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THE STORY OF CHEMISTRY AT MINNESOTA

Although the University was created in 1851 by an act of legislature, it was not until November 1867 that it functioned as an education institution when a preparatory department was opened to "boys and girls." In 1869, the University proper was established, when the small group of students from the preparatory school were ready for college training. The Board of Regents elected nine professors and instructors, and in December, 1869, William Watts Folwell was elected president. To quote from the first bulletin, "The University was established with a faculty and president competent to carry on full college work." In 1871, the Board voted to publish an almanac as a medium of advertisement, whose cost to the University should not exceed one hundred and fifty dollars. These were to be sold at twenty cents apiece. In 1872, the number of these almanacs was limited to 3000. It is largely in these almanacs, later called calendars and then catalogues and at the present bulletins, as well as in the minutes of the Board of Regents, and the President's Reports (dating from 1911-1912) that the interesting story of the School of Chemistry has been found.

The historical development of chemistry at the University falls naturally into four periods: (1) The Early Development (2) Foundation and Expansion (3) War Period and Reorganization (4) Post War Period.

Period I. The Early Development of Chemistry.

President Folwell had progressive ideas, but had the misfortune to be seventy-five years ahead of his time and his contemporaries in the field of education. Secondary education was not in an advanced stage in the state and the University was obliged to supply the deficiency by training some of its own students by preparatory or so called sub-freshman or collegiate work.

Four schools were established under the following headings: (1) The Latin School, largely devoted to preparatory work (2) The Collegiate School, which had a four year course, the first two of which were entirely of preparatory grade; this course would be equivalent to the last four years of a German gymnasium, (3) The College of Science, Literature, and the Arts, and (4) The School of Agriculture and Mechanic Arts. Natural sciences were taught in the Scientific Course and in the third year of the Collegiate School. The text used in chemistry was Eliot and Storer's Chemistry. Eliot, who was one of the authors was the very famous president of Harvard. Chemistry was recognized as being somewhat expensive as a maximum fee of three dollars per term was charged to students taking the scientific course. This fee was considered high at the time. Students completing the above course received a B.S. degree.

Edward Twining, M.A., who was instructor in natural science in the preparatory department from 1867 to 1869 was the first professor of chemistry. His title was Professor of Chemistry and Instructor of French, which position he held until 1870. June 29th, 1870, he was elected professor of chemistry at a salary of $1500 per annum. He hold this position until 1871. He had been given a laboratory in the basement, and complained of the dampness, but the committee appointed by the Board of Regents "let him know that the committee had full authority to act as <u>they</u> think best in the matter of laboratories."

In 1872, The Board passed the following resolution: "That the duties of the chair of chemistry, including a course of lectures on agricultural chemistry be devolved upon the Chair of Agriculture after the expiration of the present college year." Twining found his position somewhat anomalous and upon inquiring regarding his status, he was notified that "his resignation would be accepted if tendered." The secretary of the board was requested to furnish Twining a copy of the resolution previously cited and the information that the

action of the Board was intended to release him from further duty in the chair. On motion the chair of chemistry was declared vacant, July 15th, 1872.

In 1872, the faculty was increased to thirteen members, but Ewing's name was no longer in the Almanac; instead we find the names of Dalston P. Strange, instructor, (the next year, assistant professor) in Agricultural Chemistry and A. W. Williamson, instructor in Natural Philosophy. The Board of Regents appointed the instructor of chemistry as the chemist of the Geological Survey and Williamson was given this position on trial for a period of fifteen weeks.

Apparently the duties of the chemistry and agriculture position were too heavy for one man, and in April, 1873, the board agreed that the chair of chemistry should be filled as soon as practicable, and chemistry and physics were to be attached to the department of Agriculture. Strange was Assistant Professor of Chemistry and Agriculture in 1874-5, and Hiram W. Slack was instructor in English and Natural Sciences in 1874. The courses in chemistry were increasing in number and content, analytical chemistry was held to be very important, courses being given in both the junior and senior years. In the almanac for 1873, under General Information the statement is made that "arrangements have been made for a limited number of analytical students. A class is already at work."

In 1874, Stephen F. Peckham, M.A., was appointed assistant professor of chemistry and physics, and in 1875 he was made professor at a salary of $1800. His residence was given as 121 Pleasant Street, which is the site of the present chemistry building. Professor Peckham was a member of the faculties of the Science, Literature and the Arts, the Mechanic Arts and the Agricultural Colleges. Physics was not considered as important as chemistry at that time, for the calendar for 1874-1875 states: Physics was attached to the Department of Chem-

istry." The following description of chemistry is given in the same bulletin or almanac: "All students take General Chemistry the first year. The following year, the scientific students are required to take Applied Chemistry, also the students in the Modern Course, if they so elect." "The Chemical laboratory is fitted up in the best manner with apparatus and fixtures of the most approved construction. It is designed to furnish instruction in qualitative analysis to all students in the Scientific course of the College of Science, Literature, and the Arts, and to all students in the College of Agriculture and Mechanic Arts, and in quantitative analysis and in special research to all students of whatever department or college, who may desire such opportunities." "No charges are made for instruction, and only such charges for apparatus and chemicals as will cover the actual cost to the institution. The charges for ordinary chemicals will not exceed ten dollars per term. All glass ware is charged to student at cost. Glassware uninjured will be received back at cost; other articles will be received back under special regulations, generally at a discount of 20%. The cost of apparatus will vary from two to five dollars per term, according to the care exercised by the student."

"Advanced students in analytical chemistry are free to select their subjects for analysis or research under the advice of the professor in charge."

The Board appropriated $2800 for the purchase of chemical apparatus in 1874.

In 1878, Professor Peckham's title was changed to Professor of Chemistry and L. D. Peck was in charge of Physics.

In 1872, the legislature appropriated $12,500 for an agricultural building. The building completed in 1875 consisted of a main part, two stories high, fifty-four feet square, with two one story wings 25 x 46 feet. The building, steam heated, was white brick on a basement of blue stone. The

building which was destroyed by fire on December 5, 1888 housed the department of Agriculture, the plant house and chemistry. Chemistry occupied five rooms in the north wing. The Calendar for that period gives the following description of the rooms: "(1) The main laboratory, which is 32 x 45 feet, contains 8 tables which accommodate 64 workers in two sections or reliefs. Each table has water, gas, sink, shelving for reagents, drawers and cupboards for apparatus, all of the most approved construction and ventilating hoods of an improved form. (2) The recitation room has all appurtenances necessary for effective illustrations of lectures on chemistry and technology, (3) an apparatus room for storing apparatus and tables for balances. (4) The professor's private laboratory, a small room but adequate for the purpose. (5) The assay room." To this description the following is added: "The University offers ample facilities for successful analyses. Persons desiring analyses made, should address Professor S. F. Peckham."

In 1875-6 a cabinet of specimens was started with the idea of establishing a museum of technology. "Contributions are respectfully solicited for which due credit will be given." Professor Peckham was also in charge of chemistry given to agriculture students, which included a course in analysis of soils, fertilizers, grain and fodder. The texts used were Johnson's "How Crops Grow" and "How Crops Feed" and "Agricultural Chemical Analysis" by Caldwell.

Classical students who were preparing for medicine were advised to take analytical chemistry in their senior year. A course in toxicology was offered, as well as the following subjects: Elements of Physiological Chemistry; Preparation of Vegetables; and Pharmaceutical Products. In addition a collection of drugs was made. Students in mechanical engineering were given a course in analysis of iron ores, and iron and steel. Assaying was taught by the department of chemistry.

The assistants at that time were chosen from the undergraduates. The first assistant, 1876-1877, was Charles W. Savidge, later a Methodist minister, who died in 1933. Fred C. Bowman, assistant in 1878-1879, also held the position of carpenter, is at present a physician. In 1879-1880, Albert W. Rankin was assistant. Rankin later entered the field of education and has been recognized as one of the outstanding pioneer educators of the state as well as one of the leaders in the department of pedagogy at the University. Professor Rankin is now retired.

Professor Peckham was not very diplomatic, and because of his argumentative disposition severed his connection with the University at the time of a general faculty upheaval. In 1880, President Folwell and his faculty were not in complete accord. Dissensions in the faculty occurred between the supporters of the classics on the one hand and supporters of science on the other. There seemed to be salary difficulties and other disagreements as to the proper moral conduct of faculty members. The minutes of the Board indicate considerable friction and dissatisfaction. Six members of the faculty were not reappointed (approximately one-third of the members), Peckham among them. However, as Folwell favored the science interests, it is apparent that Peckham was not dismissed on account of championing the scientific side.

It is interesting to note the Professor Peckham did not publish any papers in the journals which he was connected with the University. On leaving the University, he became an industrial chemist and published several papers on dust explosions, cements, asphalt and other industrial projects. In a paper read before the New York section of the Society of Chemical Industry and published in the Journal of Soc. Chem. Ind. 26, 234-5, 1907, he gave an account of the tragic flour mill explosion that took place in Minneapolis in May, 1878. He and Professor Peck, who was in charge of Physics had frequently visited the

flour mills and had been there a day or so before the explosion. They were called in as expert witnesses in the investigations that followed. They performed many experiments to aid them in discovering the conditions that led to the explosion. Professor Peckham probably did not recognize the importance of this problem nor the great opportunity that field offered to the research chemist, for after these experiments, he dropped the problem.

In 1880, James Albert Dodge, Ph.D. was elected professor of chemistry at an initial salary of $1200 per annum. Charles F. Sidener, an undergraduate at the time, was his assistant. Professor Dodge was a brilliant man, who was well liked and admired by his associates and students. He was a native of Massachusetts, receiving his B.A. and M.A. degrees from Harvard. He spent about four years of graduate study in Europe under such leading chemists as Hofmann at Berlin, Bunsen, Kirchoff, and Kopp at Heidelberg, and Kolbe at Leipzig. He received his Ph.D. summa cum laude, under Bunsen. He was Professor of Natural Science at Baldwin University, Berea, Ohio, and in 1880 came to the University of Minnesota, where he remained until 1893, when he went to California on account of his wife's health. According to the last reports he is still living at Santa Barbara. Professor Dodge with his broad and splendid chemical background brought new life to the Chemistry Department. Organic chemistry which was receiving so much attention in European universities was introduced, as well as a two hour per week course in the History and Theory of Chemistry. New types of apparatus were purchased such as the Bunsen Photometer, spectroscopes, microscopes, and polariscopes; all apparatus that a Bunsen Ph.D. would naturally desire. A museum replaced the cabinet of specimens. In the description of courses given, this condensed form appears. "Ample facilities for successful study and instruction in both general and analytical chemistry and in the allied branches of study. Persons desiring chemical analyses should address the Professor of Chemistry."

In 1882, William A. Noyes, Ph.D. later Head of the Department of Chemistry at the University of Illinois and at one time president of the American Chemical Society, joined the department, but he only stayed one year, and Charles F. Sidener, so well known to all students of the School, who had just received his B.S. degree, replaced him as instructor in chemistry. Professor Noyes after leaving Minnesota, went successively to the University of Tennessee, Rose Polytechnical Institute and to the Bureau of Standards and then became head of the Chemistry department at the University of Illinois. Although retired, he is still active in chemical work.

From 1883 to 1893, while Dodge was professor of chemistry, the university was growing rapidly, new colleges or schools were added, and many changes were taking place. Among these changes we find: a Medical School and a Law School were added to the number of existing schools; Physics was detached from chemistry and attached to the department of Mechanical Engineering. Dodge's name was still included on the faculties of agricultural and medical chemistry. Agricultural chemistry consisted of a study of the elements of the volatile parts of plants as carbon and oxygen, a study of the elements of the ash of plants and their compounds, as potassium, calcium, iron, sulfates and phosphates; a study of the atmosphere and soil as related to vegetation and as sources of food to plants; a course in analysis of soils, fertilizers, grain and fodder. In medical chemistry, the course given by Dodge included toxicology, drugs and foods.

In 1885 the agricultural experiment station was authorized by the state legislature, but no funds were available. In 1887, however, Congress passed the Hatch Act providing funds for research in agriculture, a division of chemistry and a chemist. In 1888, the agricultural station was organized as a part of the department of agriculture at the University and David Harper, Ph.D., was appointed chemist. He resigned in 1891 and Harry B. Snyder, B.S.

Cornell, assistant in the Agricultural Experiment Station of Cornell, was appointed in December 1891 as Professor of Agricultural Chemistry, remaining until 1909, when he became chemist for the Russell-Miller Milling Company. So Agricultural Chemistry was not taught any longer on the main campus, though Dodge's name was still kept on the faculty list of the College of Agriculture.

In 1890, a new chemistry and physics building was ready for occupancy. The first cost of the building was $81,500 and an additional $3000 was spent when it was remodeled in 1902 and given over entirely to chemistry. The building which is now the Minnesota Union, had a frontage of 190 feet and was constructed of a romanesque brick of light reddish yellow with iron spots. L. S. Buffington, now recognized as the inventor of the skyscraper, was the architect. The chemistry department in 1890 occupied the west half of the building and had 21 rooms for its use. Of these the most important were (1) the lecture room, (2) the qualitative analytical laboratory, (3) the quantitative and analytical laboratory. The lecture room on the second floor was 30 x 40 feet and seated 100. The qualitative laboratory on the same floor was 34 x 40 feet and had work tables to accommodate forty students. Connected with this room were three small rooms, 11 x 15 feet each, a spectroscope room, a microscope room, and a storeroom for apparatus and glassware. The quantitative laboratory had tables for 32 students, for chemical work of the upper classes; connected with it was a balance room 16 x 24 feet, an apparatus room, 17-1/2 x 24-1/2 feet. On the first floor was a recitation room 24 x 27 feet, a room for water analysis, 15 x 30 feet, a private laboratory for the professor, 18 x 24-1/2 feet, and one for the assistant professor, 12-1/2 x 30 feet. The preparation room near the lecture room contained lecture apparatus. The basement had 2 rooms for the organic analytical laboratory, a room for gas analysis, a balance room, a furnace room, and a storeroom for chemicals and glassware.

The technological museum on the first floor, 24 x 28 feet had large cases of shelves and drawers. A description of the museum taken from the University Dictionary is given here.

"Considerable space is given to a collection in industrial technical and applied chemistry. There is a large collection of chemicals, with specimens of each in the various stages of preparation and purification; a collection of nearly all elements, with most of their important salts; a large number of mining and metallurgical specimens, including most of the important ores, together with many rare specimens in crystallography. The collections of coals and petroleums are especially valuable for lecture and technical work. There is a large collection of dyes, organic and inorganic, mordants, textiles, and other materials used in dyeing and bleaching, with a rapidly increasing collection of clays and materials used in making glass, earthenware, porcelain and brick. A collection of furnace products, models and series of charts, blue prints and photographs illustrating a wide range of technical and chemical processes is being added."

As the University grew and new colleges were formed, there was a tendency on the part of the individual schools or colleges to have complete charge of all courses given in their respective curricula, and for each to have all of its courses taught by its own independent faculty. This was particularly true of the Medical School and the Agricultural College.

In 1890, Chemistry Hall had been built on the Farm Campus and all chemical work for the Experiment Station as well as for Agriculture was given in this building.

In the reorganization of the Medical School, all chemistry given to the medical as well as to the dental students was given under the supervision of Professor Charles J. Bell a member of the Medical School Faculty. Professor Bell had an excellent chemical training and had a pleasing personality. He studied in

Germany for six years under such famous chemists as Hofmann and Baeyer. He was popular with his students and was known to all of them by the endearing term of "Charley Bell". He was in charge from 1883 until his death in 1903. H. C. Carol who had been instructor in medical chemistry succeeded Bell, becoming professor in 1904 and continuing as head of medical chemistry until 1906, when the School of Chemistry took over all the medical chemistry, except physiological.

In 1893, the Medical School had its own chemical laboratory, a one story red brick structure, containing 4500 square feet and costing $14,127. It occupied a site near the present library, adjacent to Woolbrook Hall. In 1901, this building burned in part, but was rebuilt. This building is described in one of the Regent's Minutes as "Bell's Laboratory". It was an ugly building and because of its appearance was nicknamed "The Bowling Alley." It had working tables for 72 students at one time, taking care of 216 students in three divisions. The lecture room with its preparation room was in the main medical building. The School of Chemistry took over the instruction of medical chemistry in 1907, but it still taught the medical students in this building until the erection of the present chemistry building in 1915. After 1915 the small structure housed pharmacy laboratories for a time and then it became the general storehouse and functioned in that capacity until the railroad tracks were removed and the campus was beautified. This eyesore was then taken down.

In the Medical School, general and qualitative chemistry were taught in the first year. In the second year, lectures were given in medical chemistry, toxicology and analysis of the urine. The texts recommended were Remsen's Inorganic Chemistry, Tyson's Examination of the Urine, Biese's Toxicology and Taylor on Poisons. The dentists took the first year only of this course.

In 1891, the College of the Mechanic Arts was reorganized and was called the College of Engineering, Metallurgy and Mechanic Arts. Professor C. W. Hall was made Dean, which position he held for five years when he resigned and

become head of the department of geology and mineralogy, a position he held until his death.

The first complete course in chemistry was to be given in the College of Engineering. This was offered in 1891. No students registered the first year, but one, a young lady, Grace Sylvia Burt, registered in 1892, but did not complete the course. The following announcement pertaining to this course is found in the bulletin of that year. "The object of this course is to provide for a greater amount of time devoted to the practical and industrial applications of the science than is afforded in an ordinary undergraduate course, and to join with the increased amount of chemistry, a considerable proportion of studies in the engineering branches." "By a course of this kind, a young man is enabled to fit himself for work leading up the business not merely of an analyst but ultimately of a manager or manufacturer." "In the latter part of his course the student is encouraged to engage in original investigations." Here is the curriculum offered for the first course in chemistry.

Course in Chemical Engineering.

First Term Freshman
- Algebra, 5 credits - simple quadratic and higher equations.
- German, 5 credits - Schiller's Maria Stuart or William Tell
- or
- French, 5 credits - Advanced grammar, reading of authors
- Chemistry, 4 credits - metallic elements. Laboratory exercises
- Drawing, 3 credits - Free hand, models, lettering
- Military Drill.

Second Term Freshman
- Trigonometry, 5 credits - Logarithms, plane and spherical.
- German, 4 credits - Geschichte des Deutschen Volkes
- or
- French, 4 credits - Advanced Grammar readings.
- Chemistry, 4 credits - Qualitative analysis
- Drawing, 3 credits - Tinting and shading
- Carpentry, 2 credits - Care of Tools. Exercises
- Military Drill, 3 credits.

Third Term Freshman
- German, 4 credits - Heine's Harzreise, Buch der Lieder
- or
- French, 4 credits - French Composition. Readings
- Chemistry, 4 credits - Qualitative completed.

Surveying, 5 credits - Methods and Instruments. Office and Field practice.
Drawing, 5 credits - Isometric and cabinet projections and perspective.
Military Drill, 3 credits.

First Term Sophomore
Analytical Geometry, 4 credits - Conic sections
French or German, 4 credits - Grammar, Prose.
Topography, Methods and Instruments. Field work.
Draughting, 1 credit. Plotting topographic notes.
Physics, 4 credits. Mechanics of liquids and gases. Heat.

Second Term Sophomore
French, 4 credits - Grammar and Composition
or
German, 4 credits - Prose and Poetry
Descriptive Geometry, 5 credits - Recitations, original problems.
Physics, 4 credits - Electricity and magnetism
Differential Calculus, 4 credits

Third Term Sophomore
Integral Calculus - 4 credits
French or German, 4 credits
Chemistry, 4 credits - Quantitative
Physics - 4 credits - Sound and Light
Mineralogy - 4 credits, Quantitative Blow Pipe essaying.

First Term Junior
Mechanics, 5 credits - Forces, center of gravity, Statics of rigid bodies
Geology, 4 credits - General and dynamic study of rocks
Chemistry, 4 credits.
Met. 3. Introductory
Technical assay.

Second Term Junior
Mechanics, 5 credits - Materials, Stress and Strain
Mechanical Lab., 1 credit
Chemistry, 4 credits. Industrial Chemistry
Chemistry, 4 credits, Analysis of Products
Geology, 4 credits - Lithology
Met. 2 credits - Slag fluxes. Iron and steel

Third Term Junior
Organic Industrial Chemistry
Chemical Philosophy - 4 credits
Metallurgy - 4 credits - Iron and Steel
Applied Geology, 4 credits
Technical Essay

First Term Senior
Chemistry, 4 credits. Ultimate Analysis (original)
Met. 4 credits, Gold and silver
Chemistry, 4 credits, Special Problems
Elective, 4 credits.
Law, 1 credit.

Second Term Senior
Chemistry, 5 credits - Analysis of Technical Products, Org. & Inorg.
Met. 3 credits - copper and lead
Chemistry, 4 credits, Special Problems
Elective, 4 credits
Third Term Senior
Designs and specifications, 5 credits.
Chemistry, 4 credits - Gas analysis
Met. 4 credits, Zinc, Mercury, and Antimony
Elective, 4 credits
Thesis.

"Excursions are to be made to various industrial and manufacturing establishments in order that the student may become acquainted with the practical and commercial side. Special attention is given to water analysis, gas analyses, furnace gases and air. Industrial chemistry covers the analysis of various commercial products."

In 1893, Dodge moved to California on account of his wife's health and the authorities again looked for a chemist with a European Ph.D.

Although Dodge was an excellent chemist, apparently little or no research was carried on during his connection with the University. The only publication during this entire period was a paper by W. A. Noyes in the American Chemical Journal on the "Oxidation of Benzene Derivatives with Potassium Ferrocyanide."

Period II. Foundation and Expansion of the School of Chemistry.

In 1893, George B. Frankforter was appointed Professor of Chemistry, a position he held until his retirement in 1928. Dr. Frankforter was born in Ohio and educated in the Lincoln, Nebraska schools receiving both his B.A. and M.A. from the University of Nebraska. He studied four years in Berlin, receiving his Ph.D. degree under the eminent Hofmann. After returning to the United States, he taught music and chemistry at the University of Nebraska until called in 1893 to head the Department of Chemistry at Minnesota. When he came, the chemistry staff was composed of the head, an assistant professor, Charles F. Sidener, an

instructor, A. D. Meeds, now the gas and light inspector of Minneapolis, and one assistant, Carl Van Cleve. Carl van Cleve, who died in 1933, did not receive a degree from the University. He probably established the first commercial laboratory in Minneapolis. This is still in operation and is owned by A. D. Bell, B.Ch.E. 1916; Ch.E. 1917.

Dr. Frankforter was a man of great vision, imagination, ambition and energy bringing with him much of the old world charm and culture. Courses in chemistry became very popular, either by choice or necessity; if a student in the arts college did not take two quarters of chemistry, he was obliged to take two quarters of physics. Chemistry was required of engineers, but the medical, dental, pharmacy and agriculture schools gave their own courses in chemistry under their own faculties. There is hardly one of Dr. Frankforter's old students who does not remember the courtly bow that began and ended his lectures, and they all remember his lecture assistant, William Methley now in the Division of Soils, who so ably supplied all the genial Doctor's needs in his lecture demonstrations. As soon as Dr. Frankforter arrived, he did everything in his power to bring the chemistry taught at the University under one directorship, that of the School of Chemistry. But there were others of similar ambitions, so most of the chemistry of the Farm School was kept on the Farm Campus, and physiological chemistry, at one time a small division, still remained a part of the Medical School. But through the efforts of Dr. Frankforter, all elementary chemistry which was given in any school at all was given in the chemistry laboratory building under the chemistry faculty. Bulletins of this period begin to mention a chemistry library - and we find on its shelves, such outstanding chemical journals as the Berichte der Deutschen Chemischen Gesellschaft, Liebig's Annalen der Chemie und Pharmacie, and the American Chemical Journal.

In 1893, Dr. Frankforter's department offered seventeen courses in

chemistry, which were called (1) Non Metals, (2) Metals, (3 & 4) Qualitative (5 & 6) Quantitative (7) Volumetric (8) Theoretical (9) History (10 & 11) Organic (12) Water Analysis (13) Gas Analysis (14) Chemistry of the Carbohydrates, (15) Iron and Steel Analysis, (16) Domestic Chemistry (17) Photographic. Later on a course in wine and beer analysis was added. Graduate courses were listed as follows: Special Inorganic Preparations, Research in Electro-chemistry, Plant Alkaloids, Stereochemistry, Optical Activity of Organic and Inorganic Compounds. While these courses were listed, no actual graduate courses with lectures or specified hours were given either at this period nor during the following two decades. Research work was carried on, even students who were registered as juniors or seniors were found working on special organic research problems.

From 1893 to 1902, students who were interested in chemistry were registered in various courses and schools. There were a few who were registered in the chemistry course offered by the College of Engineering and Mechanic Arts and some were registered in the College of Science, Literature, and the Arts, while others were registered in a course which was established in 1897 and was affiliated with the College of Science, Literature, and the Arts.

Few students were registered for the Chemistry course in Engineering as apparently at that time "the demands for technical and applied chemistry were so limited it did not seem wise to offer a course along these lines; therefore a single four year course was offered for those who wished to become teachers of chemistry, analysts, investigators, manufacturing and applied chemists. The course included: general, organic, analytical, theoretical, and applied chemistry; extended work in physics, metallurgy, mineralogy, crystallography, geology, botany, bacteriology, drawing, language, and mathematics. This work was of sufficient range to give the student a broad, liberal, scientific education. At the satis-

factory completion of this course, the student received his B.S. from the College of Science, Literature, and the Arts. There were students in the Arts College proper who chose chemistry as their major, who also received the B.S. degree. Practically all the student helpers, assistants and instructors were chosen from these undergraduates and graduates - among them were Everhart P. Harding who received his B.S. in 1894 and who later became head of the Technological Division of the School, Henry B. Hovland (B.S. 1894) who later made a fortune in Minnesota mines, and became a member of the Board of Regents, and with Regent John Lind did much to promote the growth of the School. He was the one who saw that the chemistry department received its full share of the appropriations. Others were Paul M. Glasoe, B.S., 1897, the first graduate of Minnesota to receive the Ph.D. degree in chemistry (1900), who later became professor of chemistry at St. Olaf's College, Northfield, where he is still located; William Kunze, B.S. 1897, one time Mayor of Minneapolis; Frank Keller, B.S. 1898; Levi Pease, B.S. 1898, now professor of metallurgy at Minnesota; William H. Roberts, one time city chemist.

In 1897, four men graduated from the engineering course receiving the degree of Ch.E. These were the only graduates of that course, and are considered the first actual graduates of the School of Chemistry. The four were (1) Lewis Chapin, a teacher of chemistry, now deceased; (2) Herbert C. Hamilton, who is well known as a pharmacologist and one time research chemist for one of the leading pharmaceutical companies located in Detroit, Michigan; (3) James H. Linton, who has a consulting laboratory in Seattle, Washington; (4) Frederic Webber, who is a deputy collector of customs in Minneapolis.

In 1902, the Science Hall was inadequate for both physics and chemistry; physics moved out and was later housed in a new building, while Science Hall was remodeled for the exclusive use of chemistry. The remodeled building now had

an amphitheatre in the basement or first floor, seating 345 students. Above the blackboard of this auditorium and back of the lecture table was a window, which was shaded, and here the stenographer used to peep from behind the shade, much to the delight of all the students, and take the roll. In the new building the chief had a very large office on the main floor which was connected with his adequate laboratory. The first floor or basement had a laboratory for general chemistry with accommodations for 168 students. The qualitative laboratory accommodating 120 students was on the main floor. On the next floor was the quantitative laboratory with its balance, preparation, evaporation and drying rooms and the third floor or attic was used for dark rooms and for photography. A special room was used for the library in which were found "complete sets of many of the more important journals, analytical and technical works, and many rare books of great historical value."

On June 4, 1902, the Board of Regents voted that a course of study in Chemistry and Engineering be given hereafter in the School of Chemistry and that Professor Frankforter be made Director without increase in salary.

The School was still connected with the College of Science, Literature and the Arts but on May 17, 1904, the Board separated the School of Chemistry from this College and made it independent with Dr. Frankforter as Dean. However the B.S. degree in chemistry was awarded to graduates from the chemistry courses in 1902 and 1903, and these students are considered graduates of the School of Chemistry. The graduates in 1902, who received the B.S. (Ch.) degree are Raymond Calvin Bonner, who is now Director of Research of the Carborundum Co., Niagara Falls, New York; Edgar Whitman Rice, Expert and Consultant of the National Sugar Refining Co., New York City; and Max H. Londo, deceased; Oliver M. Baldes received his B.S. degree in 1903.

Two four year courses in chemistry were given, designed for those who wished to become teachers of chemistry, analysts, investigators, manufacturing and applied chemists. The course in analytical chemistry led to the degree of Analytical Chemist and was arranged for teachers, analysts and general scientists. The course in engineering chemistry was extended for those who would become manufacturing and applied chemists or chemical technologists, and receive degree of chemical technologist (Regent's Minutes May 17, 1904). There is no record that any student received the latter degree.

Curricula for First Courses given by the School of Chemistry.
(1904)

Freshman Year - 1st and 2nd Semesters
Mathematics - 4 cr. per semester
German, French, English or Latin - 4 cr. per semester
Drawing - 4 cr. per semester
Drill - 2 cr. per semester
Gymnasium - 1 cr. per semester

Sophomore Year - 1st and 2nd Semesters
Chemistry - organic, 4 cr. per semester
Quantitative - 4 cr. per semester
Mineralogy - 4 cr. assaying 3 cr.
Botany - 4 cr. per semester
Drill - 2 cr. per semester
Rhetoric - 1 cr. per semester

Junior Year

First Semester		Second Semester	
Theoretical	4 cr.	History of Chemistry	2 cr.
Water analysis	2 cr.	Iron and Steel	4 cr.
Geology	4 cr.	Geology	4 cr.
Physics	4 cr.	Physics	4 cr.
Metallurgy	4 cr.	Metallurgy	4 cr.
Inorg. Prep.	2 cr.	Micro chemistry	2 cr.

Senior Year

First Semester		Second Semester	
Carbohydrates	2 cr.	Photographic	2 cr.
Gas analysis	2 cr.	Industrial	3 cr.
Mineral analysis	2 cr.	Electro	2 cr.
Colloquium	2 cr.	Metallurgy	4 cr.
Special problems	2 cr.	Crystallography	3 cr.
Wine and beer anal.	2 cr.	Food Adulteration	2 cr.
Thesis		Thesis	
Metallurgy	4 cr.		

Applied Chemistry Course

Freshman

First Semester		Second Semester
Chemistry, Qual.	4 cr.	4 cr.
Mathematics	5 cr.	5 cr.
German or French	4	4
Drawing	4	4
Shop	4	4
Drill	2	2

Sophomore

First Semester		Second Semester
Quant. Chem.	4 cr.	4 cr.
Math.	4	4
Physics	4	4
Language	4	4
Drawing	4	4
Drill	2	2
Rhetoric	2	2

Junior

First Semester		Second Semester
Org. Chem.	4 cr.	4 cr.
Mechanics	4	4
Physics	4	Elect. Lab. 3
Mech. Lab.	2	2
Machine Design	2	2
Strength & Materials	2	2
Industrial Elect.	3	3

Senior

First Semester		Second Semester
Industrial Chem.	4	4
Gas	2	Applied Chem. 2
Metallurgy	4	4
Political Science	2	2
Electives	4	4
Thesis		Thesis

The fees for these courses were $10.00 per semester for a resident and $30.00 for a non-resident (in 1902). A five dollar fee per semester was paid for chemistry in the freshman year.

The first graduates from the analytical course were Frank F. Grout now Professor of Geology at Minnesota; E. J. Cutsche, a research chemist; Joseph Hopkins, a farmer at Bloomington, Minnesota, and Anton R. Rose, Biochemist

for the Prudential Life Insurance Co., New York City - all of whom received the B.S.(Ch.) degree in 1904.

The School of Chemistry was now firmly established, the number of students was increasing and the faculty was enlarged. The faculty was drawn largely from the graduates of the University of Minnesota, a policy which was continued until 1911 when with the advent of a new president, inbreeding was discouraged and outside talent was brought in.

In 1901-2 there were 3 seniors, 2 juniors, 5 sophomores and 11 freshman registered in the school. At that time there were no girls, though in 1894, 3 girls registered in the freshman class, but discontinued their work after the first year. In 1902-3 there were 3 women assistants on the chemistry faculty of the school and in 1903 there was one woman as instructor and 2 women as assistants.

In 1904-5, the regulations of the Science, Literature, and the Arts College, with reference to registration, absences, etc. applied to the students in the school. The fees were raised for a semester to $15.00 for residents and to $30.00 for non-residents.

Physical Chemistry was first introduced in 1904-5 and was taught in the second semester of the junior year of the analytical course, with reference texts, Nerst and Ostwald. There were now 7 seniors, 2 juniors, 13 sophomores and 11 freshman. By 1906-7, the faculty was composed of the dean, one professor, Charles F. Sidener, two assistant professors - E. P. Harding and E. E. Nicholson, 2 instructors - Miss Lillian Cohen and Francis Frary, and 13 assistants, among them A. D. Wilhoit, Rodney West (present Registrar), and H. Porter.

In 1906-7 a new course was added: a five year course in Arts and Chemistry which was the same as the Analytical Chemistry course but was extended over five years, with 32-38 electives taken in the third and fourth years. The B.A.

degree was given at the end of the fourth year, and the degree of Analtyical Chemist at the end of the fifth year. In 1903-4, the six year medical course was established and all the chemistry taught in the Medical School or in the College of Dentistry except physiological chemistry was now transferred to the School of Chemistry, and taught in the two buildings previously described. In 1907 the school had 20 freshman, 19 sophomores, 5 juniors, and 13 seniors and 3 unclassed students, 51 of whom were men and 9 were women. The courses of study in analytical and applied chemistry had not proven satisfactory and in 1907 these curricula were revised to some extent. A program committee was appointed in 1907, consisting of three members, E. P. Harding, Frances Frary and Lillian Cohen. The students' work committee was composed of E. P. Harding, G. B. Frankforter, Charles F. Sidoner, and E. E. Nicholson; Curriculum Committee: Frankforter, Sidoner, Nicholson, and Ira Derby.

In 1905-6 the Minnesota branch of the American Chemical Society was organized with headquarters at the University of Minnesota.

A few changes were made in the curriculum from 1910 to 1913 - such as addition of a course in glass blowing by Frary, Physical and Radio Chemistry given by Derby, and Industrial, Photo and Electrochemistry by Frary.

An attempt to popularize chemistry, which was unsuccessful was made by introducing a simple course for women in Household and Sanitary Science. This course was given in cooperation with several other departments and was ultimately dropped. In 1909-10, the mathematics for applied chemists which had been taught by the Arts faculty was transferred to the Engineering School and Calculus was required.

The elementary classes in chemistry increased in numbers, now that the elementary chemistry from the Farm was also given on this campus. The teaching staff was inadequate and new instructors were added: Wm. H. Hunter, Ph.D.

Harvard; Frank W. Bliss, M.S., Illinois; D. F. P. Brenton, M.A., Johns Hopkins; and Paul H. M. P. Brinton, who had studied in the Fresenius Laboratories of Germany. This appointment, of four new instructors at one time, was a noteworthy event; however it is a matter of interest that the initial salary of each was $1000 for the academic year.

It was the year 1909, also that the four graduate Sheylin fellowships of $500 each were established, one of which was to be awarded to the School of Chemistry, but it was not awarded in chemistry until 1911 when two were given for that year, one to H. H. Brown, later an instructor, and the other to Ward Lambert, who abandoned chemistry as a career and is now a very successful basket ball coach at Purdue.

The American Chemical Society held its meeting with that of the American Association for the Advancement of Science at the University of Minnesota December 28-31, 1910. Professor W. D. Bancroft of Cornell presided. Over 275 members and guests were present. Papers were given, among them we find several by Drs. Frankforter, Derby and their students. Dr. Frankforter was elected chairman of the organic division and councillor at large. The meeting served as an incentive to research. From that time on members of the chemistry faculty began to attend scientific meetings. Many attended the International Congress of Chemistry held in 1912 in New York and Washington.

With the growth of the school, laboratories became overcrowded and desk space became inadequate. At this time over 500 students were taking laboratory work. Makeshifts in the form of unsightly black boxes for apparatus were resorted to for the students taking qualitative chemistry. The laboratories were noisy, and the time devoted to the courses could not be used to the best advantage.

When the members of the Legislature made their biennial visit to the University, (then as now), it was not difficult to convince them that a new building was an absolute necessity. So in 1911, the Legislature granted an appropria-

the conditions under which both instructors and students can work in this new building will mark a new era in the chemistry of the University." ------ George B. Frankforter, Dean.

The report of G. B. Frankforter to the President in 1913-14 states; "Unfortunately, the appropriation granted by the legislature was not sufficient to complete the building as planned. On the contrary, only three-fourths of the building could be completed by the appropriation. Lack of funds made it necessary to utilize all the old equipment not disintegrated by acid, fumes, etc." The legislature made another appropriation which still was inadequate to take care of all equipment desired.

In 1914-15, the report indicated a material increase in the number of students registered in chemistry. "The work has improved due partly to the better laboratory equipment and partly to the fact that the number of students per instructor has been somewhat reduced by increasing the number of instructors."

In 1915-16, we again read, "Unfortunately the large laboratories are crowded; some of the students in the main laboratory have no regular laboratory locker desks and have been compelled to use small boxes for their apparatus, chemicals and problems."

"The organic laboratory as indicated in the original plans was in the part left out on account of lack of funds. A temporary organic laboratory was installed in the basement (our present technological laboratory, room 10). The unexpected increase in the number of organic students due especially to the introduction of organic chemistry in some of the professional schools, as for example, dentistry, has made it impossible to accommodate all the students in this temporary room. A large number of organic students are now working in the quantitative laboratory, a necessary but unfortunate arrangement."

"There has been a material increase in the number of students taking chemistry since the last reports."

By 1910-11, the school itself was all well organized; the faculty at that time included Dr. Frankforter, Professor G. F. Sidener, Assistant Professors Derby, Harding and Nicholson, and the following instructors: Brenton, Brinton, Bliss, Cohen, Frary, Handy, Hunter, Nye, Pattijohn and Sternberg. Among the assistants of that period were Farrington Daniels now Professor of Physical Chemistry at Wisconsin and G. Dietrichson, now research associate at the Massachusetts Institute of Technology. There were 83 students in the School - 81 men and 2 women.

At the close of the senior year in 1910, the class with Drs. Harding and Frary made the first industrial trip of a week's duration to industrial plants of Chicago and other neighboring industrial centers. In the Regents' Report, we read the following: "$60 is to be granted as the traveling expenses of Instructors in the School to accompany the class to Chicago and to visit great chemical industries there." (May 13, 1910). Later on the Regents became more generous and allowed the instructors $70.

At this time a course in metallography was introduced in which the microstructure of metals and alloys was studied. This course was given by Professor Sidener and Brinton. Later on, however, the School of Mines offered all work in metallography.

"There were nine assistants in chemistry at $500 per annum, who gave twelve to fifteen hours of service a week. The object of the assistantship was to provide the department with efficient assistance, especially in connection with the large laboratory classes and to give the assistants as wide an experience as possible in teaching under competent direction. In addition, each assistant was expected to pursue some line of research whether or not he was working for a degree."

In 1915-16, the annual incidental fee of the School of Chemistry was $55.00. By this time there were many faculty changes, Harding had been made

associate professor, Frary had gone to the Oldbury Chemical Co., at Niagara Falls and Hunter and Derby were advanced to assistant professorships. The instructors included Messrs. Baker, Bliss, Dietrichson, Kritchevsky, Pettijohn, Poppe, Sternberg, Strachan, Temple, and Misses Cohen and Rye. ⟶

The first definite announcement of Divisions in the School is found in the bulletin for 1914-15. No division chiefs nor staffs are mentioned. Sixteen elementary courses were given in the General and Inorganic Division, six different courses in analytical chemistry were given (1) Quantitative (2) Iron and Steel (3) Ore and Slag (4) Mineral and Ore (5) Advanced Quantitative and (6) Water Analysis. Organic offered seven courses including (1) Theoretical Organic, (2) Coal Tar Dyes (3) Chemistry of Essential Oils and Newer Medicinal Compounds and (4) Toxicology. Toxicology was given especially for the medical and pharmaceutical students. The Physical Chemistry Division offered four courses, including one on Radiochemistry. The Technological Division offered four courses in analysis (1) Food (2) Micro (3) Gas and Coal and (4) Paint. Ten courses were given by the Industrial Division including such courses as (1) Industrial (2) Sugar (3) Electro (4) Electric Furnaces (5) and (6) Organic and Inorganic Electrochemical Preparations (7) Photochemistry (8) Color Photography and (9) Photo Engraving.

The curriculum of the course in Analytical Chemistry had been changed to the one that follows:

Freshman Year
General and Analytical Chemistry
Drawing
Algebra, Trigonometry, Analytical Geometry
Metallurgy
Rhetoric
Geology

Sophomore Year
Biology or Botany
Calculus
Inorganic Preparations
Glass Blowing
Quantitative Chemistry
German
Drill
Physics

Junior Year
Photography
Iron and Steel and Ore Analysis
Geology
Metallurgy
Electrochemistry

Senior Year

First Semester
Water Analysis
Food Analysis
Gas and Coal Analysis
Industrial Chemistry
Sugar
Metallurgy

Second Semester
Colloquium
Microchemistry
History of Chemistry
Metallurgy
Bacteriology
Thesis
Review of Organic and Inorganic Chem.

APPLIED CHEMISTRY COURSE (5 years)

Freshman Year
General Inorganic Chem.
Freehand & Mechanical Drawing
Descriptive Geometry
Algebra, Trigonometry and Analytical Chemistry
Geology
Metallurgy
Rhetoric

Sophomore Year
Quantitative Chemistry
Drawing
German
Calculus
Mech. Eng. Shop 6 hrs. per week.
Physics
Drill

Junior Year
Organic Chemistry
Physics, 14 credits
Mech. Eng. Foundry
Mechanics

Senior Year

First Semester
Iron and Steel Analysis
Water Analysis
Physical Chemistry
General Geology
Machine Design
Metallurgy

Second Semester
Physical Chemistry
Electrochemistry
Economics
Steam Engines
Metallurgy
American Government

Fifth or Post Senior Year

First Semester
Gas and Coal
Industrial Chemistry
Steam Boilers
Sugar Chemistry
Electric Power
Elective

Second Semester
Food Analysis
Industrial Chemistry
Electrical Engineering
Elective
Commercial Law
Thesis

By 1916-17, there were a few more changes, Drs. P. H. MacDougall, I. W. Geiger, Lawrence Henderson, E. E. Peck, Carl L. Schumann and H. Lee Ward had been added to the faculty; there were 13 assistants - Walter M. Lauer being one of the assistants in the School at that time. There were 103 students - 101 men and two women - distributed as follows: 43 freshmen, 23 sophomores, 14 juniors, 19 seniors and 1 post senior. In 1917, nine men received the degree of Bachelor of Science in Chemistry, 8 the degree of Bachelor of Science in Chemical Engineering and one the degree of Chemical Engineer. The latter degree was given at the end of the fifth year after the Bachelor of Science in Chemical Engineering had been given for the four year's work of the Applied Course. The degree of analytical chemist was given for the analytical Course in 1905 and 1906, but after that the Bachelor of Science in Chemistry degree was given to the graduates of this course.

Period III. War Period and Reorganization.

In 1917, America became involved in the World War; President Vincent resigned to join the Rockefeller Foundation and Marion LeRoy Burton was elected president of the University in 1917.

Quoting from the President's report for 1917-18: "On October 25, Dean Frankforter asked to be relieved of his administrative duties as Dean, because of his appointment as Major in the Warfare Service at Washington. His request was granted by the Regents and the President of the University was asked by them to assume full and immediate responsibility for the administration of the School."

The first faculty meeting of the school was held November 2, 1917, President Burton presiding. Present were Cohen, Baker, Bardwell, Bliss, Frankforter, Geiger, Harding, Hunter, MacDougall, Nicholson, Schumann, Sidener, Temple and Ward. President Burton asked for unselfish cooperation of the faculty and stated that each member of the faculty must expect to take a part of the burden

of restoring "harmony". As the President had many duties, he appointed William H. Dussey of the mathematics department of the Arts College Executive Secretary under the immediate direction of the President, and he also appointed a special committee on policy. This committee during the year considered the question: Shall the School of Chemistry be continued as a separate college of the University or shall the University work in chemistry be done by a department of chemistry in the College of Science, Literature, and the Arts, by a department in the College of Engineering or by some other form of organization? The majority favored the existence of the School of Chemistry. On recommendation of this committee, the faculty voted February 11, 1918 to recommend to the Board of Regents that the School of Chemistry be continued as a separate college in the University, which was approved by the Board of Regents, March 5, 1918.

The executive secretary, Dr. Dussey was a mathematician not a chemist. During the trying period through which he served, he was a very successful administrator. His success was due to his executive ability, tact and straightforwardness. When his term of service expired, the faculty sent him a letter of appreciation. The greatest difficulty, Dr. Dussey had to contend with was, at first, the depletion of the faculty ranks - six members and eight assistants left during the year to enter government or war service. He also was in charge during the Student Army Training Corps period.

June 3, 1918, Lauder W. Jones of the University of Cincinnati was appointed dean "with the understanding that he continue his service in government research work for the gas defense, and that frequent trips be made to the University of Minnesota in connection with the Reorganization and Administration of the School of Chemistry, Dr. Dussey to continue as Executive Secretary during the war service of Dean Jones."

Lauder W. Jones received his A.B. at Williams College in 1892 and his Ph.D. in 1897 from the University of Chicago. He was assistant professor of chemistry at Chicago from 1897 to 1907, when he left to become head of the department of Chemistry at the University of Cincinnati, where he remained until 1918, when he received the appointment of Dean of the School of Chemistry. He remained in war work until after the armistice, but supervised to some extent the work at Minnesota.

Through Dean Jones' recommendation, M. C. Snead was appointed June 19, 1918 associate professor and acting head of the Division of General Inorganic Chemistry and H. H. Barber was appointed assistant to reorganize and administer the stock room service and lecture demonstrations. During Bussey's administration, the former central chemistry storeroom of the School, located in the basement, was enlarged and made into a general chemical storeroom for the entire University under the management of the office of the comptroller. An electrified dumb waiter was installed to give service to the three main laboratories.

In the fall of 1918, the war department established a Students' Army Training Corps at the University. Quoting from the President's Report 1918-19, "This meant a complete and fundamental transformation of the University by the plans of the War Department." Again he states - "A true University cannot be a military camp. The program of work was too heavy for the average student and military duties interfered with academic responsibilities. The dual administrative control caused much difficulty." The School of Chemistry fared badly with the rest of the University and nothing was accomplished. Due to this S.A.T.C. the semester system had been replaced by the quarter system.

Dean Jones took active charge of the School on January 1, 1919, and during the following year and a half, practically everything in the school was reorganized and changed. As the quarter system had replaced the semester plan

complete curriculum changes had to be made. Courses in elementary chemistry were either dropped or combined, so that where 14 separate courses had been given, only eight were now given to a larger number of students. Many specialized courses with enrollments of five or six students were replaced by "substantial courses to give real discipline in fundamental chemistry." Four specialized courses in analytical chemistry were merged into one. Graduate courses were introduced and for the first time, graduate courses were actually given.

The faculty was enlarged and reorganized into the respective divisions. According to the minutes of the faculty for May 2, 1919, the following divisions were established (1) Technological (2) General and Inorganic (3) Physical (4) Analytical and (5) Organic. Dr. Temple who had been in charge of Industrial did not return after the war, and his work was given under the direction of Dr. Harding of the Technological Division. No one was appointed to take charge of Industrial until the fall of 1919, when Charles A. Mann was appointed associate professor and Director of the Division of Industrial Chemistry.

Dr. Mann received his training at the University of Wisconsin and was instructor there in Chemical Engineering and then became Professor of Chemical Engineering at Iowa State College before coming to Minnesota.

In 1919, the Board of Regents announced that the University would organize an Institute of Technology which should include the School of Chemistry and the College of Engineering and Architecture for the time being, and in the future other units should be incorporated under the same administration. This would provide for "economical correlation of administrative duties and the schools would retain their separate identity." Jones was considered by President Burton as an administrator of the first rank and was therefore chosen as dean.

With this coordination, the title of the "Applied Course" was changed

to the title "Chemical Engineering Course". The five year course was changed to a four year course, with the degree Bachelor of Science in Engineering and at the end of the fifth year, the degree Master of Science instead of Chemical Engineer was granted. The student registered in the graduate school of the University for his Master of Science work. The freshman year in chemistry and engineering was made practically the same.

Dr. Mann was promoted to the rank of professor with the title Acting Head of the Division of Chemical Engineering, later being made Head. So a new division was created. Meanwhile, March 22, 1919 the name "The School of Chemistry" became official and the phrase "analytical and applied chemistry" was dropped. Incidentally in April 1918, the name of the analytical course was changed to the Course in Chemistry. The change in name connoted a change in the type and contents of the courses. A new policy for advanced work was adopted; by this time there were 34 graduate students in the School. The laboratories were not well adapted for the research work that was to be undertaken. The small research laboratories of each division were thrown into single large rooms and equipped as research laboratories to accommodate 15 to 20 students, as the dean felt it was a great benefit for advanced students to associate together while at work. The physical chemistry laboratory was enlarged and modern desks and equipment were installed. Additional space was provided by equipping a room in the basement with modern desks.

The stockroom service was reorganized. Smaller stock rooms were merged into larger ones. Inventories were carefully taken. Lecture demonstration work was organized, and an assistant for that work was appointed. The central storehouse for the School of Chemistry was located in the room formerly used by the chemical museum. The chemical museum which had been so dear to the hearts of all the former chiefs, was completely dismantled and all that is left are the wall cases lining the wall leading to the main auditorium.

The present breakage system was introduced whereby students are held accountable for the care and use of his apparatus and materials. The business office of the school was enlarged with a large central office for details of administration, where an accurate record of students' work and the business affairs of the department are kept. A mechanician at $3000 was employed. Plans were made for completion of the building, for which there was great need as the laboratories were very crowded, courses were being given to 1700 freshmen, while a total of 2200 students were enrolled in all the courses offered by the school.

Industrial trips were taken under the personal supervision and guidance of members of the Chemical Engineering Department to Chicago and nearby points.

The number of assistants was increased to 23, they received $500 per annum. The two fellowships awarded were the Shevlin of $500 and the Dupont of $750. By 1931, the assistant salaries were raised to $650 or $750, where they remained until 1933.

A journal club was started and all graduate students were required to attend without credit. This club was dropped after Dean Jones left and was replaced by division seminars and a biweekly colloquium.

Other changes made during the Jones' administration were the introduction of the Junior Review Examinations and Summer Practice in Chemical Manufacture. Two credits were given for the latter in the senior or post senior year.

Junior Reviews. The Bulletin for 1920 states "at the end of junior year all students registered in the School will be given special examinations in general inorganic chemistry, qualitative, and quantitative analysis. The purpose of these examinations is to strengthen the preparation of the student in the fundamental portions of this course before he enters upon the more advanced work of the senior year."

In July 1920, Dean Jones left the University to become Hepburn professor of organic chemistry at Princeton. President Burton went to Michigan and Dean Lotus D. Coffman of the College of Education became president of the University and Professor Ora Miner Leland of Cornell University was appointed Dean of the College of Engineering and Architecture and the School of Chemistry.

In the bulletin for this period we read "graduates may secure positions in industry as analysts, assistants in research, or state and government positions. There are many new openings as a result of war conditions, the type depends on personality and ability."

Courses offered in the School of Chemistry 1919-1920.

Four Year Course in
Chemistry

Freshman

Chem. 6-7-8 - General Inorganic. 15 cr.
or
Chem. 9-10 - General Inorganic. 10 cr.
Chem. 12 - Qualitative - 5 cr.
Mathematics 11.1, 11.2, 11.3. Applied Math. & Mech. 15 cr.
German 4-5-6. 9 cr.
Drawing, Engineering, Drawing and Descriptive Geometry. 6 cr.
Military Drill, 3 hrs.
Phys. Ed., 2 hrs.

Sophomore

Chemistry 13. Qualitative 5 cr.
Chemistry 20-21. Quant. 10 cr.
Physics, 12 cr.
Mathematics, Applied Mathematics and Mechanics, 12 cr.
German, 9 cr.
Drawing, 6 cr.
Drill, 3 hrs.

Junior

First Quarter	Second Quarter	Third Quarter
Chem. 35, Organic, 5 cr.	Chem. 37, Org. 5 cr.	Chem. 131, Adv. Org. 3 cr.
Chem. 141, Physical, 5 cr.	Chem. 142, Physical, 5cr.	Chem. 143, Physical, 5 cr.
Metallurgy, 3 cr.	Metallurgy, 3 cr.	Met. 5, 3 cr.
Elective in Analytical or Technological Chem. 3 cr.	Elective in Chem. 3 cr.	Elective in Anal. or Tech. 3cr.
		Elective, 2 or 3 cr.

Senior

Chem. 171-2-3, Industrial 15 cr.
Elective in Chemistry 15-18 cr.
Thesis, 15 cr.

The five year course in arts and chemistry covered the same ground as the four year course, but the student carried enough work in the arts college to fulfill the requirements for the B.A. degree as well.

Course in Chemical Engineering

The curriculum in the first three years of the course in chemical engineering was the same as that of the four year course in chemistry.

Senior Year

First Quarter	Second Quarter	Third Quarter
Chem. 171, Industrial, 5 cr.	Chem. 172, Industrial, 5 cr.	Chem. 173, Ind., 5 cr.
Mech.Eng. Heat Engines, 4cr.	Mech.Eng. 144, Heat Engines, 4 cr.	Metallography, 3 cr.
Exp. Eng. Materials Testing Laboratory, 2 cr.	Exp.Eng. and Lab., 2 cr.	Chem. Elective 5-6 cr.
5 or 6 cr. Elective in Chem.	Chem. Elective, 5-6 cr.	Elective, 5 cr.

Post Senior

Industrial, 15 cr.
Elec. Eng. & Power, 9 cr.
Elective, 9-15 cr.
Thesis, 15 cr.

In 1920 the Industrial Division was changed to the Division of Chemical Engineering. The faculty for the School of Chemistry in 1920-21 was as follows:

Lotus Delta Coffman, President
O. M. Leland, Dean
E. E. Nicholson, Dean of Student Affairs.
Lillian Cohen, Asst. Professor →
Geo. B. Frankforter, Professor
F. P. Harding, Assoc. Professor
L. M. Henderson, Asst. Professor
W. H. Hunter, Professor
R. E. Kirk, Asst. Professor
F. H. MacDougall, Assoc. Professor
C. A. Mann, Professor
G. H. Montillon, Asst. Professor
Charles Sidener, Professor
M. C. Sneed, Associate Professor
C. Posso, Instructor
W. M. Lauer, Instructor
L. Leavitt, Instructor
H. C. Pervier, Instructor
L. H. Reyerson, Instructor
L. I. Smith, Instructor

Period IV. Post War.

In the summer of 1920, Ora Miner Leland was appointed Dean of the College of Engineering and Architecture and the School of Chemistry. Dean Leland was born in Grand Haven, Michigan. He received the B.S. (C.E.) degree from the University of Michigan in 1900, the C.E. degree in 1920. He was connected with the U.S. Land Office, the U.S. Coast and Geodetic Survey, and was also a member of the Alaska Boundary Survey 1904-11, and the Costa Rica Panama Boundary Arbitrary Commission 1911-13. He served in the army during the war and was with the Engineers in the A.E.F. in Germany. He entered service as a captain and was advanced in rank to a commission as Colonel. He was a member of the faculty at Cornell, and head of the department of topography and geodetic engineering from 1911-1920.

The development of the School of Chemistry under Dean Leland kept pace with the times; changes were made in the buildings, changes in the mode of administration and changes in the faculty and curricula.

Building Changes. By 1922, the fourth quarter and the roof house of the Chemistry building were completed with an increase of floor space from 90,000 square feet to 138,300 square feet. Four modern laboratories were added, one in the basement equipped for chemical manufacture, a first floor laboratory which at first was used as an advanced inorganic and research laboratory but later was converted into a physical chemistry laboratory with space for research students in physical chemistry.

Extensive changes were made in the library. The old library was converted into a reading room and a modern library was constructed.

The new second floor laboratory was equipped for inorganic and qualitative chemistry and the third floor one for organic chemistry. The old organic laboratory in the basement was used for technological chemistry. Part of the

fourth floor was converted into drawing rooms for the Engineering College and for the School of Chemistry, the rest was used for ventilating equipment and two large lecture rooms. The total cost of this addition was $398,000. Since 1922, a good deal of minor remodelling has been done, the greatest change being made in 1931-32, when one of the large lecture rooms of the fourth floor was converted into an exceptionally well equipped organic research laboratory.

The Dean of Student Affairs and the Federal Board Coordinator occupied rooms on the second floor until the administration building was completed, when those rooms were converted into offices and research laboratories for the division of inorganic chemistry. Outside of the drawing rooms, part of the basement and most of the subbasement which is used by the General Storehouse of the University, the Chemistry Building is occupied by the School of Chemistry.

Library. The School of Chemistry Library is considered one of the three best university chemical libraries in the country and owes its growth to the farsightedness of Dean Frankforter, who laid the foundation by subscribing to the best foreign and American chemical periodicals. The first library was a room adjoining the dean's office in the old chemistry building. The room contained a large reading desk and a few hundred volumes. With the removal to the new building and the growth of both library and school, it was recognized that to make the best use of the library facilities an attendant would be needed, and in 1917, Mrs. Kathryn Crowley was appointed to the position of librarian-stenographer. With the new addition to the library, Mrs. Crowley was continued in the position of librarian. By 1926 there were over 7,085 volumes in the library with over 5,000 bound periodicals. 74 periodicals were subscribed for regularly. At present there are over 8000 books and subscriptions which includes about 100 periodicals.

Administration Changes. No general faculty meetings were held during the administration of Dean Jones, all the work being done by the Executive Committee,

made up of the division chiefs or acting chiefs and the dean. December 8, 1920, the Executive Committee ruled that faculty meetings of the School were to be held at the beginning of the college year and near the end of each quarter.

After the war, there was a large influx of students and the staff was not adequate. At that time, teaching did not seem to be a lucrative profession for chemists and it became increasingly difficult to secure able men for "openings" on the staff. It is of special interest to note that the Executive Committee of the faculty in session August 1920, decided to insert advertisements in Science and in the Journal of Engineering and Industrial Chemistry for instructors and assistants. The same committee agreed that the normal schedule for instructors should be twelve hours recitations or lectures or eighteen hours of laboratory teaching.

In 1925-26, the supply and equipment service was reorganized and H. H. Barber was made superintendent. The service is maintained under four headings: (1) Stockroom service, (2) Instrument service, (3) Shop-construction and repair of instruments and equipments, and (4) Lecture demonstration and preparation service.

Other minor changes and developments include the following: In 1921 women were permitted to take the chemical engineering course, which previously had been restricted to men. Miss Ruth Sher (Mrs. Cecil Mayo) who received the degree Ch.Eng. 1925 is so far the only woman registered in the course. In 1922, a new curriculum was made for the four year course in chemistry. In 1923, it was voted to publish a chemistry handbook with rules and regulations applying to the students in the school. Before 1923, the Inspection trip was optional, but in this year the trip became a regular course necessary for graduation from the chemical engineering course. In 1925, the Arts and Chemistry course was discontinued.

Chemical Society, president of the Minnesota Section of the American Chemical Society. He was a member of the committee on organization of the Eighth International Congress of Applied Chemistry. In the President's report for 1925-26, we find this tribute from President Coffman - "His chief work was that of thirty-three years' service to his students. He saw the School of Chemistry develop from a small and insignificant department into an influential school in a new building well equipped in every respect. The University is grateful for the faithful and devoted service of Dr. Frankforter. It joins with thousands of his students in wishing him many years of active interest in his chosen field." Dr. Frankforter spent the year 1925-26 teaching at Leland Stanford University and retired at the close of that year.

The retirement of Dr. Frankforter left an important position to be filled. The Executive Committee wished to fill this vacancy with an outstanding professor. A lectureship for the next year was suggested and lectures were to be given by men which included other leading chemists as well as the candidates. The series of lectures were given during the year 1925-26 under the auspices of the School of Chemistry by the following distinguished chemists: F. G. Cottrell, James Kendall, W. D. Noyes, W. K. Lewis, S. C. Lind and W. Lash Miller, the latter from the University of Toronto.

In 1926, Samuel Colville Lind was appointed professor and director of the School. Dr. Lind received his B.A. in 1899 from Washington and Lee University, his B.S. in 1902 from Massachusetts Institute of Technology and his Ph.D. in 1905 from the University of Leipzig. During 1910-11, he studied at the University of Paris with Madame Curie and at the Institute for Radium at Vienna. From 1905-1914, he was on the chemistry staff at the University of Michigan. He was connected with the Bureau of Mines at Golden and Reno, and was Chief Chemist at Washington in 1923 and in 1925 he was Associate Director of the Fixed Nitrogen

Research Laboratory at Washington. Dr. Lind was elected to the National Academy of Science in 1930, was President of the Electrochemical Society in 1927, was awarded the Nichol's Medal from the New York Section of the American Chemical Society for the most outstanding work in the field of chemistry for 1925. He was appointed a member of the International Radium Standards Commission. In 1926 the American Petroleum Institute made an annual grant through the National Research Council of $4500 for research on the Chemical Effect of the Electric Discharge in Hydrocarbons under the direction of Dr. Lind. Dr. George Glockler was appointed research associate in prosecution of this research and continued until 1929, when he was made associate professor of inorganic chemistry. His place was taken by Dr. George Schultze. The grant was continued until 1931.

In 1927, Dr. Izaack M. Kolthoff of the University of Utrecht, Holland was appointed professor of analytical chemistry and in 1928 he was made Chief of the Division of Analytical Chemistry. Dr. Kolthoff's interest is largely in the field of indicators and coprecipitation from both the theoretical and practical view points.

Until the summer of 1931, the School had suffered no losses by death. In August of that year Dr. William H. Hunter, Chief of the Organic Division died, and a year later Dr. Assistant Percy Harding, who had retired the year previous because of failing health, died.

Dr. Hunter was born in Boston, Massachusetts in 1882. He received his training at Harvard, being granted his doctor's degree in 1912. In 1909, he was appointed to an instructorship in organic chemistry at the University of Minnesota and at the time of his death held the position of Chief of the Division of Organic Chemistry.

"Dr. Hunter was well read and one of the outstanding leaders in the development of graduate studies at the University of Minnesota." He represented

chemistry on the Graduate School Science Group Committee for several years. He was considered one of the most outstanding educators at the University.

Dr. Everhart Percy Harding was a native of Minnesota, being born in Waseca in 1870. He attended the elementary schools and the University of Minnesota and obtained his Ph.D. at Heidelberg, Germany in 1901. During his undergraduate years, he was a famous football player and after graduation maintained his interests in athletics, devoting much of his time to the Athletic Board of Control.

With Dr. Hunter's death, staff changes were made, Dr. Leo Irvin Smith was promoted to acting head and eventually became Chief of the Organic Division. Dr. Smith is an energetic and excellent executive and has had the same zeal for graduate and research work as his distinguished predecessor.

The Technological Division, which had never been officially recognized by the Board of Regents (neither has the Division of Physical Chemistry received this recognition), was discontinued on Dr. Harding's retirement. The courses and staff were divided between the Division of Analytical and Chemical Engineering. Since that period some of these courses have been modified and some dropped and new ones added.

Salaries and Promotions. Toward the close of the administration of President Burton in 1920, the Board of Regents adopted a definite minimum salary schedule for the various ranks. From that date, salary increases and promotions for cause were the general rule. Until the year 1932-33, there were no reductions in salary, in that year, the faculty took a voluntary cut of approximately 5% of their salary on account of the depression - the proceeds of which were used for scholarships. In 1933-34, a definite salary cut was made on all salaries over $1200. There was a reduction in the number of half time assistants, and the salary was reduced to $600. Some quarter time assistants were appointed at $300.

Prizes, Awards and Fellowships. During this period, the increased interest shown by the general public and the students themselves, is shown by the number of awards and prizes offered.

Two of the Guggenheim Fellowships for research and study abroad were awarded respectively to Dr. Lloyd H. Reyerson in 1927-28 and to Dr. Nelson W. Taylor in 1929-30. They both spent this period largely in study in Germany. The Langmuir Prize, is an award of $1000 and a certificate of award granted annually by the American Chemical Society to be known as the American Chemical Society Award in Pure Chemistry. Its aim is to stimulate and encourage young men and women in research. It is awarded to that person who had done the most promising chemical research work for that year, and who has not attained his thirty-first birthday. The award in 1934 was given to C. Frederick Koelsch, an instructor in Organic Chemistry of the University of Minnesota. The Twin City Alumni Association of Alpha Chi Sigma Fraternity offers an annual prize of books to the value of $10 to that male sophomore in the School of Chemistry having the highest scholastic average at the end of the winter quarter. A gift of $25 annually from the faculty of the School of Chemistry for the establishment of an annual prize of $25 in scientific books or journals to the senior who, while registered in the School of Chemistry, has attained the highest scholastic average in the work of the sophomore and junior years and the first two quarters of the senior year. Phi Lambda Upsilon, national honorary chemical fraternity, offers an annual prize of $15 to that male sophomore student registered in the School of Chemistry, or specializing in agricultural biochemistry, who shall have the highest scholastic standing up to the beginning of the spring quarter, as certified by the registrar upon a prescribed basis.

Changes in Curricula. With the changes of the years, new fields which seem to promise opportunities for chemists have opened. With this in view the

curriculum for the four year course in chemistry was so arranged that a student could start specializing in chemistry as applied to allied fields such as geology, biochemistry and bacteriology. In 1934, curricula was arranged with the School of Business so that a student at the end of five years could have a degree in Chemistry or Chemical Engineering and Business. Changes in entrance requirements have been made. Applicants who stand in the upper 60 per cent of their high school class on the basis of scholarship are admitted directly. Others will be given individual consideration. Since 1924, Iowa Placement Tests in English, Chemistry and Mathematics are given in the fall to entering freshman. All applicants must have as entrace requirements, solid geometry, higher algebra and high school chemistry.

Meetings. The National Colloid Symposium of the National Research Council was held in 1925 at Minnesota. Eminent chemists in the field of colloid chemistry came here from many parts of the United States and Canada. Dr. Herbert Freundlich, now of London, but at that time of the Kaiser Wilhelm Institute, Berlin, Germany, was the guest lecturer. Dr. Langmuir, Nobel Laureate of 1932, also took a very active part in the meeting. After the meeting, Dr. Freundlich remained as guest lecturer during the first summer session. All the papers given at this symposium are found in the Colloid Symposium Monograph, Volume III.

In May 1928, the Midwest Regional Meeting of the American Chemical Society was held at Minnesota. In August 1929, at the second summer session, a Symposium on Chemical Activation was held by the School of Chemistry . The visiting lecturers were the outstanding chemists, Professor Hugh S. Taylor of Princeton, and Professor M. Polanyi of the University of Berlin, now at the University of Manchester. Dr. Lind was the resident lecturer. This symposium preceded the seventy-eighth general meeting of the American Chemical Society,

which was held in Minneapolis September 9-13, 1933. There were 1175 members and guests registered. Irving Langmuir presided. Among the distinguished foreign guests present were Dr. Max Bodenstein, of the University of Berlin, Dr. F. Perrin of the Physical Chemical Institute of Paris, Dr. K. F. Bonhoeffer now professor at the Kaiser Wilhelm Institute, Berlin, Professor A. E. Chichibabin of Moscow and Professor James Kendall of the University of Edinburgh, Scotland. The Priestley medal of the Society was presented to Francis R. P. Garvan of New York for distinguished service to chemistry. Mr. Garvan being unable to be present on account of illness, made his address of acceptance over the radio.

The scientific contribution of this meeting was the lecture demonstration of Bonhoeffer of the presence of para ortho hydrogen in hydrogen. Dr. Langmuir made the presidential address on "Modern Concepts in Physics and Their Relation to Chemistry."

The American Association for the Advancement of Science met in Minneapolis in June 1935. Division C or Chemistry held a two day session, during which several papers prepared by members of the chemistry faculty were given.