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William J. Kerr

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## The Graduate Schools: Circular of Information

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- 37, 38, 39. **Experimental Physics.**—A course of laboratory work, chiefly devoted to the repetition of classical experiments, such as: Determination of the Mechanical Equivalent of Heat, Maxwell's "V" Hertzian Oscillation, Relative and Absolute Wave-lengths, etc. Mj. 10 hrs. a week

Autumn, Winter, Spring Quarters

PROFESSOR MICHELSON

AND ASSISTANT PROFESSOR MANN

Prerequisite: *Physics, 16, 17, and 18.*

- 40, 41, 42, 43. **Research Course.**—This course is intended for those Graduate students who are prepared to undertake special research. Except in the case of a purely mathematical problem, the entire time is to be devoted to work in the laboratory. 20 hrs. a week. Every Quarter.

DMj. Summer Quarter

ASSISTANT PROFESSOR MANN

3DMj. Autumn, Winter, and Spring Quarters

PROFESSOR MICHELSON

AND ASSISTANT PROFESSOR MANN

48. **Spectrometry.**—Laboratory work in photographing and measuring the spectra of various elements. Use of the concave grating echelon and interferometer. Mj. Spring Quarter

DR. GALE

51. **Thermodynamics.**—Lectures upon the fundamental principles underlying the mechanical theory of heat and the application of these

principles to physical and thermochemical problems.

5 hrs. a week. Mj. Autumn Quarter; 2:00

ASSISTANT PROFESSOR MILLIKAN

52. **Electron Theory.**—A course of graduate lectures covering the work of the last ten years on the electrical properties of gases; the electron theory, and radioactivity.

5 hrs. a week. Mj. Summer Quarter; 10:30

Mj. Spring Quarter; 8:30

ASSISTANT PROFESSOR MILLIKAN

53. **Experimental Electricity.**—A laboratory course in practical electricity involving a study of dynamos, motors, and transformers. 10 hrs. a week.

Mj. Summer Quarter; 2:30-4:30

ASSISTANT PROFESSOR KINSLEY

54. **Electric Waves.**—A discussion of the theory of the generation and detection of electric waves, of stationary waves on wires, and of electric resonance. 5 hrs. a week.

ASSISTANT PROFESSOR KINSLEY

[Not to be given in 1906-7]

55. **The Theory of Alternating Currents.**—A discussion of the distribution of alternating currents in stationary wires, including transformers and long distance circuits, and of dynamos and induction and synchronous motors.

Mj. Summer Quarter; 1:30

ASSISTANT PROFESSOR KINSLEY

## XX. THE DEPARTMENT OF CHEMISTRY

### OFFICERS OF INSTRUCTION

JOHN ULRIC NEF, PH.D., *Professor and Head of the Department of Chemistry.*

ALEXANDER SMITH, PH.D., *Professor and Director of General and Physical Chemistry.*

JULIUS STIEGLITZ, PH.D., *Professor of Chemistry.*

HERBERT NEWBY MCCOY, PH.D., *Assistant Professor of Physical Chemistry.*

JOHN CHARLES HESSLER, PH.D., *Instructor in Chemistry.*

LAUDER WILLIAM JONES, PH.D., *Instructor in Analytical Chemistry.*

THOMAS BRUCE FREAS, A.B., *Curator.*

WILLIS B. HOLMES, PH.D., *Associate in Chemistry.*

EDITH ETHEL BARNARD, S.M., *Associate in Quantitative Analysis.*

OSCAR ECKSTEIN, Sc.D., *Research Assistant in Chemistry.*

ELLIOT S. HALL, PH.D., *Research Assistant in Chemistry.*

WALTER STANLEY HAINES, A.M., M.D., *Professor of Chemistry, Pharmacy, and Toxicology, Rush Medical College; Professorial Lecturer on Toxicology.*



## FELLOWS, 1905-6

HENRY MAY GOETTSCH, S.B. (Lowenthal Fellow)    JAMES WRIGHT LAWRIE, S.B.  
 WILLIS STOSE HILPERT, S.B.                      ANDREW FRIDLEY McLEOD, A.B.  
    HERMANN IRVING SCHLESINGER, S.B.

## INTRODUCTORY

*Research.*—Research students in the University, or coming from other institutions, are encouraged to begin research if, and as soon as, their preparation justifies it. Facilities for research in all lines, whether of inorganic, organic, or physical chemistry, are provided. Special opportunities to pursue entirely independent research work will be given to maturer students who have already obtained the Doctor's degree.

*Instruction.*—The objects of the instruction are to prepare students (1) to teach in colleges or universities; (2) to teach in secondary schools; (3) to fill positions as technical experts or assistants in chemical industries; (4) to become analysts in commercial or sanitary laboratories. The elementary courses may be taken with advantage by students having none of these ends in view.

Special stress will be placed on thorough preparation and symmetrical development of the student's knowledge. The object of the courses will be not so much to train specialists as to prepare the student to undertake intelligently any and every kind of work of a chemical nature. Those intending to become practical chemists will find a thorough course of purely scientific chemistry the best basis for future specialization in any direction whatever. Those who incline toward inorganic chemistry will be required to do much physical and a considerable amount of organic work; those proposing to become organic chemists will be required to do work in inorganic chemistry of a more advanced nature than that given in the elementary and analytical courses, and some physical chemistry, and so forth.

*The degree of Ph.D.: Chemistry as major subject.*—The requirements for the degree of Doctor of Philosophy (for general University regulations, see p. 11 of this *Circular*) are:

1. The presentation of a thesis embodying the result of original research in General Inorganic, Organic, Physico-Organic, or Physical Chemistry. This must constitute a real contribution to knowledge, and the work is usually done under the direction of an officer of the Department.

2. Specially thorough and mature knowledge of the branches of Chemistry touched by the thesis, and less thorough but sufficient knowledge of other fundamental branches of the science.

The general requirements for all candidates are as follows: Courses 1-3 (or 1A, 2A), 4\*, 6-9, 28A, 28B, and two Majors selected from Courses 10, 11, 13A-13G, 14-16; total twelve Majors, of which eight Majors are undergraduate work.

Special requirements in addition to the above, arranged according to the thesis subject, are as follows:

General Chemistry: Courses 25-27, 20 or 31, and two Majors taken from Courses 13, 14, 15, 16, 19, 21, 22, 29-32; total, six Majors.

Organic Chemistry: Courses 6, 20-22, 25, and one Major from 10, 13, 19, 26, 27, 29-32; total, six Majors.

Physico-Organic Chemistry: Courses 15, 20, 21, 25, and 22 or 31, and one Major taken from Courses 10, 13, 19, 26, 27, 29-32; total, six Majors.

Physical Chemistry: Courses 25, 26, 31, 32, and two Majors taken from Courses 10, 13, 14, 16, 19, 20-22, 27; total, six Majors.

In addition to one set of these specific requirements, at least six half-Majors will be chosen from the special lecture courses, 23, 29, 30, 34-38, 40, 42. The research work will require from four to six Quarters.

3. Sufficient work in one or two minor subjects. For instance, if Physics is a minor subject, two years of College Physics, Courses 1, 2, 3, and three of the Courses 11, 12, 13, 16, 17, 18. In addition to the regular minor subject, all candidates are advised to take mineralogy and crystallography (about  $\frac{1}{2}$ Mj).

4. A reading knowledge of French and German is required of candidates for higher degrees.

*The degree of Ph.D.: Chemistry as secondary subject.*—When Chemistry is a secondary subject, the requirement is determined after conference with the Head of the Department in which the major work is done. In the past it has consisted of Courses 1, 2, 3, 6, 7, 8, or their equivalent, together with elementary Physical Chemistry (28A and 28B) or Organic Chemistry, according as the major subject belonged to the Physical or the Biological Group.

\* Course 4 may be omitted when advanced lecture and laboratory work in Organic Chemistry is taken.



*The Master's degree.*—For the specialist Master's degree a dissertation and seven Majors of graduate work in Chemistry are required. These must be selected from Courses 10 to 42, with the approval of the Head of the Department. Courses prerequisite to these must be taken, but cannot be counted in reckoning the seven required Majors. For the non-specialist degree the selection may be made from Courses 8 to 42, with the approval of the Heads of the three Departments concerned.

*Special students.*—Special or unclassified students, not candidates for a degree, will be received, but in every case they will be required to give evidence, satisfactory to the instructors in the different branches, that their previous training has been sufficient to enable them to derive full profit from the courses they propose to take.

*Preparation for teaching.*—While students who have not taken the work required for the Doctor's or Master's degree are not usually recommended for college or university positions, the degree of bachelor, with a sufficient amount of work in Chemistry, is at present considered preparation for teaching in secondary schools. In general the work in Chemistry should include Courses 1, 2, 3, 4, 6, 7, 8, 28A, 28B, and 40, or their equivalent, as well as work in the College of Education (see the *Annual Register* for 1905-6). The prospective teacher should secure preparation to teach at least one science besides Chemistry.

*Preparation for technical positions.*—1. The thorough scientific training in all branches of Chemistry required for the Ph.D. degree forms the best basis for a future career as a chemical expert in any branch of chemical industry. With this preparation, the principles and details of technical processes are quickly grasped, advances in industrial processes are intelligently followed, and newly discovered principles are readily applied.

2. Students who have taken from ten to fifteen Majors of work in the Department are able to fill satisfactorily positions as assistants in technical and analytical laboratories, and after some practical experience to advance to positions of independent responsibility. Students should take at least Courses 1 to 10, inclusive, and one or two Majors in Courses 13A-13G. If possible, Courses 28A and 28B and, according to the choice of work in Organic or Inorganic Chemistry, two or three courses selected from Nos. 12, 14-16, 20-22, 25-27 should be taken in the interest of a broader and more thorough preparation. Students taking such a preparation are given the preference in answering requests received by the Department. Students taking the less complete training mentioned above, however, are also sought by technical firms.

3. The Department gives, with other Departments (notably Physics and Mathematics) of the University and the Department of Manual Training of the University High School, the equivalent of three years of a four years' course in Chemical Engineering. Students are able to take a large part of this work in the purely scientific fundamental branches while candidates for a Bachelor's degree.

*Recommendation of Students to Positions.*—The Department of Chemistry does not undertake to secure positions for those who have studied in it, but as a matter of fact, worthy students find suitable places quickly, and in the past the demand for chemists of all the kinds mentioned above has far exceeded the supply.

University Fellowships yielding an income of \$320 or \$520 annually are open to Graduate students in Chemistry. A Fellowship in Chemistry has been endowed since 1901 by Mr. Berthold Loewenthal, of Chicago, as a memorial of his son Joseph B. Loewenthal; it yields an annual income of \$420.

The Departmental Library is equipped with an almost complete list of periodicals, past and current, necessary for prosecuting research; it also possesses a large number of reference and handbooks.

A number of general scientific journals and many of the proceedings of learned societies are received in the General Library.

One Senior College and one Graduate Scholarship are awarded yearly in accordance with the general regulations of the University, to two students graduating from the Junior and Senior Colleges respectively.

#### COURSES OF INSTRUCTION

NOTE.—Courses 6, 7, 8, 9, 10, 11 and 13 are given in the analytical laboratories. The laboratories are open from 8:00 A. M. to 6:00 P. M. (Saturdays only to 1:00 P. M.). The hours of instruction provide for morning and afternoon sections and will be posted in the laboratory.

Courses 8 and 9 will count toward a Master's or the Doctor's degree when Chemistry is the *secondary* subject.

#### PRIMARILY FOR THE SENIOR COLLEGES

#### 6. Qualitative Analysis.—Introductory Course.

Mj or DM. 8 or 16 hrs. a week, laboratory.

2 hrs. a week classroom. Lectures, 2:00.

First Term, Summer Quarter

PROFESSOR STIEGLITZ

AND DR. HOLMES

Second Term, Summer Quarter

DR. HOLMES

Autumn Quarter

PROFESSOR STIEGLITZ

Winter and Spring Quarters

DR. JONES

Prerequisite: Course 3, or 2A, or 2B.

The lectures deal with the chemistry of the analytical reactions, and special attention is given to the development and application of the laws of equilibrium and solutions. This course is, in an important sense, one in advanced general chemistry.



- \* 7. **Qualitative Analysis.**—Continuation of Course 6.  
Hours as in 6. Mj or DM. Summer Quarter  
DR. HOLMES  
Autumn Quarter  
PROFESSOR STIEGLITZ  
Winter and Spring Quarters  
DR. JONES

Courses 6, 7, 10 form a continuous course, which may be begun in any Quarter.

The aim of Courses 6, 7, 10 will be to train the student to do intelligent analytical work based on a knowledge of the scientific principles of the subject and to apply and amplify his knowledge of General and Physical Chemistry.

- \* 8. **Quantitative Analysis.**—*Introductory Course.*  
Chiefly laboratory work in gravimetric and volumetric analysis.

Mj or DM. 8 or 16 hrs. a week, laboratory.  
Lecture 1 hour.

Summer, Autumn, and Spring Quarters.

MISS BARNARD

Winter Quarter

PROFESSOR STIEGLITZ AND MISS BARNARD

Prerequisite: *Qualitative Analysis* (Courses 6 and 7). Medical students will be admitted to the course after having taken Course 6.

- \* 9. **Quantitative Analysis.**—Continuation of Course 8.  
Mj or DM. 10 or 20 hrs. a week, laboratory.

Summer, Autumn, and Spring Quarters

MISS BARNARD

Winter Quarter

PROFESSOR STIEGLITZ AND MISS BARNARD

Courses 8, 9, and 11 form a continuous course, which may be begun in any Quarter.

PRIMARILY FOR THE GRADUATE SCHOOL

10. **Advanced Qualitative Analysis.**—Mj or DM. 10 or 20 hrs. a week, laboratory.

Summer Quarter

DR. HOLMES

Autumn Quarter

PROFESSOR STIEGLITZ

Winter and Spring Quarter

DR. JONES

Open to College students. Continuation of Courses 6 and 7.

11. **Advanced Quantitative Analysis.**—Mj or DM. 10 or 20 hrs. a week.

Summer and Winter Quarters

PROFESSOR STIEGLITZ AND MISS BARNARD

Continuation of Courses 8 and 9. Open to students in the Senior Colleges.

12. **Elementary Spectrum Analysis (Qualitative).**—  
Emission (flame and electric spark) and absorption spectra of inorganic substances. Chiefly laboratory work.  $\frac{1}{2}$ Mj. Winter Quarter

DR. JONES

13. **Special Methods in Quantitative Analysis.**—Chiefly laboratory work.

13A. Electrolytic Methods.  $\frac{1}{2}$ Mj or Mj

13B. Special Mineral Analysis. Mj

13C. Water Analysis.  $\frac{1}{2}$ Mj

13D. Gas Analysis.  $\frac{1}{2}$ Mj

13E. Organic Elementary Analysis.  $\frac{1}{2}$ Mj

13G. Iron and Steel Analysis.  $\frac{1}{2}$ Mj or Mj

13H. Proximate Food Analysis.  $\frac{1}{2}$ Mj or Mj

Summer, Autumn, Winter, and Spring Quarters

PROFESSOR STIEGLITZ AND MISS BARNARD

Prerequisite: *Quantitative Analysis*, 8 and 9.

- 13F. **Assaying.**—Fire-assay of gold, silver, and lead ores. Mj. Spring Quarter

MR. ———

Prerequisite: *General Chemistry, Qualitative and Quantitative Analysis* (Courses 8 and 9).

- \* 14. **Organic Chemistry.**—Lectures 3 hrs. a week.

Mj. Autumn Quarter; 12:00

PROFESSOR NEF

Prerequisite: *General Chemistry and Qualitative Analysis*. *Taking at present*

- \* 15. **Organic Chemistry.**—Continuation of Course 14.

Mj. Winter Quarter; 12:00

PROFESSOR NEF

16. **Organic Chemistry.**—Continuation of Course 15.

M. First Term, Spring Quarter; 12:00

PROFESSOR NEF

Courses 14, 15, 16 form a continuous course, covering the compounds of carbon, including the fatty and the aromatic series. The aim of the course will be to take up very thoroughly the simpler compounds, going with great detail into the chemical behavior, the characteristic reactions, and relationships of the different classes of organic compounds, and considering with great care the synthetic methods by which they can be obtained. Richter's or Berntsen's *Organic Chemistry* is used as a reference book, but recent literature will, in special cases, be considered in detail.

- \* 17. **General Organic Chemistry.**—Fatty and aromatic series.

Lectures, 5 hrs. a week.

Mj (or M. First Term). Summer Quarter 8:30.

DR. JONES

Prerequisite: *General Chemistry and Qualitative Analysis*.



**18. Elementary Organic Preparations.**—Laboratory work; 10 hrs. a week. This course is arranged to accompany the lectures of Course 17. It may be taken without the lectures by students who have had organic chemistry.

$\frac{1}{2}$ Mj or Mj. Summer Quarter  
DR. JONES

Prerequisite: *As in Course 17.*

**19. Toxicology.**  $\frac{1}{2}$ Mj. Autumn Quarter  
PROFESSOR HAINES AND ASSISTANT

**19B. Poisons and Their Detection.**—A conference and laboratory course.

M. Second Term, Spring Quarter  
PROFESSOR HAINES

**20. Organic Preparations.**—Laboratory work, 10 or 20 hrs. a week.

Mj or DM. Autumn, Winter, and Spring Quarters.  
PROFESSOR NEF  
Summer Quarter  
DR. JONES

Prerequisite: *Qualitative and Quantitative Analysis*, and *Organic Chemistry* (it may be taken simultaneously in connection with lectures on Organic Chemistry). A reading knowledge of German is essential.

**21. Organic Preparations.**—Continuation of Course

20. *Present work.* Mj or DM.  
Autumn, Winter, and Spring Quarters  
PROFESSOR NEF  
Summer Quarter  
DR. JONES

**22. Organic Preparations.**—Continuation of Course 21.

Mj or DM.  
Autumn, Winter and Spring Quarters  
PROFESSOR NEF  
Summer Quarter  
DR. JONES.

**23. Physical Chemistry Applied to Problems in General Chemistry.**

PROFESSOR SMITH

Prerequisite: *College Physics, General Chemistry, and Qualitative Analysis.*

[Not to be given in 1906-7]

**24. Advanced Inorganic Chemistry.**—Two lectures a week on selected topics.

$\frac{1}{2}$ Mj.  
Winter Quarter  
DR. JONES

Prerequisite: *General Chemistry and Qualitative Analysis.*

**25. Inorganic Preparations.**—Laboratory work.

Mj or DM. 10 or 20 hrs. a week  
Summer, Autumn, and Winter Quarters  
DR. JONES

Prerequisite: *Qualitative and Quantitative Analysis, and a reading knowledge of German.*

**26. Inorganic Preparations.**—Continuation of Course 25.

Mj or DM  
Autumn and Winter Quarters  
DR. JONES

**27. Inorganic Preparations.**—Continuation of Course 26.

Mj or DM  
Autumn and Winter Quarters.  
DR. JONES

**28A. Elementary Physical Chemistry.**—With special reference to Physico-Chemical measurements.

$\frac{1}{2}$ Mj. Summer and Spring Quarters  
ASSISTANT PROFESSOR MCCOY

Prerequisite: *College Physics* (Course 1) and *Qualitative Analysis* (Course 6).

**28B. Practical Physical Chemistry.**  $\frac{1}{2}$  Mj or M

First or Second Term, Summer Quarter  
ASSISTANT PROFESSOR MCCOY  
 $\frac{1}{2}$ Mj. Spring Quarter  
ASSISTANT PROFESSOR MCCOY

Prerequisite: *College Physics* (Course 1), *Quantitative Analysis* (Course 8); Course 28A should accompany or precede this course.

**29. Chemical Dynamics.**  $\frac{1}{2}$ Mj. 2 hrs. a week.  
Autumn Quarter; 12:00

ASSISTANT PROFESSOR MCCOY

Prerequisite: *Elementary Physical and Organic Chemistry, including laboratory work; the elements of Calculus.*

**29A Chemical Dynamics and Electro-Chemistry.**

Mj. Summer Quarter  
ASSISTANT PROFESSOR MCCOY

**30. Electro-Chemistry.**

$\frac{1}{2}$ Mj. 2 hrs. a week. Spring Quarter  
ASSISTANT PROFESSOR MCCOY

Prerequisite: *Elementary Physical Chemistry, including laboratory work; the elements of Calculus.*

**31. Advanced Physical Chemistry.**—Laboratory course.

Mj or DM  
Summer, Autumn, and Spring Quarters  
ASSISTANT PROFESSOR MCCOY

Prerequisite: *College Physics, 1 year.* Course 29 should accompany or precede this course.



32. **Advanced Physical Chemistry.**—Laboratory course. Continuation of Course 31.

Mj or DM. Summer Quarter; Autumn and Spring Quarters.

ASSISTANT PROFESSOR MCCOY

33. **Research Work.**—This course will include from 30 to 40 hrs. a week of laboratory work, under the special direction of some one of the instructors in the department. It is expected that research work for a Ph.D. thesis will require 4-6 Quarters, 4-6 DMj.

33a. *Research in Organic Chemistry.*—Autumn, Winter, and Spring Quarters.

PROFESSOR NEF

33b. *Research in General Chemistry.*—Autumn, Winter, and Spring Quarters.

PROFESSOR SMITH

33c. *Research in Organic and Physico-Organic Chemistry.*—First Term, Summer Quarter; Autumn, Winter, and Spring Quarters.

PROFESSOR STIEGLITZ

33d. *Research in Physical Chemistry.*—Summer, Autumn, and Spring Quarters.

ASSISTANT PROFESSOR MCCOY

Before being admitted to Research, a candidate must satisfy the instructors of the Department, by an oral test, or otherwise, that his previous training has been sufficient.

34. **Physical Chemistry Applied to Organic Problems.**  
Lectures 2 hrs. a week.

$\frac{1}{2}$ Mj. Spring Quarter

PROFESSOR STIEGLITZ

Prerequisite: *Organic Chemistry and Elementary Physical Chemistry.*

- X 35. **The Carbohydrates and the Terpenes** (and their derivatives). Autumn Quarter.

PROFESSOR STIEGLITZ

Prerequisite: *Organic Chemistry.*

36. **Organic Nitrogen Derivatives.**—Uric acid series; pyridine, quinone-imides, and phenazine compounds; a discussion of the alkaloids, ptomaines, and organic dye-stuffs.

$\frac{1}{2}$ Mj. Winter Quarter

PROFESSOR STIEGLITZ

Prerequisite: *Organic Chemistry.*

37. **Special Chapters of Organic Chemistry.**—Lectures, 4 hrs. a week.

M. Second Term, Spring Quarter  
PROFESSOR NEF

Prerequisite: *Organic Chemistry.*

38. **The Aromatic Series.**—Lectures, 2 hrs. a week. Spring Quarter.

DR. HESSLER

Prerequisite: *Organic Chemistry.*

39. **The Atomic Theory.**  $\frac{1}{2}$  Mj

ASSISTANT PROFESSOR MCCOY

[Not to be given in 1906-7]

40. **Training Course in the Teaching of Chemistry.**—

This course, for prospective teachers in secondary schools, will include: (1) In autumn, observation of teaching in several schools in the city and reports on the same; (2) in winter, a series of conferences on the didactic of chemistry; (3) in spring, practice-teaching in the University High School and in the Junior Colleges under criticism and supervision.

$1\frac{1}{2}$ Mj. Continued through Autumn, Winter and Spring Quarters.

PROFESSOR SMITH

Prerequisite: *Chemistry* 1, 2, 3, 4, 6, 7, 8, 28A, 28B; *Physics* 1, 2, 3, or their equivalents, must precede or accompany this course.

42. **History of Chemistry.**—2 hrs. a week. Winter Quarter.  $\frac{1}{2}$  Mj

DR. HESSLER

[Not to be given in 1906-7]

44. **The Chemistry of Photography.**  $\frac{1}{2}$  Mj

[Not to be given in 1906-7]

43. **Club Meetings.**—Meetings will be held twice a month. They may be attended by anyone interested, whether connected with the University or not; the subjects for the meetings will be announced at least one week beforehand.

Summer, Autumn, Winter, and Spring Quarters

VARIOUS MEMBERS OF THE STAFF