even of this number "only a few were prepared for a profound study of the sciences of pharmacy." The apprentice system still dominated the pharmaceutical scene and the older colleges, all of them private institutions established mostly by local druggists or druggist associations, were intended to supplement the training and experience received in "the store" rather than to furnish scientifically educated pharmacists. There were no educational prerequisite requirements, or at best very modest ones, until the beginning of the twentieth century. A person with only a grammar school education or even less could enter most of the colleges of pharmacy in the United States. Evening courses were the rule, and laboratory work was offered only in exceptional cases.

Kremers was by no means the first one to attempt a change of this situation and the idea underlying it. The first step forward was taken, when an American state university, Michigan, in 1867, made the academic education of pharmacists a part of its tasks, and the Dean of this New School of Pharmacy, Albert B. Prescott, ignored the traditional apprenticeship as an obligatory preliminary to pharmaceutical college education not only for admission but even for graduation. It was but natural that he was outlawed for this sacrilege by the leaders of what was then official American pharmacy. Prescott furthermore replaced at Ann Arbor the evening courses of the old-line colleges by a balanced combination of laboratory work and lectures during the day demanding practically the entire time of the student for two academic years. When the second American State University School of Pharmacy, that of Wisconsin, was established in 1883, the man who was to become its leader, Professor Power,

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14 E. Kremers, 1893, Pharm. Rundschau, 11:76.
15 At the St. Louis meeting of the American Pharmaceutical Association in 1871 the (School of Pharmacy of the) University of Michigan was denied the recognition of being "within the proper meaning of our [the association's] Constitution and By-laws, a College of Pharmacy: it being neither an organization controlled by pharmacists, nor an institution of learning which, by its rules and requirements, insures to its graduates the proper practical training, to place them on a par with the graduates of the several colleges of pharmacy represented in this Association." Proc. Amer. Pharm. Assoc., 19:1871, 47.
visited at Ann Arbor and "received much encouragement and valuable suggestions from Professor Prescott."

There was, however, one fundamental difference between the origin of the Michigan and the Wisconsin School of Pharmacy. The former was started without the cooperation of the local pharmacists, hence was not obligated to any kind of compromise, while the latter, being the child of the druggists of the State, was to a great extent responsible to them. Kremers describes the course in pharmacy offered by Professor Power at the University of Wisconsin in 1883 as "a compromise between the old and new with strong leanings to the old," and states that "it was not until ten years later," i.e., under his, Kremers', leadership "that changes were made which placed the Wisconsin course on a footing similar to that of Michigan." In one respect, however, Power from the very beginning of his activity at the University of Wisconsin vied successfully with Michigan: in the spirit of research, work which at that time was scarcely in existence at other American Schools of Pharmacy and even very rare in the other departments of American universities.

"In this," says Kremers, "he [Power] was far ahead of most of his colleagues in other departments of the University. Long before graduation theses were required in the College of Letters and Science, they were insisted upon in Pharmacy. What is more, these theses were not essays copied from encyclopedias and textbooks, but were based on laboratory experimentation." This statement found an authoritative confirmation when, on the occasion of the conferring of the honorary degree of Doctor of Laws upon Frederick B. Power by the University of Wisconsin on June 17, 1908, President Van Hise said: "The value of your services here were greatly enhanced by scientific research at a time when this aspect of university activity was in its infancy."

The question may well be asked, what, after such beginnings and examples, were the reformation due to Kremers which made him the foremost figure in the fight for adequate pharmaceutical education in the United States of America. The answer

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28 The Badger Pharmacist, 1900, 113.
28 Ibid.
29 Pharm. Review, 26:1908, 192a.
is that of the three men in question, Prescott, Power and Kremers, only the latter felt himself actually a pharmacist and was prepared for fight by inclination as well as by professional pride. He alone saw in the leadership of a School of Pharmacy not only a locally restricted task to be taken care of to the best of his ability, but a mission in the service of American pharmacy and, through it, of American society on the whole. Prescott, after his rebuke by American pharmacists in 1871, withdrew for a while, until a changed time asked for his cooperation, from the public pharmaceutical arena devoting himself to his School and the pharmaceutical affairs of his home state only. Power, after nine years at Madison and just when the development had reached a critical point, left educational pharmacy for scientific work in the pharmaceutical industry. Kremers did not make any attempt to evade the issue in the one or the other way. On the contrary, he invited fight by fearless and sometimes even aggressive presentation of his views.

b. The Four Years’ Course in Pharmacy

As pointed out above, Kremers had already begun his work of reform while still an instructor. During the winter term he gave a preparatory “review of pharmaceutical chemistry” of three lectures weekly. The outline of this course as published in the Catalogue of the University of Wisconsin for 1890–1891 reads as follows: “The subjects may be taken from inorganic or organic chemistry. Facts of pharmaceutical interest will be chiefly dwelt upon. These, however, will be viewed in the light of general and theoretical history. The end to be attained is to lead the student to think and reason for himself in order to better prepare him for the original investigations connected with his thesis work.”

Here the entire educational program of Edward Kremers is given in a nutshell. Understanding instead of memorizing was the goal. Everything else was only a more or less elaborate means of achieving this aim. That the end was to be attained in employing historical views was another novelty not only in American pharmaceutical education but in scientific education in this country at large.

The young instructor was especially proud of the fact that a number of students had remained at the University during the
spring term of 1892 and continued to work with him voluntarily. This encouraged him, when he had taken the chair of Professor Power, to lengthen the Course in Pharmacy from two years of two terms to two full academic years of three terms each. While the title of his predecessor had been “Professor of Pharmacy and Materia Medica,” Kremers’ title as given in the University Catalogue 1891–1892 reads “Professor of Pharmaceutical and Pharmacognostical Chemistry.” This change was a very deliberate one. It meant a program, a new departure in American pharmaceutical education following resolutely and even expanding the pattern set by Professor Prescott at Ann Arbor.

It was evidently when Kremers still acted ad interim, during the spring term of the academic year 1892, that the changes referred to were decided upon, and it was still before he definitely started his new office in the fall of 1892 that he let the American pharmaceutical world know who and what was coming. On June 6 of this memorable year Edward Kremers married Laura Haase of Milwaukee and in July he attended with her the annual meeting of the American Pharmaceutical Association held at the Profile House, in the White Mountains, New Hampshire. It was the first time that the young man had appeared before this forum. But he certainly made his debut impressive. He presented one paper entitled “The Menthol Group,” reporting highly successful scientific (phytochemical) research, another one dealing with queries published in earlier volumes of the Proceedings of the Association and not yet answered, and finally “Notes on Pharmaceutical Education” which, in tone and contents, was a challenge to the generally accepted concepts and was recognized as such. The three papers together cover twenty-eight printed pages in the Proceedings of the Association for 1892 (vol. 40). Not less than six pages in small type are devoted to the discussion of Kremers’ views on education.

In his “Notes on Queries” Kremers criticized severely the American pharmaceutical journals. Stating that “the very existence of the customary queries is a confession of poverty of thought and observation in the ranks of the pharmaceutical profession,” he assured his audience that, to use his own words, “I shall do as much as is in my power to oppose them, at least in their present form.”20 In his “Notes on Pharmaceutical Educa-

tion" the young debutant wholly discarded the customary way of subdividing the subject-matter to be taught at the American colleges of pharmacy and stressed something hitherto unheard of in American pharmaceutical education, the necessity of humanizing the technical sciences. "The professional student," he said, "should at least have a fair knowledge of the history of his profession. If philosophy makes the natural sciences interesting, history lends them a peculiar charm. Both, I dare say, are equally important in the symmetric development of a scholar." 21 Finally he ventured the opinion that "medical materia medica receives an undue share of attention in the pharmaceutical schools" due to the fact that a majority of the then teachers at these schools were M. D.'s. 22

No less a person than Henry H. Rusby 23 called Kremers' Notes on Pharmaceutical Education "a very learned paper, and one which will rank among the historical brochures of this Association." 24 But he was opposed to the statements as well as to the conclusions of the speaker and so were most of the others taking part in the discussion. Joseph P. Remington, 25 the foremost representative of the private schools and then-President of the American Pharmaceutical Association, expressed certainly the opinion of the majority of the pharmacy teachers present; when he charged that "Professor Kremers has considered the subject of materia medica without also thoroughly taking into consideration the needs of the institution." 26 The head of the Wisconsin delegation to the 1892 meeting of the American Pharmaceutical Association, Mr. John A. Dadd, 27 was undoubtedly right in stating in his report that the paper on pharmaceutical education read by Professor Kremers had caused

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21 Ibid. 316.
22 Ibid. 310.
23 Henry H. Rusby (1855–1940), M. D., botanist and pharmacognosist, botanical explorer and author, professor at the New York College of Pharmacy.
25 Joseph P. Remington (1847–1918), professor in the Philadelphia College of Pharmacy (1874) and its Dean (1893), author of a most successful American pharmaceutical textbook, one of the most influential men in American contemporary pharmacy.
27 John A. Dadd (1829–1895), English-born Milwaukee druggist, first president of the Wisconsin Pharmaceutical Association, one term vice-president of the American Pharmaceutical Association, one of the fathers of early Wisconsin pharmaceutical legislation and education.
"much comment and discussion, the views expressed being much at variance with existing conditions." 28

This experience of seeing his ideas refused and misunderstood, and as he was inclined to think partly even deliberately, had by no means a discouraging effect on the young reformer. He had seen that the same people who had answered his suggestions with a more or less disguised "crucifige!" had welcomed with "hosannah!" and as an extremely progressive step the suggestion of Professor W. Simon 29 of a "three-years' course in colleges of pharmacy." Supposed to consist of "three sessions (of six months each)." 30 Simon's course was to cover exactly the same time of study, i.e., eighteen months, as the two full academic years which Kremers just had introduced as the pharmaceutical minimum course at the University of Wisconsin. Furthermore, the only practical argument advanced against his suggestions had been the allusion by Professor R. G. Eccles 31 to "the brevity of time that is allotted" for the study of pharmacy. "It is simply the fable of Aesop of the boy and the nuts," Eccles had said. "The boy putting his hand into the narrow necked jar to pull out the nuts, fills his hands too full and gets none at all." 32

As Kremers apparently saw it, there were two steps to be taken: 1. The eighteen months' course, welcomed as an aim to be approached by the recognized leaders in pharmaceutical education and just realized at Wisconsin, had to be built up as a more or less strictly pharmaceutical course, complete and satisfactory as possible; 2. In order to counteract the idea that this eighteen months' course was the ultimate educational end of American pharmacy, another course had to be offered, aiming at a general education with pharmacy as its main but by no means only objective. Kremers took both steps immediately. He had hardly returned from his trip to the East, his honeymoon and his first crossing of swords in his lifelong fight for progress in education, when he initiated what proved to be the second milestone in American pharmaceutical education after Prescott's emanci-

29 William Simon (1844-1916), German-born pharmacist, professor of chemistry at the Maryland College of Pharmacy and the Baltimore Colleges of Physicians and Surgeons and of Dental Surgery, author of a well-known textbook.
31 Robert G. Eccles (1847-1934), Scotch-born M. D. and Ph. G., research and sometime government chemist, professor in the Brooklyn College of Pharmacy, author, editor of Merck's Archives.
pation of the academic teaching in pharmacy from "the store" program: the first academic four-years' course in pharmacy on American soil, and the first course of this kind in the whole world.

In announcing the extension of the University of Wisconsin Course in Pharmacy to two full academic years, Kremers in a "general statement" in the Catalogue of the University 1891–1892 says that "the addition of two terms admits of remodeling of the fundamental studies and of a closer adjustment of the studies to those of the General Science Course. (The italics here and in the paragraphs that follow are the writer's.) In the Catalogue of 1893–1894 he triumphantly tells of a "decided improvement" in this eighteen-months' course which was to meet the first goal of his program. "The object of this course," he says, "has been and still is to lay as thorough a scientific foundation as time and means will permit for the pursuit of the profession of pharmacy. The elements of chemistry, botany and physics must be studied before their application to pharmacy can rationally be considered. This is as true for pharmacy as for any other applied science or art. Any other process must tend toward superficiality."

It was in the University Catalogue issued between the two quoted above, i.e., that for 1892–1895, that the establishment of a four-years' course in pharmacy was announced giving the pharmacy students the possibility of a complete instead of merely "a closer" adjustment to the General Science Course. "This longer course," reads the Catalogue, "was created in order to accommodate those students who desire to obtain a general scientific education and to include in their course the pharmaceutical studies; and with the hope of stimulating a broader pharmaceutical education." In later years Kremers frequently stated that to him in 1892 the contents of the four-years' course in pharmacy, although he took them very seriously, were of little significance as compared with the fundamental idea of placing the pharmaceutical course on a par with the other courses on the University campus. It was for the same reason that from the very beginning the course was open to high-school graduates only. When the President of the University, Dr. Chamberlin, before giving his consent to the planned innovation, asked Kremers how many students he expected in the proposed four-years'
course, the young reformer proudly replied: "Mr. President, I am not concerned with numbers, but with an ideal."

Like everyone fighting for an ideal, Kremers did not immediately find complete understanding and appreciation. On the contrary, he encountered plenty of difficulties within Wisconsin as well as without. At times the opposition among the Wisconsin druggists against his emphasis on scientific achievements and teaching methods was so strong that his position was in danger, and his colleagues at the other American schools of pharmacy viewed his reformatory zeal and actions with much reserve and suspicion, if not even fear and indignation, and resented heartily his continuous criticism and admonitions. At this place details would lead too far. They may be reserved for a biography of Kremers and/or a History of Pharmaceutical Education in the United States of America. Kremers himself, in an address delivered at the dedication ceremonies of the University of Maryland School of Pharmacy in 1930, describes the reaction to the establishment of a four-years' course in Pharmacy as follows:

"The new step, so far as it did not remain unnoticed, received little else than ridicule. Thus the Dean of Northwestern Oscar Oldberg\(^{35}\) who, in the name of efficiency, had concentrated the former so-called two-year course into one calendar year, suggested that someone might be crazy enough—though he did not use this word—to offer an eight-year course. This criticism amused. But it did hurt when Professor Prescott replied to a question as to what he thought of the step: 'it will do no harm.' The young innovator had looked up to his venerable colleague for encouragement and had received a shrug of the shoulder. This was in 1898. Soon thereafter,\(^{36}\) President James, then of Northwestern, left his Evanston Campus to address the pharmacy students in Chicago. He told them that every boy and girl aspiring to become a pharmacist should take a four-year course at college. It was also a few years later that Professor Prescott wrote: 'We are contemplating giving a four-year course. Upon looking over the catalogues, we find that you are already giving such a course. What has been your experience?""

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\(^{34}\) Ibid.

\(^{36}\) Oscar Oldberg (1846–1913), Swedish-born pharmacist, teacher, editor, author.

\(^{30}\) In fact it was nine years later, in 1902. Bull. Pharmacy, 1902. 16:242.
What then had been Kremers' experience? In 1896 he states that "no school or college of pharmacy in this country or in Europe can boast of such an organization" as it existed at this time at the University of Wisconsin. In 1897 he reports that "more than two thirds of the Wisconsin pharmacy students were taking courses longer than the two-years' course," and in 1897 "the school graduated five students from the four-years' course, six from the three-years' course and but two from the two-years' course."

Still more, the young reformer's bold experiment found the highest recognition possible, that of imitation, after an almost incredibly short incubation period. Kremers' reply to Prescott's inquiry caused the introduction at Ann Arbor of an analogous elective "college course of four years, leading to the Degree of Bachelor of Science in Pharmacy" in 1895 (School of Pharmacy of the University of Michigan, Announcement for 1895-96). In the same year the University of Purdue School of Pharmacy followed suit, and two other schools, established in 1895 as departments of educational state institutions, of the Alabama Polytechnic Institute and of the Maine State College of Agriculture (later University of Maine), introduced the elective four-years' course in pharmacy from the very beginning of their existence. One year later, in 1896, Louis E. Sayre, who was given the new title of a Michigan Bachelor of Science in Pharmacy as an honorary degree by Prescott, introduced the four-years' course at the School of Pharmacy of the University of Kansas.

One of the new schools, that of Maine, made the four-years' course even a kind of drawing card for itself and for the University Schools of Pharmacy in general. In its Catalogue for 1898-99 it contended incorrectly that "only three other courses of the same length and kind exist in the United States"; and in 1901 the Bulletin of the University of Maine, after having outlined the all-round education offered by the four-years' course in pharmacy, went on to say that "such opportunities are found, in their entity, only in University Schools of Pharmacy."

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38 Ibid. 1897, 17:68.
39 Ibid. 1899, 19:30.
40 Louis E. Sayre (1848-1925), retail druggist in Philadelphia, then Dean of the School of Pharmacy of the University of Kansas from its founding in 1885, author of a well-known text on pharmacognosy.
This latter statement was undoubtedly correct, and it was the idea behind it which Kremers expressed much more definitely before a meeting of the American Pharmaceutical Association in 1895, only three years after his dramatic debut on the same platform. Having triumphantly announced that his ideas had "this year received the endorsement of three large state universities," he gives an outline of the studies to be recommended for a four-years' university course in pharmacy and admits cold-bloodedly that the development which he advocates was to undermine the old private schools. His recommendation to these schools is to give up their fragmentary independence and to become affiliated with state universities in order to make available for their students "all education and training in general sciences and letters which they may demand." It does not need to be proved that this suggestion did not enhance Kremers' popularity with those, teachers as well as druggists, interested in the maintenance of the private schools of pharmacy, then still outnumbering by far the few university schools already in existence.

Time has confirmed Kremers' farsighted step by step. With the beginning of the twentieth century one school (or department or college) of pharmacy after the other offered an elective four-years' course, and this course was made the only official (minimum) course at the Ohio State University College of Pharmacy in 1925, at Georgia in 1926, and at Minnesota in 1927. In 1932, finally, it became the obligatory minimum course at all accredited schools of pharmacy in the United States of America on the basis of a resolution adopted by the American Association of Colleges of Pharmacy as early as 1928 and accepted by the National Association of Boards of Pharmacy. This development was paralleled by another one presaged likewise by Kremers which has been summarized in the Kremers-Urdang-History of Pharmacy as follows:

"More and more private colleges of pharmacy sought and secured affiliation with universities and in this way offered to students and teachers an open door to broader intellectual opportunities. Even those colleges which were so proud of their traditional independence that they did not want any affiliation, followed the general trend, although in another way. The Phila-

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delphia College of Pharmacy, for example, responded to the challenge by remodelling the structure of the school, adding courses of purely scientific character and developing into 'a great specialized scientific school. In token of the extension of its activities, a new charter was secured, and the name of the corporation was changed to the Philadelphia College of Pharmacy and Science.'"

At the present time, all but seven of the sixty-five accredited schools of pharmacy in the United States of America are either parts of or more or less closely affiliated with general institutions of higher learning (Universities, Polytechnic or Technologic Institutes, State Colleges, Agricultural or Medical Colleges).

c. Graduate Study in Pharmacy

It has not been recognized sufficiently that in introducing the full academic four-years' course in Pharmacy, Kremers opened the way for the realization of another aim of pharmaceutical education to which the adoption of the general academic undergraduate requirements by pharmacy was only the necessary prerequisite: The degree of Doctor of Philosophy or Science to be granted by acknowledged institutions of higher learning to pharmacists doing graduate work in their own schools on scientific problems.

The emancipation of the academic teachers in pharmacy from the necessity of obtaining their advanced training and degrees in fields outside of pharmacy or, like Kremers himself, abroad, by opening to them an opportunity of such training and degrees in their own country was at least as important as the emancipation of the academic teaching in pharmacy from "the store" concept by Prescott in 1868. From now on the self-taught teachers gradually disappeared from the pharmaceutical faculties, and it became increasingly less frequent that pharmacists with teaching talent and intention acquired the M. D. degree or that M. D.'s without pharmaceutical training or experience were entrusted with professorships and deanships at Colleges of Pharmacy. There had been so-called graduate courses in Schools of Pharmacy before Kremers. They represented, however, essentially a prolongation of the usual twelve or eighteen-months' courses adding one more year of study and leading to titles like Master of Pharmacy, Pharmaceutical Chemist and Doctor of
Pharmacy which carried little weight outside of pharmacy and not even very much within.\footnote{Such a three-years' course leading to the degree of Master of Pharmacy was announced at the University of Wisconsin for the first time in the Catalogue 1890–91 and for the last time in the Catalogue 1916–17. According to W. L. Scoville the title of Doctor of Pharmacy was still given in 1906 by six schools after two years and by nine after three years of study. The title of Pharmaceutical Chemist could be earned at sixteen schools after pursuing a two-year course and at one institution even after only one year. Although for the Master of Pharmacy a three-year course was the rule, it could be obtained at two schools after only two years.}

In 1899 and in 1900 the first Master of Science degrees acquired under regular academic conditions were earned in the School of Pharmacy of the University of Wisconsin, and in 1902 the first Ph. D. degree was given to a student of Dr. Kremers, Oswald Schreiner.\footnote{Oswald Schreiner (1875–1934), German-born pharmacist, joined the U. S. Department of Agriculture, Bureau of Plant Industry, shortly after having received his Ph. D. and advanced to Chief, Division of Soil Fertility. A recognized authority in the field, Schreiner represented the United States at the First International Congress of Soil Science in 1928.} In his report submitted to the Wisconsin Pharmaceutical Association in the same year, Kremers proudly states that according to his knowledge “this is the first time that an American university has given its highest degree to a graduate student who pursued his major work in a pharmaceutical department.”\footnote{Proc. Wis. Pharm. Assoc. 1902. 22:49.} In an article written exactly thirty years later, in 1932, Oswald Schreiner preserved for posterity the significant remark of another “admiring alumnus” which he quotes as follows: “Many have come to him [Kremers] to learn the art of making pills and have departed as doctors of philosophy.”\footnote{Industrial and Engineering Chemistry, 1932. 24:115.} Surveying in 1930 the development of pharmaceutical graduate study at the University of Wisconsin Kremers himself wrote this:

“At first we were permitted to give the degree of Doctor of Philosophy with Pharmaceutical Chemistry as major. Pharmaceutical Botany under Dr. True,\footnote{Rodney H. True (1866–1940), pharmacognosist in the School of Pharmacy of the University of Wisconsin (1895–98), physiologist in charge of physiological investigations in the Bureau of Plant Industry, U. S. Dept. Agr., professor of botany in the University of Pennsylvania (1920–37).} a recent disciple of Pfeffer,\footnote{Wilhelm Pfeffer (1845–1920), author of a fundamental book on plant physiology.} the noted plant physiologist at Leipzig, followed. When, however, we offered Pharmacy as major, a battle was on. . . . Pharmaceutical chemistry, after all, was chemistry, and pharma-
ceutical botany was botany, but pharmacy, God forbid! If his colleagues of the Philosophical Faculty at Giessen had accused Liebig of introducing the methods of the kitchen into academic procedure, we were accused of doing something equally abhorrent or even worse. Well, strange things have happened educationally since the days of Liebig—a hundred years ago. Not only did we win the fight, but in 1926 the Department of Pharmacy had six successful candidates for the doctorate, five of whom took it with pharmacy as major."

More than fifty Ph. D.'s have earned their degree under the personal guidance of Edward Kremers and they have proved the value, scope and special meaning of pharmaceutical research all over the United States and even beyond the borders of this country. Kremers' men have excelled in government positions and in industry as well as in academic work, in research and in teaching. They have carried Kremers' ideas and methods into the staffs of many continental American Colleges of Pharmacy as well as to Puerto Rico, the Philippines and even Beirut in Syria, and it is certainly not accidental that most of those Schools of Pharmacy in this country in which at present research is regarded as an indispensable part of the school activities and given special attention are headed by or staffed with former students of Kremers. Of the fifty members of the Committee of Revision of the United States Pharmacopoeia Convention elected in 1940 ten were men who received their doctor's degree at Wisconsin. "Considered from the point of view of geographical distribution," says Kremers, "Wisconsin would have been entitled to one representative." The significance of this recognition of the scientific capacity warranted by a doctor's degree acquired under Kremers becomes still more evident from the fact that only thirty-two of the fifty members of the Committee of Revision were representatives of pharmacy (schools, associations, retail and manufacturing business), while the rest represented medicine or, in one case, dentistry. Hence almost one third of the pharmaceutical group within this most important Committee concerned with the utilization of medical and pharmaceutical

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60 Justus von Liebig (1803-1873), German chemist known especially for his pioneer work in agricultural and physiological chemistry. With pharmacy he was connected by ten months of apprenticeship and lifelong collaboration with the leading men in German scientific and industrial pharmacy.
62 Wisconsin Druggist. 1940. 8:6.
science and experience for the sake of the people consisted of former students of Kremers.

d. Cooperation Between Schools and State Boards of Pharmacy

There has always been one danger in the educational set-up of American pharmacy: Lack of understanding between the schools of pharmacy supposed to warrant the scientific capacity of the applicants for a pharmaceutical license and the boards of pharmacy supposed to guarantee the practical ability and reliability of the licentiates. In earlier times this danger was still aggravated by the fact that the practitioners acting as State Board examiners often did not have any or but little scientific education, hence were inclined to underestimate its meaning and importance. There has been factual overlapping and personal suspicion resulting from lack of sufficient cooperation.

It was on Kremers’ instigation that a common platform was established on which Schools and Boards of Pharmacy have met regularly and presented their views to each other since 1904. He initiated this innovation in his capacity as the third president of the Conference of Pharmaceutical Faculties (now American Association of Colleges of Pharmacy) in 1903. “His only recommendation was that the colleges invite the boards to effect a similar organization [as the schools had founded in 1900] and to hold one joint meeting of the two bodies annually. In 1904, the boards organized as a national body . . . which is not only carrying out his [Kremers’] suggestion of an annual conference with the college faculties but also joint district conferences throughout the year.”

It testifies to the gradually growing appreciation of the work and person of Kremers by the representatives of pharmaceutical retail practice that in 1939, two years before his death, he found himself Honorary President of the National Association of Boards of Pharmacy.

e. The Pharmaceutical Experiment Station at the University of Wisconsin

The main distinction between the reformer by nature and by mere accident is that the first will find some reform to be made or initiated everywhere, while the latter restricts himself to the

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58 National Association of Boards of Pharmacy, Bull. 1939. 3, No. 7.
one problem he accidentally happens to stumble upon. Having made plant chemistry his special field and knowing about the prominent part taken by European pharmacists in the cultivation of medicinal plants through the ages, it was to be expected that some day Kremers would also turn his energies to this task as an educational and research problem of American pharmacy. In his report submitted to the Wisconsin Pharmaceutical Association in 1909, Kremers makes the following announcement:

"For fifteen years your reporter had hoped that his botanical or agricultural colleagues might take up the cultivation of medicinal plants. In this he was disappointed, but not discouraged. So during the summer of 1908 he, with the cooperation of the pharmacy students, made an attempt in his own garden. The results were such that when Dr. True, in charge of medicinal and poisonous plants at Washington, visited Madison last fall, a plan of cooperation between the Department of Agriculture at Washington and the University was agreed upon. We now have an acre of University ground seeded and planted. . . . With this step, the University has gone back to first principles in pharmacy."

This statement disproves the claim of the University of Minnesota College of Pharmacy of having been the first American School of Pharmacy to add a plant garden to its educational facilities. Anyway, a mere plant garden would not have satisfied the vision of this born reformer. What he conceived was a State-supported "Pharmaceutical Experiment Station." On June 21, 1912 the Wisconsin Pharmaceutical Association following Kremers' suggestion resolved unanimously to prepare a draft of a bill "to be presented to the next legislature." On June 2, 1913 the bill became law, and for the first time there came into existence on American soil a State-supported Pharmaceutical Experiment Station in connection with the Department of Pharmacy of a State University supposed to cooperate with the Federal Department of Agriculture and to disseminate information on the basis of research. The work done by the new Station met all justified expectations of a practical as well as of a scientific nature. With an appropriation of originally $2,500 which was doubled in 1917, it carried through a series of investigations

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55 Ibid. 1912. 32:43.
yielding valuable results. It was due to the research done at the Station that the indigenous horsemint (*Monarda punctata* L.) became a source of thymol in the United States of America, and a new method for purifying digitalis was put to general use during the first world war. The *Pharmaceutical Journal*, the official organ of the British Pharmaceutical Society, called the Wisconsin innovation, "a model," and the renowned English pharmacognosist, H. G. Greenish, in referring to the Wisconsin Pharmaceutical Experiment Station expressed his regret "that no experimental station exists in this country [Great Britain] in connection with the Pharmaceutical Society."

A new method of extraction of thymol which proved to be of economic interest was worked out at the Station. An especially remarkable amount of successful study was devoted to the various species of Monarda. It is due to the work done by and in connection with the Pharmaceutical Experiment Station of the University of Wisconsin that we possibly know more at present about the chemical constituents of these plants and the role they play in the life processes than of any other genus of plants. Finally, the Station paralleled its analytical work by synthetic ones. It prepared synthetics, such as guajacol derivatives.

It was at the height of the period of depression, in 1933, that the Wisconsin legislature discontinued the appropriation which had made possible the work of the Pharmaceutical Experiment Station and thus put an unjustified end to it that, if merit and usefulness are decisive, can be but transitory.

**III. CONCLUSION**

It would be wrong to consider the reformer Kremers as a lonely figure in the American pharmacy of his time. If that would have been the case, the period of incubation which his ideas had to go through, would have lasted much longer. His merit was that he not only grasped what had to be done but did it without even thinking of compromise at a time when the steps he took required a considerable amount of courage and defiance of what is commonly regarded as collegial courtesy. In starting his reformatory action at a turning point in American education in general, Kremers delivered once and forever American pharmaceutical education from its traditional isolation.

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57 Year Book of Pharmacy (London), 1912. 361.
Kremers' reform activities were due undoubtedly to his vision and the strength of his conviction. It was, however, his being a high-grade scientist and historian that made his fight a success. If the young man had not proved very early his capacity as a teacher and a research worker and established his scientific reputation on the campus by his learned paper on "The Limonene Group of Terpenes" read before the Wisconsin Academy of Sciences, Arts and Letters on December 30, 1891, the President of the University of Wisconsin would scarcely have permitted him to establish the first American full academic course in pharmacy. If his historical sense and knowledge would not have enabled him to use the experience of the past for his plans for the future, he would have lacked the adequate arguments and power of inspiration.

It must remain for a more comprehensive biography of Kremers to record in detail his scientific achievements and to list his publications. At this place it must suffice to say that phytocchemistry, especially the knowledge of the essential oils, owes him much, that he furnished fruitful ideas to theoretical chemistry, and that his numerous articles on pharmaceutico-historical and cultural subjects placed this branch of the history of civilization on a level which in this country it had not had before. As an editor he became the guardian of pharmaceutical ethics, and his many and profound book reviews created a new standard in this field of American pharmaceutical journalism. As early as 1901 Henry B. Mason, a well-versed pharmaceutical journalist, wrote about the then thirty-six-year-old Wisconsin professor as follows:

"Edward Kremers ... is one of the best-equipped and ablest men in American Pharmacy ..., a specialist who has read widely and thought deeply; whose interests range over a wide field of observation, and whose activities are directed into several channels. ... What he believes, he believes earnestly, and he is as sincere in his devotion to pharmacy as any man in this broad land of ours."

And yet, the record testifying to the merits of Edward Kremers is not without its other side. Working so intensively in so many fields, Kremers was an inspiring and even impetuous

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59 Such a biography is in the process of preparation.
60 Bulletin of Pharmacy. 1901. 15:150.
initiator rather than a man finishing meticulously one job after
the other. The Kremers-Urdang History of Pharmacy published
by J. B. Lippincott Company, Philadelphia in 1940, not quite one
year before Kremers' death, would never have appeared had it
not been for the fact that his co-author took over the actual
writing. The "detailed classification of all constituents isolated
from volatile oils," promised by Kremers in 1900\textsuperscript{11} has never
been published, and the only hope that the standard work on
phytochemistry expected from Kremers will ever be presented
to the world, rests on the fact that in the last years of his life
he delivered the preliminary work done by him to one student
of his in whose scientific ability and human reliability he put
confidence. "As a matter of fact, I have been too busy collecting
material to find time to edit it," he himself once confessed.\textsuperscript{62}

Edward Kremers closed a biographical sketch devoted to
another reformer, the founder of the Russian Pharmaceutical
Society, Alexander N. von Scherer (1771–1824), with a quota-
tion from the Neuer Nekrolog der Deutschen which, in some
measure, may well be applied to himself. This quotation reads
in translation as follows: "He had learned much but finished
less because of his lack of consistency and perseverance [mean-
ing here concentration on one task]. He knew the highest aims
of his science and had them in mind. He did, however, never
reach them entirely because there was so much that attracted
his curiosity and led him astray. He had worked much and
fought much. But although he weathered storms and waves, he
never really entered the port, and peace came to him only with
his death."\textsuperscript{63}

In all probability that is as it has to be. Although peace may
be the reformer's aim, fight is his lot. What the world expects
of him, is the opening of new ways rather than the completior
of some special work; perfectioning rather than perfection.

\textsuperscript{11} Amer. Drugg. and Pharm. Rec. 1900. 36:172.
\textsuperscript{62} Isis, 1925. 7:110.
\textsuperscript{63} Journ. Amer. Pharm. Assoc. 1930. 19:1246.