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The College of Arts and Sciences

Announcement of the Department of Chemistry for 1930-31

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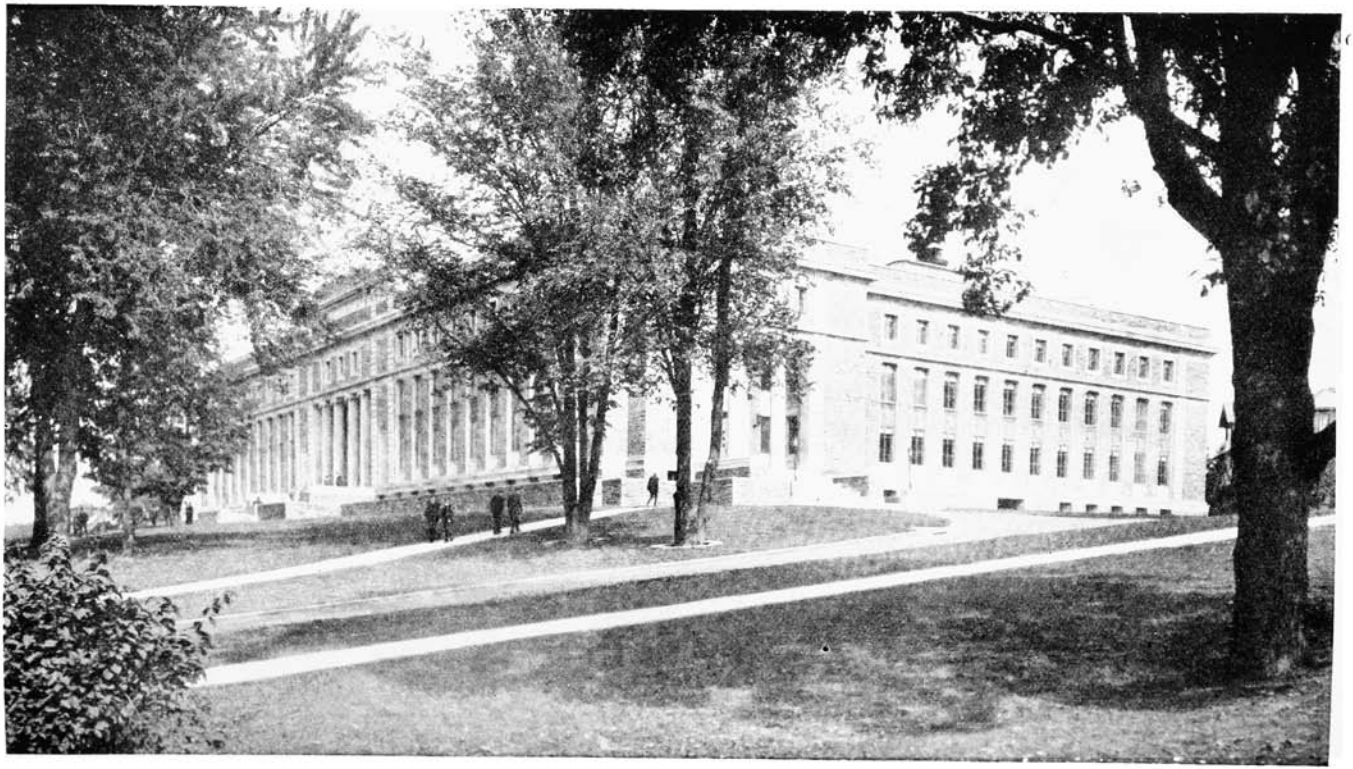

THE BAKER LABORATORY OF CHEMISTRY

DEPARTMENT OF CHEMISTRY

STAFF OF INSTRUCTION

LOUIS MUNROE DENNIS, D.Sc., Head of the Department and Professor of Inorganic Chemistry.
WILDER DWIGHT BANCROFT, Ph.D., D.Sc., Professor of Physical Chemistry.
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CHARLES WALTER MORSE, Ph.D., Instructor in Analytical Chemistry.
HAROLD ARTHUR BEDIENT, Ph.D., Instructor in Sanitary Chemistry.
GEORGE CROSBIE FLOYD, A.B., Instructor in Analytical Chemistry.
ARTHUR WALTHER LEWIS, B.Chem., Instructor in Industrial Chemistry.
RALPH COLTON TALLMAN, A.B., Instructor in Organic Chemistry.
ALFRED WILLIAM AVENS, B.S., M.S., Instructor in Analytical Chemistry.

ASSISTANTS IN CHEMISTRY, 1929–30

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WILLIAM JAMES CONGDON, B.Chem.
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DAVID ADAMS FLETCHER, B.A.
WILLIAM DAVID FORGENG
ALTON GABRIEL, B.S., M.S.
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LAWRENCE PEABODY GOULD, B. Chem.
WENDELL PHILLIPS HAWTHORNE, B.S.
EARL JONES HOAGLAND, A.B.
ALFRED GORDON HOUPT
DAVIS HALBERT HOWARD, JR., A.B.
HENRY CROCKER KETCHAM, B.Chem.
JULIUS ANSON KUCK, 3RD, A.B.
JAMES WILBUR LEONARD
FLOYD EDWARD LOVELACE, A.B.
PAUL PENDLETON MCCLELLAN, B.S., Chem. Eng.
NELSON FRANCIS MURPHY, Ch.E.
LELAND BERNARD NORTON, B.S.
WINTON IRVING PATNODE, B.Chem.
JAMES ALBERT RAYNOLDS, B.S.
RICHARD ALVIN REINECKE, B.S.
JESSE LEROY RIEBSOMER, B.A.
JOSEPH CHARLES RINTELEN, B.S. Chem.
ASHLEY ROBEY, B.S., M.S.
FREDERICK WILLIAM SCHUMACHER
ANTHONY MAX SCHWARTZ, B.Chem.
EUGENE WARREN SCOTT, B.S.
KENNETH WAYNE SHERK, A.B.
ALBERT CORNWELL SHUMAN
NORMAN ALEXANDER SKOW, B.S., M.S.
WILLIAM ROGERS SUTTON, B.Chem.
PAUL WENDELL VITTUM, A.B.
CHARLES OLIVER WILLITS
MAYNARD FAYETTE WITHERELL, B. Chem.

FELLOWS AND SCHOLARS IN CHEMISTRY 1929–30

The Sage Fellowship: RAYMOND CLIFFORD INGRAHAM, B.S., M.S.
The Grasselli Fellowship: ROBERT EDWIN HULSE, B.S., M.S.
The duPont Fellowship:: WALTER JEBENS, B.S., M.S.
The Graduate Scholarship: WILLIAM DWIGHT WARREN, B.S., M.S.

NON-RESIDENT LECTURESHIP

The George Fisher Baker Non-Resident Lectureship in Chemistry at Cornell University was established early in the year 1926 by a gift of $250,000 from Mr. Baker, the income to be used by the University for the benefit and advancement of teaching and research in Chemistry and allied sciences. Under this plan the University invites eminent men of science to come to Cornell, each for one or two semesters, to present the most recent advances, and the methods and results of their own investigations, in the fields in which they have won distinction. A private office and a research laboratory are placed at the disposal of the Non-Resident Lecturer and he is thus enabled to carry forward investigational work while in residence at Cornell.

The Non-Resident Lecturers under the George Fisher Baker Foundation deliver two lectures a week, and hold a colloquium. In some cases they also conduct experimental research with a few advanced students. The Lecturers thus far have been:

Ernst Cohen, Professor of Physical and Inorganic Chemistry, University of Utrecht, Holland. *Second term, 1925–26.*

Fritz Paneth, Professor of Inorganic Chemistry, University of Berlin, Germany. *First term, 1926–27.*

A. V. Hill, Foulerton Research Professor of the Royal Society of London, England. *Second term, 1926–27.*

Paul Walden, Professor of Chemistry, University of Rostock, Germany. *First term, 1927–28.*

George Barger, Professor of Chemistry in its Relations to Medicine, University of Edinburgh, Scotland. *Second term, 1927–28.*

Hans Pringsheim, Professor of Chemistry, University of Berlin, Germany. *First term, 1928–29.*

F. M. Jaeger, Professor of Physical and Inorganic Chemistry, University of Groningen, Holland. *Second term, 1928–29.*

G. P Thomson, Professor of Natural Philosophy, University of Aberdeen, Scotland. *First term, 1929–30.*

K. Fajans, Professor of Physical Chemistry, University of Munich, Germany. *Second term, 1929–30.*

The program for these lectures through the year 1931–32 is as follows:

First Term, 1930–31

Professor G. Hevesy, University of Freiburg in Baden, Germany.
Topics of Lectures:
A) Chemical Analysis by X-rays and Its Application
B) Rare Earth Elements and Atomic Structure
C) Chemistry of Hafnium
D) Electrolytic Conduction and Diffusion in Solids
E) Separation of Isotopes.

Second Term, 1930–31

Doctor N. V. Sidgwick, Lincoln College, Oxford, England.
Topic of Lectures: Molecular Structure and the Periodic Classification.

FIRST TERM, 1931–32

Professor W. L. BRAGG, University of Manchester, England.
Topics of Lectures:
A) Crystal Structure and Methods of X-ray Analysis.
B) Structure of Simple and Complex Inorganic Salts.
C) Aliphatic and Aromatic Organic Crystals.
D) X-ray Optics.

SECOND TERM, 1931–32

Professor ALFRED STOCK, Technische Hochschule, Karlsruhe, Germany.
Topic of Lectures: To be announced later.

HECKSCHER RESEARCH FOUNDATION

August Heckscher in 1920 endowed a Foundation for the Promotion of Research at Cornell University. Numerous grants to members of the Staff of the Department of Chemistry have been made from this fund, and several advanced students now hold positions as Heckscher Research Assistants.

ASSISTANTSHIPS AND FELLOWSHIPS

A number of Teaching Assistantships, (which are really working fellowships) are open to graduate students majoring in Chemistry. Applications for these positions should be filed with the Department before March 1.

Fellowships and Scholarships are ordinarily awarded to students who have had at least a year of graduate study. Applications for them should be filed before March 15.

THE CALDWELL PRIZE

An annual prize of fifty dollars was established by Grace Caldwell Chamberlain and Francis Cary Caldwell in memory of their father, George Chapman Caldwell, Professor in the Department of Chemistry from 1867 to 1902, and Head of the Department until 1902. It is awarded by the Staff of the Department to a member of the Senior class in recognition of general excellence in chemistry. The prize was awarded in 1929 to Lawrence Peabody Gould. The previous winners were: 1914, A. Bridgman; 1915, F. R. Georgia; 1916, C. G. Stupp; 1917, B. H. Carroll; 1918, M. L. Nichols; 1919, L. H. Clark; 1920, A. C. Wintringham and M. P. Woodward; 1921, H. F. Vieweg; 1922, R. E. Burk; 1923, E. L. Arnold; 1924, T. Parsons, jr.; 1925, H. A. Lovenberg; 1926, R. M. Herbst; 1927, Miss Florence Bush; 1928, M. Benedict.

COLLEGE OF ARTS AND SCIENCES

The requirements for entrance to the courses leading to the degree of Bachelor of Chemistry or to that of Chemical Engineer, together with information concerning tuition, fees, living expenses, scholarships, prizes, financial assistance, and opportunities for self-support, will be found in the General Information Number, which may be obtained from the Secretary of the University.

Students who do not present, on entrance, at least two units of French and two units of German, will be required to make up the shortage before the beginning of the junior year. This may not be done, except with special permission of the Department, by taking University courses in French or German during the academic year.

THE COURSES IN CHEMISTRY

The Department of Chemistry offers a four-year course leading to the degree of Bachelor of Chemistry. Graduates who have fulfilled the requirements for this degree, or the substantial equivalent thereof, may obtain either the degree of Master of Chemistry or the degree of Chemical Engineer by completing satisfactorily one additional year of study. The additional year of residence required for either of these degrees may, upon recommendation of the student's special committee, be accepted as satisfying one year of the residence requirement for the degree of Doctor of Philosophy. The four-year course leading to the degree of Bachelor of Chemistry is not a prerequisite for the degree of Master of Arts or Master of Science with major subject in Chemistry.

The Degree of Bachelor of Chemistry

The degree of Bachelor of Chemistry will be awarded to those who have satisfactorily completed either of the following curricula, and the requirements prescribed by the University in Hygiene and Preventive Medicine and in Military Drill or in Physical Training. The completion of Curriculum No. 2, or its substantial equivalent, is required for admission to the fifth year of study leading to the degree of Chemical Engineer (see page 8). Since the first two years of work are identical in the two curricula, the student is afforded ample time to discover whether his interests lie chiefly in the field of pure chemistry or in the field of chemical engineering before he is compelled to decide upon his further course of study.

CURRICULUM No. 1

First Year

	Course	*First Term*	*Second Term*
Introductory Inorganic Chemistry	Chemistry 101	3	–
Inorganic Chemistry Laboratory	Chemistry 105	3	–
Introductory Qualitative Analysis	Chemistry 205	–	3
Qualitative Analysis Laboratory	Chemistry 206	–	3
Analytic Geometry and Calculus	Mathematics 5a, 7	5	5
Introductory Experimental Physics	Physics 3, 4	3	3
English	English 1	3	3
		17	17

Second Year

Introductory Organic Chemistry	Chemistry 305	3	3
Organic Chemistry Laboratory	Chemistry 310	3	3
Introductory Quantitative Analysis	Chemistry 220	3	–
Quantitative Analysis Laboratory	Chemistry 221	3	–
Introductory Chemical Spectroscopy	Chemistry 505	–	3
Gas and Fuel Analysis	Chemistry 250	–	4
General Physics	Physics 31, 32	2	2
Physical Measurements	Physics 34	2	2
Drawing	Engineering 125	3	–
		19	17

THIRD YEAR

Introductory Physical Chemistry	Chemistry 405	3	3
Physical Chemistry Laboratory	Chemistry 410	3	3
Advanced Inorganic Chemistry	Chemistry 130	3	3
Introductory Chemical Microscopy	Chemistry 530	3	–
Advanced Quantitative Analysis	Chemistry 230	–	4
Elementary Mineralogy	Geology 311	3	–
Introduction to Economics	Economics 3	–	3
Elective		3	3
		18	19

FOURTH YEAR

Introductory Industrial Chemistry	Chemistry 705	3	3
Seminary	Chemistry 905	–	1
Research for Seniors	Chemistry	4	4
Chemical Engineering	Chemistry 710	–	4
Electrical Engineering	Engineering 417	4	–
Elective	(at least)	6	6
		17	18

CURRICULUM No. 2

(This curriculum is prerequisite to registration for the degree of Chemical Engineer.)

FIRST YEAR

As in Curriculum No. 1

SECOND YEAR

As in Curriculum No. 1

THIRD YEAR

	Course	*First Term*	*Second Term*
Introductory Physical Chemistry	Chemistry 405	3	3
Physical Chemistry Laboratory	Chemistry 410	3	3
Advanced Quantitative Analysis	Chemistry 230	4	–
Mechanics	Mechanics 330	6	–
Mechanics	Mechanics 331	–	5
Introductory Engineering Laboratory	Engineering 103	1	–
Materials of Construction	Engineering 360	2	2
Introduction to Economics	Economics 3	–	3
Elementary Mineralogy	Geology 311	–	3
		19	19

FOURTH YEAR

Introductory Industrial Chemistry	Chemistry 705	3	3
Industrial Organization	Engineering 380	–	2
Heat-Power Engineering	Engineering 343	3	3
Mechanical Laboratory	Engineering 368	3	–
Mechanical Laboratory	Engineering 369	–	3
Advanced Inorganic Chemistry	Chemistry 130	3	3
Introductory Chemical Microscopy	Chemistry 530	3	–
Research	Chemistry	4	4
		19	18

Candidates for the degree of Bachelor of Chemistry are required to take at least eight hours in research during the senior year in a division of the Department to be selected by the student. These divisions are: Inorganic Chemistry (Course 195); Analytical Chemistry (Course 295); Organic Chemistry (Course 395); Physical Chemistry (Course 495); Optical Chemistry (Course 595); Sanitary Chemistry (Course 695); Industrial Chemistry (Course 795); Agricultural Chemistry and Biochemistry (Course 895).

Students in the Courses in Chemistry may not register for more than 20 hours a term without first securing the consent of the Department.

The degree of Bachelor of Chemistry, granted upon completion of the four-year course of study just outlined, has a significance that is in some respects unique, and, in so far as a degree may do so, represents a distinctive type of training which its holders have undergone. Although for many years a certain sequence of courses has been required of all students majoring in chemistry, the present degree originated only after careful consideration and trial of its prerequisites. Since 1910, when it was first announced, the course in chemistry has been tested in the classroom as well as by more than four hundred alumni, and minor modifications in its curriculum have been made in the light of the development of the science and the demands of industry.

The large majority of Bachelors of Chemistry go into some field of industrial work, and the course in chemistry is planned to give them the training necessary for positions either in the research laboratory or in the plant. This preparation is primarily in the fundamental divisions of chemical science; it moreover includes instruction in special branches designed to acquaint the student with the best modern methods of attacking the various problems that may arise in the future practice of his profession. In the curriculum for this degree, some instruction in engineering subjects is included so that the student may be acquainted with the methods and point of view of the engineer. Students are required to spend a considerable portion of their fourth year in research, and in this way gain first-hand experience in the methods of investigation, both in the library and in the laboratory.

The Degree of Chemical Engineer

A holder of the degree of Bachelor of Chemistry who has completed Curriculum No. 2, as given above, may obtain the degree of Chemical Engineer by completing a fifth year of study offered jointly by the College of Engineering and the Department of Chemistry of the College of Arts and Sciences. The curriculum for this fifth year leading to the degree of Chemical Engineer is as follows:

Course		First Term	Second Term
Electrical Engineering Lectures	Engineering 415	3	–
Electrical Engineering Lectures	Engineering 416	–	3
Electrical Engineering Laboratory	Engineering 435	2	–
Electrical Engineering Laboratory	Engineering 436	–	2
Mechanical Engineering Laboratory	Engineering 372	2	–
Chemical Engineering Laboratory	Chemistry 710	–	4
Machine Design	Engineering	3	–
Chemical Plant Design	Chemistry 730	3	3
Electives		5	5
		18	17

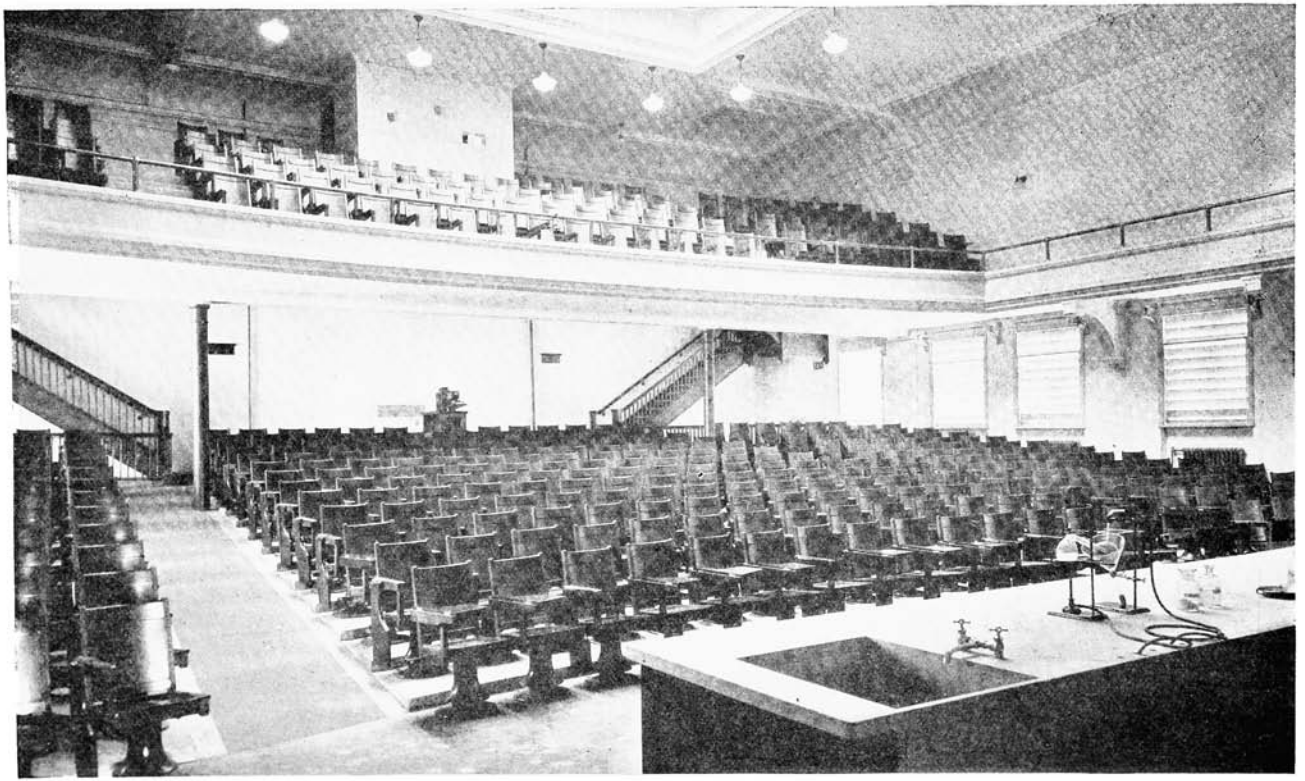
The course of study leading to the degree of Chemical Engineer is intended primarily to prepare the graduate for technical work involving the development and supervision of the operation of industrial chemical processes and plants. It comprises instruction not only in the theoretical principles of chemistry and engineering, but also in the methods of applying these principles to the solution of the problems that arise in the industries.

Choice of Electives

Although the Courses in Chemistry and in Chemical Engineering are rather highly specialized, they include a sufficiently large portion of electives to enable the student to broaden his education by taking courses in Literature, Public Speaking, Education, Psychology, Philosophy, History, Economics, and other humanistic studies, or to pursue intensive study in pure or applied science.

The first three years of the university work of a candidate for the degree of Bachelor of Chemistry are devoted to training in fundamental theories, applications, and methods, of chemistry and of allied sciences. By the fourth year, when the student undertakes a research problem in one of the Divisions of the Department, he should have some idea as to the field of chemistry which is most attractive to him, and should be looking ahead toward his career after graduation. It is eminently desirable that the student's choice of electives should be made after such consideration, and the student is advised to consult with his class adviser during the junior and senior years in order that this may represent a certain continuity of purpose.

Where electives are included in the junior year, these should be selected so as to insure adequate preparation for the senior research work. The elective hours of the senior year may be devoted to courses in the "humanities," or to advanced courses in Chemistry or in allied sciences such as Physics, Geology, Botany, and Biology, or emphasis may be placed upon the engineering phases of Chemistry. By a proper choice of electives the student who wishes to secure a more extensive training than is offered in the Courses in Chemistry, may extend his studies over five years, interspersing additional elective courses throughout this period. Such a five-year course is particularly recommended for students desiring a broadly cultural training in addition to their specialized work in Chemistry.



MAIN LECTURE ROOM

OPPORTUNITIES FOR EMPLOYMENT AFTER GRADUATION

The student's occupation as a chemist after graduation is likely to fall into one of the following classes:

Inspection and control, in industrial, institutional, or government laboratories,

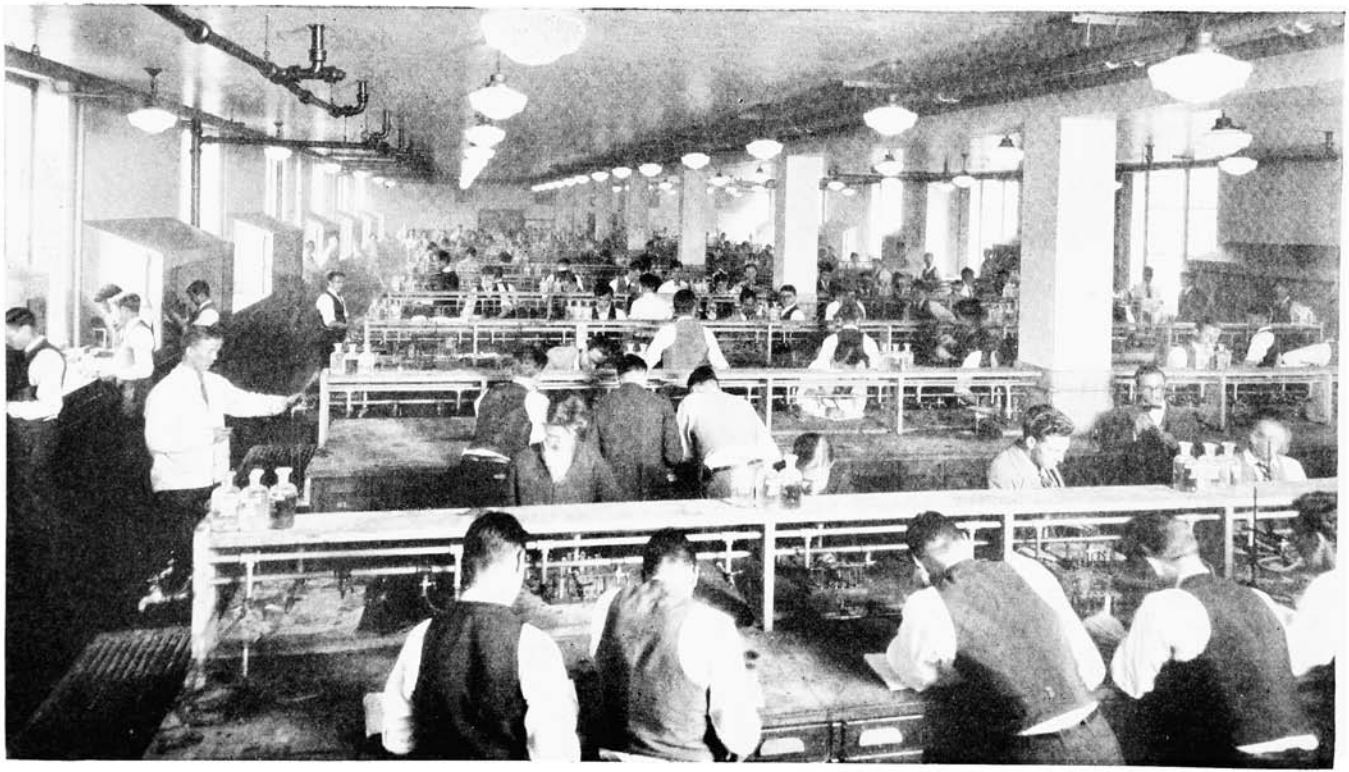
Supervision of operation in chemical plants,

Research and development,

Technical sales or technical purchases,

Teaching.

A Committee on Employment has charge of finding suitable positions in the above fields. It is constantly in touch with commercial organizations which employ chemists, and which frequently send representatives to visit the Baker Laboratory for the purpose of interviewing seniors and graduate students who may wish to enter their employment. For a number of years the demand for Cornell chemists has exceeded the supply in the ratio of about three to one. Great care is taken to aid the young graduate, the more mature holder of a Doctor's or Master's degree, or the experienced alumnus, in securing the type of position for which he is best fitted and in which he may be most interested.



LABORATORY OF INTRODUCTORY INORGANIC CHEMISTRY

GRADUATE WORK IN CHEMISTRY

In any of the possible careers mentioned above, the scientific and economic position of a chemist is greatly advanced by post-graduate training. In research or plant work the holders of advanced degrees are given preferment, while for teaching positions in institutions of collegiate rank the doctor's degree is usually prerequisite. The number of graduate students in the Department of Chemistry is constantly increasing, and at present some seventy are candidates for the degree of Doctor of Philosophy with major in Chemistry. In order that this degree may have a uniform significance, graduates of other universities are required to present the substantial equivalent of the chemical training included in the Courses in Chemistry, (see p. 6) or to complete this during their graduate study at Cornell. Such prerequisite courses will normally be taken during the first half of the candidate's period of residence, and together with the minor subjects, should give him a sound foundation for the major research problem which will occupy the greater part of his last two years of residence.

REQUIREMENTS FOR GRADUATE STUDY

The announcement of the Graduate School gives information regarding the general requirements for graduate work at Cornell and, the following paragraphs are to be considered as supplementing but in no way superseding these requirements.

All graduate students in chemistry are required to register at the Record Office of the Department of Chemistry, at the beginning of each term of residence, and to file at this office, as well as at the office of the Graduate School, all records of changes in registration, or in major and minor subjects, of completion of language requirements, and of the passing of qualifying examinations.

MASTER OF ARTS, MASTER OF SCIENCE

(Major outside of Chemistry)

PREREQUISITE COURSES

The equivalent of

Introductory Inorganic Chemistry	101 and 105
Shorter Course in Qualitative Analysis	210
Shorter Course in Quantitative Analysis	225

MINOR.—The candidate shall have such a knowledge of the minor subject as could be acquired by six credit hours of work in the field.

MASTER OF ARTS, MASTER OF SCIENCE

(Major in Chemistry)

PREREQUISITE COURSES

The equivalent of

Introductory Inorganic Chemistry	101 and 105
Longer Course in Qualitative Analysis	205–206
Longer Course in Quantitative Analysis	220–221
Introductory Organic Chemistry	305–310

It is further required that the student take the lecture course in Introductory Physical Chemistry, 405, either in connection with the major or minor work or in addition to it. It is desirable that the laboratory course in Introductory Physical Chemistry, 410, should also be taken.

MINOR.—The candidate shall have such a knowledge of the minor subject as could be acquired by six credit hours of work in the field.

MASTER OF CHEMISTRY

PREREQUISITE COURSES

Full equivalent of the requirements for the degree of Bachelor of Chemistry in Cornell University.

MINOR.—The candidate shall have such a knowledge of the minor subject as could be acquired by six credit hours of work in the field.

DOCTOR OF PHILOSOPHY

(Major outside of Chemistry)

PREREQUISITE COURSES

The equivalent of

Introductory Inorganic Chemistry	101 and 105
Shorter Course in Qualitative Analysis	210
Shorter Course in Quantitative Analysis	225

MINORS.—As under Doctor of Philosophy, Major in Chemistry.

DOCTOR OF PHILOSOPHY

(Major in Chemistry)

Attention is called to the fact that the additional year of residence required for either the degree of Master of Chemistry or for that of Chemical Engineer at Cornell University may, upon recommendation of the student's special committee, be accepted as satisfying one year of the residence requirement for the degree of Doctor of Philosophy with major subject in Chemistry.

PREREQUISITE COURSES

The equivalent of

Introductory Inorganic Chemistry	101 and 105
Longer Course in Qualitative Analysis	205 and 206
Longer Course in Quantitative Analysis	220 and 221
Advanced Quantitative Analysis (Lab.)	230
Gas and Fuel Analysis	250
Introductory Organic Chemistry	305 and 310
Introductory Physical Chemistry	405 and 410
Introductory Chemical Spectroscopy	505
Introductory Chemical Microscopy	530

QUALIFYING EXAMINATION

Every candidate is required to pass a Qualifying Examination before he is allowed to begin actual experimental work on his thesis problem. This examination will comprise tests in the following four Divisions of Chemistry: (A) Inorganic and General; (B) Analytical; (C) Organic, and (D) Physical. The individual tests, each consisting of a written examination covering a period of two to three hours, will be given in succession at intervals of one week.

One such Qualifying Examination is given at the beginning of each regular term, and at the end of the second regular term of the University year, on days set by the Committee on Qualifying Examinations. The candidate should present himself for the Qualifying Examination not later than the beginning of the term in which he expects to begin actual laboratory work on his thesis problem. In the light of the candidate's achievement in this examination, his Special Committee may further examine his qualifications for graduate study.

Failure of the candidate to pass any one of the four tests with a minimum grade of 60 will entail repetition of that particular test; failure in this second trial, or failure to pass two or more of the tests with a minimum grade of 60 will necessitate repetition of the entire Qualifying Examination. Any candidate who fails to pass all four parts of the Qualifying Examination on this final trial will not be allowed to complete the requirements for the degree of Doctor of Philosophy.

Minors

Two minor subjects, chosen from the Divisions of the Department, or from other Departments, are required. The candidate is expected to acquire a general knowledge of the fundamental topics (subjects, achievements) in the field of each Minor and an acquaintance with the history of the chief discoveries and generalizations in that field.

The candidate is at liberty to secure this information by lectures, by laboratory courses or by reading, as he may prefer, except that the Member of the Staff in charge of the Minor may require the successful completion of lecture and laboratory courses amounting to not more than six credit hours in all.

If the candidate has acquired the above general knowledge by courses taken before entering upon his graduate work in this Department, he will be assigned advanced reading in the field of the Minor as a means of fulfilling its requirement.

Examinations on the Major and Minor Subjects, and on the Thesis

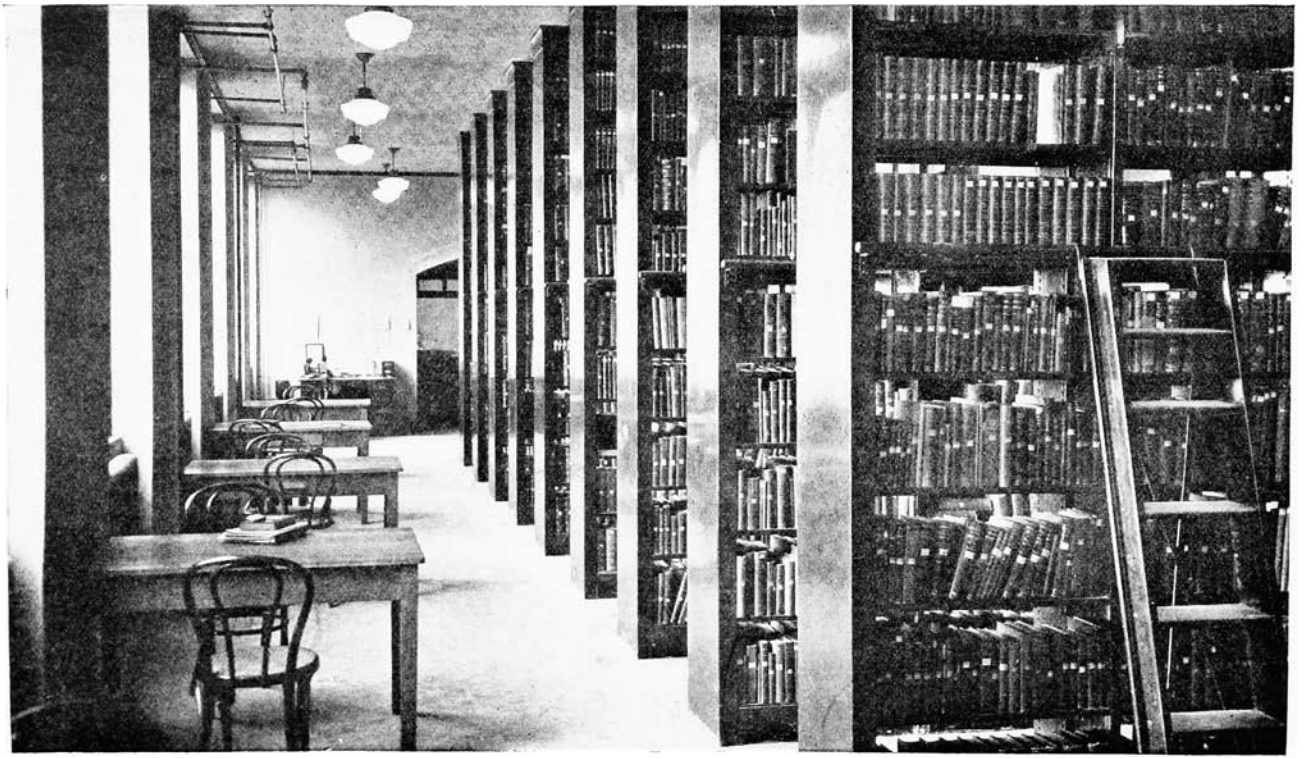
After the candidate has passed the Qualifying Examination, and has completed his minor subjects, he will be required to pass a general examination on his major and minor subjects. Upon the recommendation of the candidate's Special Committee, this examination may be taken toward the end of the term preceding his last year of residence. This procedure makes it possible for the candidate to devote his last year of residence to uninterrupted research on his thesis. In no case may the general examination be taken before the completion of the entire list of prerequisite courses.

At the close of his period of residence, and after the acceptance of his thesis, the candidate will be required to pass a final oral examination on the thesis and on related subjects.

THE BAKER LABORATORY OF CHEMISTRY

The general equipment of the laboratory and the administration of its various facilities are planned to give the maximum opportunity for unhampered work in the various fields of chemistry. Materials may be subjected to temperatures ranging from those of the electric furnace to that of liquid air, to extreme pressures or high vacua, to electrolysis or to the action of various radiations; they may be studied microscopically, spectroscopically, or by means of x-rays, and the production may be carried out under the exacting conditions of research or in semi-plant scale apparatus. The aim has been to enable chemical behavior to be studied under the widest possible variety of conditions, and by all the different methods used by chemists. On the instructional side, these special methods are available for the demonstration of the whole range of properties of chemical substances, and for the training of students in their observation and interpretation.

The building in which the Department of Chemistry is housed was given to the University by George Fisher Baker. The close co-operation between the Staff of the Department and the architects and engineers engaged in its construction is responsible for scope and



LIBRARY STACK ROOM WITH READING ROOM BEYOND

facilities hardly to be surpassed. Some four acres of floor space are available for purposes of instruction, which is given to over 2,000 students every year; the number of registrations in Chemistry courses exceeds 4,000 annually. Exceptionally complete administrative and engineering equipment takes up an additional acre of floor space.

Each of the Divisions of the Department occupies a group of rooms, adjacent to the offices of the instructors in charge, and provided with special plumbing and electric current as required. Distilled water, steam, circulating hot water, cold water, gas and compressed air are supplied to all lecture rooms and laboratories, the last three being supplied to all individual desks. A motor generator set in the basement furnishes direct current of constant potential, 55 or 110 volts, by means of a three-wire system, to all the advanced laboratories. A number of these are also connected with a storage battery current for lower voltages. A second motor generator set having a capacity of 2,000 amperes, D.C. or A.C., supplies the heavy currents necessary for electric furnace work, and a special high frequency converter is used in connection with an Ajax-Northrup induction furnace.

The building is ventilated by two separate sets of electrically driven fans which are located in the attic. One set supplies fresh air to all rooms, while the other exhausts air from the hoods in the various laboratories. These hoods are of the open front type, and each is vented to the exhaust flue at the top and bottom of a "baffle-plate" at the back.

The laboratory table tops, sinks, hoods and much of the shelving in the building are of alberene stone.

The main stock rooms are located in the basement, and are connected by elevators with the eight dispensing stock rooms which serve the various laboratories.

A mechanician, in charge of a completely equipped shop, is available for the construction of special apparatus, and a second workshop is provided for student use in connection with problems in industrial chemistry and in research. Unusual glass apparatus is constructed by a professional glass blower, who also gives instruction in glass blowing. An equipment for the production of liquid air, owned jointly with the Department of Physics and housed in the neighboring Laboratory of Physics, Rockefeller Hall, is of such capacity as to furnish an abundant supply of liquid air for lecture demonstrations and investigational purposes.

A locker room with showers, men's and women's rooms, and numerous coat rooms are provided for the convenience of the students and a first aid room is equipped to care for minor accidents.

The main lecture room, seating 476, is so arranged, that all the seats are within 55 feet of the lecture table. It is equipped with rapid-acting shutters, so that it may conveniently be darkened for showing slides or motion pictures. Five other lecture rooms, all containing projection lanterns, communicate through their preparation rooms by electric elevators with the museum. A number of recitation rooms are also provided.

The Museum, through which the main lecture room is reached, is part of the working equipment of the Department and is used as a repository for much of the illustrative material used in the various courses. It contains, in addition to specimens of synthetic and naturally occurring chemical substances, an extensive collection of raw materials and finished products of industries exemplifying the more important commercial chemical processes.

The Department Library is very fully supplied with works of reference and standard books on chemistry and allied subjects, numbering about 7,500 volumes in all. The current numbers of some seventy periodicals are on file in the reading room. In addition the facilities of the library are supplemented by the various other libraries of the University, which contain extensive collections of works in other fields of science and engineering. The reading room is open till 10:30 P. M. daily. Advanced students have the privileges of the stack room. Books may be withdrawn through the librarian between the hours of 9 A. M. to 5 P. M. and 7:30 P. M. to 10:30 P. M., except on Saturdays, when the library closes at 1:00 P. M.

COURSES OF INSTRUCTION

All courses listed below are to be given in the Baker Laboratory of Chemistry.
Those courses which are marked with the asterisk (*) may not be counted for upper-class group by candidates for the degree of Bachelor of Arts.

INORGANIC CHEMISTRY

In addition to an extensive assortment of apparatus and specimens for demonstration purposes, the Division of Inorganic Chemistry has perhaps the largest stock of rare elements in any laboratory. The Department affords exceptional facilities for the construction of unusual or elaborate apparatus and special equipment is available for vacuum distillation of low boiling liquids, for extraction with liquified gases, and for the study of gas evolution in inert atmospheres. The laboratories are also provided with several types of vacuum pumps and furnaces.

*101. **Introductory Inorganic Chemistry.** Lectures. Repeated in the second term. Credit three hours.

Two sections: M W F 11; T Th S 11. *Main Lecture Room.* Professor BROWNE and Assistant Professor LAUBENGAYER.

Entrance credit in chemistry does not carry with it University credit in Course 101 or 105. If a student entering the University from a preparatory school desires credit for these Courses, he must pass an examination set by the Department of Chemistry. This examination is held in New York City and in Ithaca on the same day in September as the entrance examination. University credit in Courses 101 and 105 that is obtained by passing this examination does not carry with it entrance credit in Chemistry.

Examinations for those who were unavoidably absent from the final examination in courses 101 and 105 will be held at 2 p.m. on the day before instruction begins in the fall.

*105. **Introductory Inorganic Chemistry.** Recitations and laboratory practice. Repeated in the second term. Credit three hours.

Recitations, one hour a week, to be arranged.

Laboratory sections: M F 1:40–4; T Th 1:40–4; M W 8–10:30; W 1:40–4; S 8–10:30 (first term only). *Room* 150. Professor BROWNE, Assistant Professor LAUBENGAYER, and assistants.

Chemistry 101 and 105 must be taken simultaneously unless permission is obtained by the student from the Dean of his college and from the Department of Chemistry to take either course alone.

130. **Advanced Inorganic Chemistry.** Throughout the year. Credit three hours a term. Prerequisite or parallel courses, Chemistry 405 and 410. Professor DENNIS. M W F 11. *Baker* 107.

Lectures. The chemical elements are discussed in the order in which they occur in the Periodic Table of Mendeléeff, with special attention to the group properties of the elements and to the relations of the groups to one another. The rare elements and the rare earths are treated in as great detail as are the more common elements.

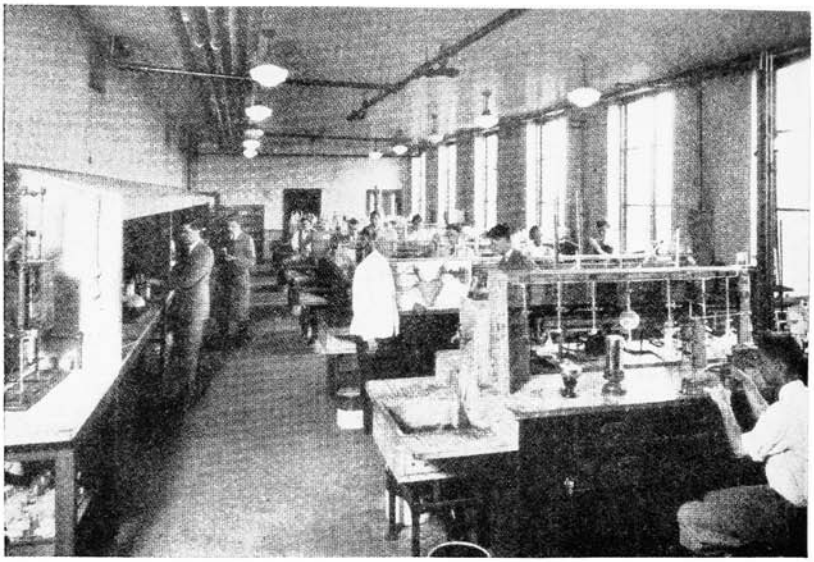
135. **Advanced Inorganic Chemistry.** Either term. Credit one to six hours. Prerequisite, Chemistry 305 and 310. Professors DENNIS and BROWNE and assistants. Day and hour to be arranged. *Baker* 178 and 122.

Laboratory practice. The preparation, purification, properties, and reactions of inorganic compounds including those of the rarer elements.

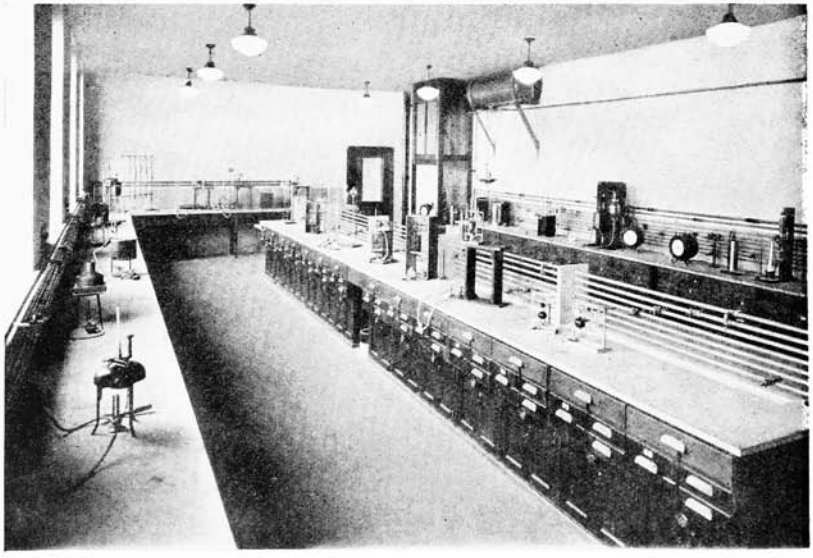
Chemistry 135 is designed to accompany Chemistry 130, but either course may be taken separately.

[140. **Selected Topics in Advanced Inorganic Chemistry.** Lectures. Second term. Credit two hours. Prerequisite courses 405 and 410. W F 9. *Room* 107. Professor BROWNE. Not given 1930–31].

150. **The Chemistry of Glass.** Second term. Credit one hour. Assistant Professor LAUBENGAYER. M 9. *Baker* 107.



RESEARCH LABORATORY, INORGANIC CHEMISTRY



LABORATORY OF GAS AND FUEL ANALYSIS

A discussion of the development and manufacture of glass and related ceramic ware, such as pottery and porcelain, with special emphasis on the relations between constitution and physical and chemical properties. Inspection trips to nearby ceramic plants will be arranged.

195. **Research for Seniors.** Throughout the year. Professors DENNIS and BROWNE and Assistant Professor LAUBENGAYER. See page 8.

ANALYTICAL CHEMISTRY

The laboratory tables for qualitative analysis are equipped with small sinks at intervals of six feet. Hydrogen sulphide precipitations are carried on in a separate room, having hooded tables and special ventilation. The laboratories of quantitative analysis are provided with two balance rooms, containing chainomatic, calibrating and microbalances in addition to the usual equipment. Electrically heated muffles and furnaces for steel and organic combustions, special Kjeldahl racks, apparatus for the electrolytic determination of copper and lead, and for micro-quantitative analysis are also available. In the laboratory of electro-analysis storage battery current of a wide range of potential is supplied for electrolytic determinations; apparatus for conductivity and electrometric titrations is also part of its equipment. Crucible and muffle furnaces, coke and gas fired, together with the pulverizing apparatus, are part of the facilities of the assaying laboratory. Gas and fuel analyses are carried out in a large room on the north side of the building, away from the direct rays of the sun and free from exposed water and steam lines which might cause temperature fluctuations. Gas samples for analysis are mixed and stored in large gasometers in the apparatus room, and are piped to the desks, together with oxygen and room-temperature water in addition to the ordinary plumbing. The laboratory is provided with all the principal types of equipment for gas and fuel analysis, including absorption apparatus, pipettes and burettes, nitrometers and calorimeters, all of numerous types, as well as apparatus for viscosity, flash point, density, and distillation determinations, and an interferometer for optical analysis of gases.

205. **Introductory Qualitative Analysis.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 101 and 105. Must be taken with Course 206. Assistant Professor NICHOLS and assistants.

Lectures: M W 9. *Baker* 177.

Recitations: one hour a week, to be arranged.

A study of the application of the theories of general chemistry, to the systematic separation and detection of the common elements and acid radicals.

Students in science are advised, and candidates for the degree of Bachelor of Chemistry are required, to take this course together with Course 206 instead of Course 210.

206. **Introductory Qualitative Analysis.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 101 and 105. Must be taken with Course 205. Mr. AVENS and assistants.

Laboratory section: M W F 1:40–4. *Baker* 50.

Laboratory practice. A study of the properties and reactions of the common elements and acid radicals; the qualitative analysis of a number of solutions and solid compounds.

Students in science are advised, and candidates for the degree of Bachelor of Chemistry are required, to take this course together with Course 205 instead of Course 210.

*210. **Introductory Qualitative Analysis.** Shorter course. Repeated in the second term. Credit three hours. Prerequisite, Chemistry 101 and 105. Mr. AVENS and assistants.

Lecture: Mr. AVENS. T 12. *Baker* 207.

Laboratory sections: T Th 8–10:30; T Th 1:40–4. *Baker* 50.

The properties and reactions of the common elements and acids; their detection in various liquid and solid mixtures.

215. **Advanced Qualitative Analysis.** First term. Credit three hours. Prerequisite, Chemistry 220, 221, 305, and 310. Assistant Professor NICHOLS, Mr. AVENS, and assistants. Day and hour to be arranged. *Baker* 50.

Laboratory practice. Essentially a continuation of Course 206. The methods for separating and detecting a number of metals and acids not studied in Course 206, including many of the rare elements. The qualitative analysis of a number of solutions, solid mixtures, natural and commercial products will be required. For graduates and advanced undergraduates.

220. **Introductory Quantitative Analysis.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 205 and 206. Must be taken with Course 221. Assistant Professor NICHOLS, Mr. FLOYD, and assistants.

Lectures: Assistant Professor NICHOLS. T Th 9. *Baker* 207.

Recitations: one hour a week, to be arranged.

A study of the fundamental principles of gravimetric and volumetric analysis with practice in stoichiometry.

Students in science are advised, and candidates for the degree of Bachelor of Chemistry are required, to take this course together with Course 221 instead of Course 225.

221. **Introductory Quantitative Analysis.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 205 and 206. Must be taken with Course 220. Mr. FLOYD, and assistants.

Laboratory sections: M T W 1:40–4; T Th 10–12:30, Th 1:40–4. *Baker* 252.

Laboratory practice in the preparation and standardization of various volumetric solutions and the analysis of a variety of substances by volumetric and gravimetric methods.

Students in science are advised, and candidates for the degree of Bachelor of Chemistry are required, to take this course together with Course 220 instead of Course 225.

*225. **Introductory Quantitative Analysis.** Shorter course. Repeated in the second term. Credit three hours. Prerequisite or parallel course, Chemistry 210. Mr. FLOYD and assistants.

Lecture: Mr. FLOYD. Th 12. *Baker* 207.

Laboratory sections: T Th 8–10:30; T Th 9–11:30; M W 1:40–4; T Th 1:40–4. *Baker* 252.

A study of the fundamental principles of gravimetric and volumetric analysis.

230. **Advanced Quantitative Analysis.** Repeated in the second term. Credit four hours. Prerequisite Chemistry 220 and 221. Mr. FLOYD and assistants.

Recitation: one hour a week, to be arranged.

Laboratory periods: first term, M T W 1:40–4; T Th 9–1; S 8–1; second term, M T W Th F 1:40–4; T Th S 8–1. *Baker* 277 and 294. Students will be assigned to a combination of laboratory periods that will total seven and one-half hours a week.

Gravimetric, volumetric, and electrolytic methods of analysis, and methods of combustion analysis; the calibration of weights and volumetric apparatus; analysis of iron and steel, alloys, silicates, etc.

235. **Advanced Quantitative Analysis.** Second term. Credit two hours. Prerequisite, first term of Chemistry 405. Assistant Professor NICHOLS. M W 12. *Baker* 207.

Lectures: Selected topics in advanced quantitative analysis.

240. **Electrochemical Analysis.** Repeated in the second term. Credit two hours. Prerequisite, Chemistry 230 and 405. Mr. FLOYD. Day and hour to be arranged. *Baker* 292.

Laboratory practice. The most approved electrochemical methods for the determination of silver, lead, copper, tin, nickel, cobalt, and zinc; practice in the analysis of alloys and ores.

245. **Assaying.** First term. Credit two hours. Prerequisite, Chemistry 225 (or 220 and 221), and, if possible, a course in mineralogy. Mr. FLOYD and assistants.

Lecture: Mr. FLOYD. M 9. *Baker* 202.

Laboratory sections: M 1:40–4; W 1:40–4. *Baker* B-91 and B-96.

Lectures on the theory and practice of scorification and crucible assay, and on the metallurgy of copper, lead, zinc, silver and gold; laboratory practice in the assay of zinc, lead, copper, gold and silver ores, mattes, and bullion.

250. **Gas and Fuel Analysis.** Repeated in the second term. Credit four hours. Prerequisite, Chemistry 220 and 221. Dr. MORSE and assistants.

Lectures: Dr. MORSE. M W 10. *Baker* 207.

Laboratory sections: M T 1:40–4; W Th 1:40–4; T Th 10–12:30; S 8–1. *Baker* 282.

The complete analysis of coal gas, flue gas, and air; the determination of the heating power of gaseous, liquid, and solid fuels; the analysis of coal; standard methods of testing various petroleum and coal-tar products; the analysis of various substances by methods involving the use of different types of gas evolution apparatus. Problems are assigned which afford practice in the calculation and interpretation of results.

255. **Advanced Gas Analysis.** Either term. Credit two or more hours. Prerequisite, Chemistry 250. Dr. MORSE and assistants. Day and hour to be arranged. *Baker* 282.

Conferences and laboratory practice. The study of the important methods and special forms of apparatus used in scientific gas analysis.

270. **Special Methods of Quantitative Analysis.** Either term. Credit two or more hours. Prerequisite, Chemistry 230 and 235. Assistant Professor NICHOLS and assistants. Day and hour to be arranged. *Baker* 277.

Laboratory practice in the application of special methods such as indirect analysis, conductivity, electrometric titrations, etc., to quantitative analysis, and the analyses of special steels, ores, slags, alloys, etc.

Within certain limits the work may be selected to suit the requirements of the individual student.

295. **Research for Seniors.** Throughout the year. Assistant Professor NICHOLS, Dr. MORSE, Mr. AVENS, and Mr. FLOYD. See page 8.

ORGANIC CHEMISTRY

The equipment for work in this Division includes fractionating columns of very modern design for the purification of liquids, at atmospheric and under reduced pressure. Vacuum pumps, modified MacLeod manometers, and specially designed distilling apparatus are available for distillations under low pressures. An apparatus for catalytic reduction with hydrogen under pressure, a Maquenne melting-point block, devices for mechanical stirring, and autoclaves are available for advanced work. The research laboratories are provided with electrically heated equipment, such as melting-point tubes, hot-plates, drying-ovens, and combustion furnaces.

305. **Introductory Organic Chemistry.** Throughout the year. Credit three hours a term. Prerequisite, Chemistry 210 and 225 (or 205, 206, 220 and 221).

Open to those who are taking Course 220. Assistant Professor J. R. JOHNSON and Mr. TALLMAN. M W F 9. *Baker* 207.

Lectures and written reviews. The more important compounds of carbon, their occurrence, methods of preparation, relations and uses; illustrated by experiments and material from the museum.

310. **Introductory Organic Chemistry.** Throughout the year. Credit three hours a term. Prerequisite or parallel course, Chemistry 305. Assistant Professor J. R. JOHNSON, Mr. TALLMAN, and assistants. Laboratory section: F 1:40–4, S 8–1. *Baker* 250.

Laboratory practice and oral reviews. The student prepares a large number of typical compounds of carbon and familiarizes himself with their properties, reactions, and relations.

315. **Advanced Organic Chemistry.** Throughout the year. Credit two hours a term. Prerequisite, Chemistry 305 and 310. Assistant Professor JOHNSON and Mr. TALLMAN. T Th 9. *Baker* 177.

Lectures. A presentation of important chapters of organic chemistry and a discussion of classical researches in this field.

Students may register for any term separately.

320. **Advanced Organic Chemistry.** Either term. Credit two to six hours a term. Prerequisite, Chemistry 305 and 310. Assistant Professor J. R. JOHNSON, Mr. TALLMAN, and assistants. Day and hour to be arranged. *Baker* 208.

Laboratory practice. An advanced course in the preparation of organic compounds. The original literature is consulted, and the student is required to repeat some extended and important piece of work, and to compare his results with those published.

340. **Methods of Organic Analysis.** Second term. Credit three to six hours. Prerequisite, Chemistry 305 and 310. Assistant Professor J. R. JOHNSON, Mr. TALLMAN, and assistants. Laboratory conference, W 1:40. *Baker* 207. Laboratory sections, W Th F 1:40–4. *Baker* 250.

Laboratory work based upon Kamm: Qualitative Organic Analysis.

375. **Elementary Organic Chemistry.** First term. Lectures and written reviews only, four hours credit; with laboratory, five to six hours credit. Students who are preparing for study of medicine should determine the entrance requirements in Organic Chemistry for the medical school they desire to enter. If more than six credit hours is required, the student should register in Chemistry 305 and 310. Students may obtain 9 hours credit by taking Chemistry 305 throughout the year (6 hours) and Chemistry 310 (3 hours) during the first term. Prerequisite, Chemistry 101 and 105. Assistant Professor J. R. JOHNSON, Mr. TALLMAN, and assistants.

Lectures and written reviews, M W F S 12. *Baker, Main Lecture Room.*

Laboratory sections (six hours credit).

M W 1:40–4, *Baker* 250. Conference M 1:40, *Baker* 207.

T Th 1:40–4, *Baker* 250. Conference T 1:40, *Baker* 207.

Laboratory section (five hours credit) Th 1:40–4, *Baker* 250.

395. **Research for Seniors.** Throughout the year. Assistant Professor J. R. JOHNSON and Mr. TALLMAN. See page 8.

PHYSICAL CHEMISTRY

The special facilities of the Division include thermostats, an ultrafilter, a supercentrifuge, a Fade-O-Meter, a large ultraviolet monochromator, and apparatus for investigations at very high pressures, in addition to the usual equipment for instructional purposes. The electric wiring is exceptionally complete, distributing panels being arranged so that any desired potential between 2 and 40 volts may be furnished to the individual desks from a storage battery of twenty 120 ampere hour cells. The "fifty special stations" throughout the laboratories also carry 55–110 volt D. C., 110 volt A. C., and 1,000 cycle current from a special high frequency generator. The laboratory of Electrochemistry is provided with student and precision potentiometers and conductivity apparatus, and a 3.5 K. W. 60,000 volt maximum transformer with a Tesla coil, for silent discharge through gases or other work requiring high frequencies and potentials. The electric furnace equipment, already described, is available for the study of thermoelectric processes.

405. **Introductory Physical Chemistry.** Throughout the year. Credit three hours a term. Prerequisite, Chemistry 305 (or 357) and Physics 3 and 4, and 30. Professor BRIGGS. M W F 9. *Baker* 7.

Lectures. A systematic presentation of modern chemical theory in which special attention is paid to the following topics: Gases, liquids, and solids; the theory of solution; reaction velocity, catalysis, and chemical equilibrium; the Phase Rule; colloid chemistry; thermochemistry; and elementary electrochemistry. Problems in physical chemistry.

It is advisable, but not obligatory, that course 410 accompany this course.

410. **Introductory Physical Chemistry.** Throughout the year. Credit three hours a term. Prerequisite or parallel course, Chemistry 405. Professor BRIGGS and assistants. Laboratory sections: M T 1:40–4; S 8–1. *Baker* 1.

Laboratory practice. Qualitative and quantitative experiments illustrating the principles of physical chemistry and including practice in performing physico-

chemical measurements. An important feature of this course is the presentation of detailed reports based upon data obtained in the laboratory.

415. **Advanced Physical Chemistry.** Throughout the year. Credit two hours a term. Prerequisite, Chemistry 405. Professor BANCROFT. T Th 11. *Baker* 7.

An exposition of the law of mass action in its application to chemical equilibrium and reaction velocities.

430. **Applied Colloid Chemistry.** Throughout the year. Credit two hours a term. Open to candidates for the degree of Bachelor of Chemistry if they have completed Chemistry 405, to others only by special permission. Professor BANCROFT. T Th 10. *Baker* 7.

Lectures. The theory of colloid chemistry and its application in the arts.

450. **Applied Electrochemistry.** Throughout the year. Credit two hours a term. Prerequisite, Chemistry 405. Professor BRIGGS, M W 12. *Baker* 7.

Lectures. The theory of electrolysis and electromotive force; electrolytic extraction and refining of metals; electrolytic manufacture of organic and inorganic compounds; theory and practice of storage cells; preparation of compounds in the electric furnace. Problems in electrochemistry.

455. **Applied Electrochemistry.** Throughout the year. Credit two hours a term. Prerequisite or parallel course, Chemistry 450. Professor BRIGGS and assistant. Day and hour to be arranged. *Baker* 1-A.

Laboratory practice. Qualitative and quantitative study of electrolysis; determination of electrical conductivity; potentiometric measurements; hydrogen ion concentration; determination of current and energy efficiencies in electrolytic and electrothermal work; electrolytic preparation of organic and inorganic compounds; tests of storage cells; preparation of compounds in the electric furnace; measurement of furnace temperatures.

[460. **Theoretical Electrochemistry.** Throughout the year. Credit two hours a term. Prerequisite, Chemistry 405. Professor BANCROFT. T Th 11. *Baker* 7. Not given in 1930–31.]

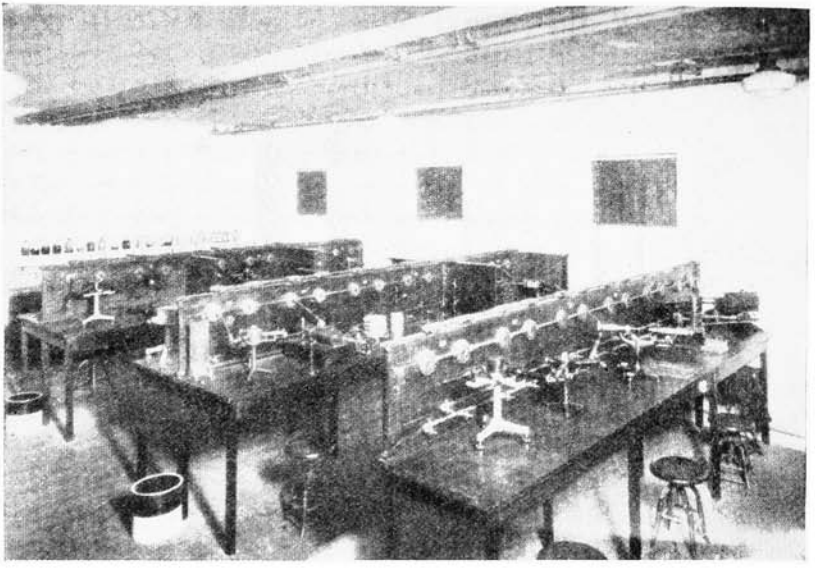
465. **Advanced Physical Chemistry.** Either term. Credit variable, but not to exceed six hours a term. Prerequisite determined in each case by the Professor in charge. Professors BANCROFT and BRIGGS and assistants. Hour and work to be arranged. *Baker* 94.

Laboratory practice. Students may elect in mass law, reaction velocity, or efficiency measurements with special reference to course 415; in photo-chemistry, photography, or colloid chemistry with special reference to course 430; in conductivity, or electrometric determinations with special reference to course 460; in electrolytic, or electric furnace products with special reference to course 450; in the application of physical chemical methods to organic chemistry.

495. **Research for Seniors.** Throughout the year. Professors BANCROFT and BRIGGS. See page 8.

OPTICAL CHEMISTRY

The equipment of this division affords unique facilities for research and instruction. The laboratory of Introductory Chemical Spectroscopy is supplied with numerous spectroscopes of the Bunsen type, together with several Hilger instruments with camera attachments. Four large prism spectrographs, three with quartz systems for ultra-violet spectroscopy, as well as two grating instruments, are available for advanced work. In addition to much accessory equipment for the study of spectra, other optical studies are provided for with a Hilger-Nutting spectro-colorimeter, and a number of other colorimeters of various types, several polarimeters and saccharimeters, Abbe and Pulfrich refractometers of the usual types, immersion refractometers with interchangeable prisms, and a Pulfrich instrument for very high refractive indices. Two photographic dark rooms are adjacent to the spectrographic laboratories. A Hilger-Muller universal type x-ray spectrograph for the study of crystal structures and x-ray spectra is housed in a lead lined room in the basement.



LABORATORY OF INTRODUCTORY CHEMICAL SPECTROSCOPY

LABORATORY OF INTRODUCTORY CHEMICAL MICROSCOPY

The laboratories of Chemical Microscopy have unsurpassed equipment for research and instruction; the introductory laboratory contains work tables and instruments for thirty-six students. Special rooms are provided for photomicrography, ultramicroscopy, and other advanced work. Different types of binocular, petrographic, projection, fluorescence, and long distance microscopes, ultramicroscopes and photomicrographic apparatus are available, and an ever growing collection of specimens furnishes material for comparative study and research. The microscopy of metals and alloys is carried on in separate rooms, equipped with grinding and polishing apparatus, electric heat-treating furnace, pyrometers, and several metallographic microscopes. Two large metallographs are used for photomicrographic work. An extensive collection of alloys affords specimens for demonstration and study.

505. **Introductory Chemical Spectroscopy.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 210 and 225 (or 205, 206, 220, and 221). Open to those who have completed or are taking Physics 30 or by special permission. Professor PAPISH and assistants.

Lectures and written reviews. Professor PAPISH. T Th 9. *Baker* 377.

Laboratory sections: Hours to be arranged. *Baker* 396.

The construction and use in chemical analysis of the spectroscope, polariscope, refractometer, colorimeter, and nephelometer. The laboratory instruction is devoted to the training of the student in the use of these instruments in the solving of chemical problems.

510. **Advanced Chemical Spectroscopy.** Either term. Credit two or more hours. Prerequisite, Chemistry 505. Professor PAPISH and assistants. Day and hour to be arranged. *Baker* 396.

Laboratory practice. The study of arc, spark, and absorption spectra and the application of spectroscopic methods to the identification of dyestuffs. Practice in one or more of the subjects mentioned may be selected by the student.

520. **Spectrographic Methods.** Either term. Credit one or more hours. Prerequisite, Chemistry 505. Professor PAPISH. Laboratory hours to be arranged. *Baker* 396. Conference, hour to be arranged.

Laboratory practice. The application of photographic methods to arc, spark, and absorption spectroscopy. Practice is also given in the application of ultraviolet spectroscopy in chemical analysis.

530. **Introductory Chemical Microscopy.** Repeated in the second term. Credit three hours. Prerequisite, Chemistry 210 and 225 (or 205, 206, 220, and 221) and Physics 30, or special permission. Professor CHAMOT, Assistant Professor MASON, and assistants.

Lecture: M 10. *Baker* 377.

Laboratory section: M T 1:40–4; T Th 9–11:30; Th F 1:40–4 (first term only). *Baker* 378.

Lectures and laboratory practice. The principles and uses of the microscope and its accessories; microscopic methods as applied to chemical and other scientific investigations; micrometry; the examination of crystalline compounds and industrial materials; recognition of textile and paper fibers, etc. The application of microscopic methods to quantitative analysis.

535. **Microscopic Qualitative Analysis (Inorganic).** Second term. Credit three or more hours. Prerequisite, Chemistry 530. Professor CHAMOT, Assistant Professor MASON, and assistants. Laboratory periods, to be arranged. *Baker* 378. Conference, T 9. *Baker* 384.

Laboratory practice in the examination and analysis of inorganic substances containing the more common elements with special reference to rapid qualitative methods and to the analysis of minute amounts of material.

[540. **Microscopic Qualitative Analysis (Organic).** First term. Credit two hours. Prerequisite, Chemistry 530. Professor CHAMOT, Assistant Professor MASON, and assistants. Day and hour to be arranged. *Baker* 378.

Laboratory practice. Organic qualitative microscopic reactions of common commercial organic compounds, vegetable alkaloids, "strong drugs," etc., with

particular emphasis upon the analysis of minute quantities of material. Not given 1930–31.]

545. **Microscopy of Commerical Alloys.** Second term. Credit two hours. Prerequisite, Chemistry 530 or special permission. Assistant Professor MASON and assistants. M T 1:40–4. *Baker* 384.

Laboratory practice and conferences. An introduction to the principles and methods involved in the macroscopic and microscopic examination of metals, alloys, and other metallurgical products; practise in the preparation of specimens for microscopic study; metallographic microscopes and their use.

This course may be extended to cover other materials of construction.

[550. **Microscopy of Foods and Beverages.** First term. Credit two hours. Prerequisite, Chemistry 530. Professor CHAMOT, Assistant Professor MASON, and assistants. Laboratory hours to be arranged. *Baker* 378. Not given in 1930–31.]

560. **Advanced Chemical Microscopy.** Second term. Credit two hours. Prerequisite, Chemistry 530. Professor CHAMOT and Assistant Professor MASON. Hours to be arranged.

Conferences and demonstrations. Theory and applications of instruments, accessories and methods used in critical microscopy, ultra-microscopy, photomicrography, and other special fields. Typical applications of microscopic methods in research and industry.

565. **Special Methods in Chemical Microscopy.** Either term. Credit one or more hours. Prerequisite, special permission. Professor CHAMOT and Assistant Professor MASON. Hours to be arranged. *Baker* 378 and 382.

Laboratory practise may be elected in various fields such as photomicrography, ultra-microscopy, crystal studies, micro-manipulations, quantitative determinations, and the microscopy of industrial materials.

595. **Research for Seniors.** Throughout the year. Professor CHAMOT, Professor PAPISH, and Assistant Professor MASON. See page 8.

SANITARY CHEMISTRY

The special equipment of the division of Sanitary Chemistry includes the necessary autoclaves, sterilizers, and incubators for bacteriological examinations of water and food products. Determinations of hydrogen-ion concentrations are made by means of a potentiometer. A large laboratory centrifuge and a vacuum oven are used in the preparation of material for analyses. Two full size outfits are available for studies of water softening by zeolites.

605. **Introductory Sanitary Chemistry (Foods).** First term. Credit two hours. Prerequisite, Chemistry 305 (or 210, 225, and 375). Dr. BEDIENT. T Th 11. *Baker* 377.

Lectures. Chemistry of foods, beverages, and food accessories; special apparatus; adulteration and misbranding, sweeteners, preservatives, food colors, food poisonings, and methods for their detection. Relation of the chemical composition of materials used in the household to the public health. Garbage disposal.

It is advisable, but not obligatory, that Course 610 accompany this course.

610. **Introductory Sanitary Chemistry (Foods).** First term. Credit two hours. Prerequisite or parallel course, Chemistry 605. Dr. BEDIENT and assistant. Laboratory sections at hours to be arranged. *Baker* 352.

Laboratory practice. Laboratory exercises designed to illustrate the material presented in Course 605. General and special methods of analysis of foods, beverages, and food accessories, with special reference to the detection of adulteration. The use of saccharimeters, refractometers, cryoscopes, muffle furnaces, vacuum ovens, etc.

615. **Introductory Sanitary Chemistry (Water).** Second term. Credit two hours. Prerequisite, Chemistry 305 (or 210, 225, and 375). Dr. BEDIENT. T Th 11. *Baker* 377.

Lectures. Pollution of water; physical, chemical, bacteriological, and microscopical examination of water for household and municipal purposes; introduction to the methods of water purification, and water softening, and their control. Interpretation of analytical results and the preparation of sanitary surveys.

It is advisable, but not obligatory, that Course 620 accompany this course.

620. **Introductory Sanitary Chemistry (Water).** Second term. Credit two hours. Prerequisite or parallel course, Chemistry 615. Dr. BEDIENT and assistant. Laboratory sections at hours to be arranged. *Baker* 352.

Laboratory practice. Laboratory exercises designed to illustrate the material presented in Course 615.

[630. **Advanced Sanitary Chemistry (Water).** First term. Credit two hours. Prerequisite, Chemistry 615. Dr. BEDIENT.

Laboratory practice to accompany this course may be elected under Course 635. Not given in 1930–31.]

635. **Advanced Sanitary Chemistry.** Either term. Credit two or more hours. Prerequisite to be determined in each case by the instructor in charge. Dr. BEDIENT and assistant. Day and hour to be arranged. *Baker* 352, 356, 358.

Laboratory practice.

Students who have had adequate preparation may elect work in any branch of sanitary chemistry. Among others, work along the following lines may be taken:

The bacteriology of water.

Continuation of work offered in courses 610 or 620.

The control of water purification.

Water softening.

The work in many cases may be arranged to meet the needs of the individual student.

695. **Research for Seniors.** Throughout the year. Dr. BEDIENT. See page 8.

INDUSTRIAL CHEMISTRY

The laboratories of this Division are fitted out for instruction and research in Industrial Chemistry and Chemical Engineering processes, with facilities for semi-plant scale operations. The larger apparatus is located in the basement for convenience in handling heavy materials, and for ready access to the electric furnaces; an eighteen plate fractionating column, arranged for the study of batch or continuous distillations extends through the floor above. Steam and fire heated stills, a double vacuum evaporator with salt box and vertical and horizontal tube units, rotary drum and vacuum dryers, a sulphonator, vats, agitators, pumps, crushing and grinding mills, a centrifugal, a super-centrifuge, and various types of accessory equipment are available for practice in typical industrial procedures.

705. **Industrial Chemistry.** Throughout the year. Credit three hours a term. Prerequisite, Chemistry 405. Professor RHODES. M W F 10. *Baker* 177.

Lectures. A discussion of various typical processes of chemical manufacturing from the standpoint of: (a) available materials, their properties and limitations; (b) standard forms of apparatus used in chemical manufacturing; (c) properties and specifications of commercial chemicals; (d) computation of costs and profits in chemical manufacturing.

By special permission, candidates for the degree of Bachelor of Chemistry may be permitted to register for the second term of Course 705 in their junior year and to postpone a part of their elective hours until the senior year.

710. **Chemical Engineering.** Second term. Credit four hours. Prerequisite, Chemistry 405. Professor RHODES, Mr. LEWIS, and assistants. One laboratory period, to be arranged, and one conference period, F 9. *Baker* B-78.

Laboratory practise. The study in the laboratory, on a semi-plant scale, of the unit processes of chemical engineering, such as agitation and mixing, filtration, fractional distillation, evaporation, drying, absorption of gases, and heat transfer.

715. **Selected Topics in Chemical Engineering.** Second term. Credit three hours. Prerequisite or parallel course, Chemistry 705. Professor RHODES. M W F 11. *Baker* 177.

Lectures. A discussion of special topics in chemical engineering. The lectures in 1930–31 will deal with the theory and design of chemical plant equipment for distillation, evaporation, drying, etc.

725. **The Chemistry of Fuels.** First term. Credit three hours. Prerequisite or parallel course, Chemistry 705. Professor RHODES. M W F 11. *Baker* 177.
Lectures. The chemistry of coal, coke, petroleum, tars, and the fuel gases. Particular stress is laid upon the theoretical chemistry involved in the carbonization of coal, the gasification of coal, and the distillation and refining of petroleum and tar.

730. **Chemical Plant Design.** Throughout the year. Credit three hours a term. Prerequisite, Chemistry 705. Professor RHODES. Day and hour to be arranged.
Conferences and calculation periods. Practice in the calculation and design of chemical plant and equipment.

*775. **Engineering Chemistry.** Repeated in the second term. Credit two hours. Prerequisite, Chemistry 101. Not open to students who are candidates for the degree of Bachelor of Chemistry. Mr. LEWIS. M W 8. *Baker, Main Lecture Room.*
Lectures. Chemistry in its relations to engineering.

776. **Chemistry of Pulp and Paper.** Second term. Credit two hours. Prerequisite, Chemistry 775. Open to students in Forestry, to others only by special permission. Mr. LEWIS. T Th 10. *Baker* 177.
Lectures. The chemistry of the manufacture of pulp and paper.

795. **Research for Seniors.** Throughout the year. Professor RHODES and Mr. LEWIS. See page 8.

AGRICULTURAL CHEMISTRY

Electrically heated digestion, steam distillation and extraction apparatus, of special design, is available for studies of dairy and cereal products leading to the ultimate utilization of surplus material. The equipment also includes muffles, drying ovens, grinding mills, microscopes, refractometers, and polarimeters, of various types, as well as apparatus for the determination of hydrogen ion concentration.

Students will not be allowed to register in courses in Agricultural Chemistry until after they have taken and passed Chemistry 101 and 105 or their equivalent.

[805. **Introductory Agricultural Chemistry (Fertilizers, Insecticides, Soils).** First term. Credit two hours. Prerequisite, Chemistry 305 (or 375). Professor CAVANAUGH. T Th 11. *Baker* 302.
Lectures. The relation of chemistry to agriculture; an introduction to the study of plant growth, the composition and chemical properties of soils, fertilizers, amendments, insecticides, and fungicides. Not given 1930–31.]

810. **Introductory Agricultural Chemistry.** First term. Credit three hours. Prerequisite, Chemistry 205 and 220 (or 210 and 225). Mr. LOVELACE. *Baker* 350.
Laboratory practice, day and hour to be arranged; recitation, day and hour to be arranged. Practice in the methods used by the chemist in the control laboratories of the factory, of the Government, and of the Experiment Stations, where fertilizers, insecticides, fungicides, and soils are examined.

815. **Introductory Agricultural Chemistry (Foods and Feeds).** Second term. Credit two hours. Prerequisite, Chemistry 305 (or 375). Professor CAVANAUGH. T Th 11. *Baker* 302.
Lectures. Discussion of the sources, chemical composition, and properties of the principal foods and feeds such as cereals, fruits, animal products, and dairy products. Relation of methods of preservation and manufacture to the nutritive value of foods.

820. **Introductory Agricultural Chemistry.** Second term. Credit two hours. Prerequisite, Chemistry 205 and 220 (or 210 and 225). Professor CAVANAUGH and assistant. *Baker* 350.

Laboratory practice, day and hour to be arranged; recitation, day and hour to be arranged. The methods of the Association of Official Agricultural Chemists are used in the examination and analysis of foods and feeding stuffs, such as milk and milk products, cereal products, canned vegetables, etc.

*825. **Elementary Agricultural Chemistry.** Second term. Credit three hours. Prerequisite, Chemistry 101. Professor CAVANAUGH. M W F 12. *Baker* 377. Candidates for the degree of Bachelor of Chemistry may not receive credit for this course toward the degree.

Lectures. The relation of chemistry to agriculture, and an introduction to the study of the composition and chemical properties of plants, fertilizers, feed stuffs, insecticides, and fungicides.

*830. **Elementary Chemistry of Food Products.** Second term. Credit two hours. Prerequisite, Chemistry 101. Professor CAVANAUGH. W F 10. *Baker* 377. Candidates for the degree of Bachelor of Chemistry may not receive credit for this course toward the degree.

Lectures. The chemical composition, physical and physiological properties, sources, and methods of manufacture of the principal food products.

835. **Advanced Agricultural Chemistry (Fertilizers, Insecticides, Soils).** Second term. Credit two or more hours. Prerequisite, Chemistry 810. Professor CAVANAUGH. Day and hour to be arranged. *Baker* 350.

Laboratory practice. Advanced work in the chemistry of soils, fertilizers, plant composition, insecticides, or fungicides. Special topics may be selected.

840. **Advanced Agricultural Chemistry (Foods and Feeds).** Second term. Credit two or more hours. Prerequisite, Chemistry 820. Professor CAVANAUGH. Day and hour to be arranged. *Baker* 350.

Laboratory practice. Special topics in the chemistry of foods and food preparations.

895. **Research for Seniors.** Second term. Professor CAVANAUGH. See page 8.

SEMINARY

905. **Seminary.** Credit one hour. M 5. *Baker* 107.

For seniors who are candidates for the degree of Bachelor of Chemistry.

1000. **Non-Resident Lectures.** Either term. Credit two hours. T Th 12. *Baker* 107. Colloquium, W 4:15. Open to seniors in the course in chemistry, and to juniors by special permission.

First term. (a) Chemical Analysis by X-rays and its Application. (b) Rare Earth Elements and Atomic Structure. (c) Chemistry of Hafnium. (d) Electrolytic Conduction in Atoms and Crystals. (e) Separation of Isotopes. Professor G. HEVESY, University of Freiburg in Baden, Germany.

Second term. Molecular Structure and the Periodic Classification. Doctor N. V. SIDGWICK, Lincoln College, Oxford, England.

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