1954 Meeting of

MIDWESTERN ASSOCIATION OF CHEMISTRY TEACHERS IN LIBERAL ARTS COLLEGES

held at

Grinnell College

Grinnell, Iowa

October 29, 30, 1954

Department of Chemistry
Grinnell College

T A B L E   O F   C O N T E N T S

PROGRAM

Third Annual Meeting

MIDWESTERN ASSOCIATION OF CHEMISTRY TEACHERS IN LIBERAL ARTS COLLEGES

Grinnell, Iowa. October 29, 30, 1954

Friday, Oct. 29, A.M.

9:15	Auto caravan leaves campus for Newton, Iowa. Optional tour of Maytag Manufacturing Company, Plant No. 1 producing the famous Maytag washing machines. Guided tour $1\frac{1}{2}$ hours.
11:00	Optional guided tour of Grinnell College buildings and campus.

Friday, Oct. 29 P.M.

1:00 - 3:00	Registration*, foyer, Science Hall Short tours of Science Hall starting at 1:30, 2:00, 2:30 Alternate Grinnell College campus tour starting at 1:45
3:00 - 3:45	Opening Session of the Conference, Science Hall
3:45 - 5:45	Discussion Groups, Science Hall, rooms to be announced
6:30	Dinner for Conference Members and their Wives Quadrangle Dining Room, courtesy of Grinnell College
8:00	Address: "Chemists Have to be People too" by Dr. John C. Gerber, professor of English and Coordinator of Communications Skills, State Univ. of Iowa. Grinnell College Chapel
9:30	Coffee, Cake, and Conversation. Younker Lounge

Saturday, Oct. 30 A.M.

9:00 - 10:30	Discussion Groups Reconvene
10:30 - 10:45	Recess
10:45 - 12:00	Talk and Demonstration on the Use of Radioactive Isotopes, Dr. Adolf Voigt, Head of Radiochemistry Section, Institute for Atomic Research, I.S.C. Ames, Ia.
12:30	Luncheon by ticket, Fellowship Hall, Congregational Church.

Saturday, Oct. 30 P.M.

1:30 - 3:00	Special Reports, Room 125, Science Hall
3:00 - 3:15	Recess
3:15 - 4:30	Business Meeting, followed by adjournment.

* Ladies are asked to register, and will receive copies of special program at time of registration.

LADIES PROGRAM

Third Annual Meeting

MIDWESTERN ASSOCIATION OF CHEMISTRY TEACHERS IN LIBERAL ARTS COLLEGES 10/29/54

Grinnell College Grinnell, Iowa.

Friday, Oct. 29, A.M.

9:15 Auto caravan leaves campus for Newton, Iowa. Optional tour of Maytag Manufacturing Company, Plant No. 1 producing the famous Maytag washing machines. Guided tour $1\frac{1}{2}$ hours.

11:00 Optional guided tours of Grinnell College buildings and campus.

Friday, Oct. 29 P.M.

1:00 - 3:00 Registration, foyer, Science Hall.

Short tours of Science Hall starting at 1:30; 2:00; 2:30
Alternate Grinnell College campus tour starting at 1:45

4:00 Tea W. C. Oelke residence MEET IN SCIENCE HALL FOYER
Hostesses: Mesdames Oelke, Sherman, Danforth, Wynberg

6:30 Dinner for Conference Members and their Wives.
Quadrangle Dining Room, courtesy of Grinnell College

8:00 Address: "Chemists Have to be People too" by Dr. John C. Gerber
professor of English and Coordinator of Communications Skills, State University of Iowa.
Grinnell College Chapel

9:30 Coffee, Cakes, and Conversation. Younker Lounge

Saturday, Oct. 30 A.M.

10:30 Tour of Grinnell's four new Churches
Meet in Science Hall Foyer at 10:20 A.M.

12:30 Luncheon by ticket, Fellowship Hall, Congregational Church.

We are glad that you have come, and hope that you enjoy your visit with us.

The Problem of Recruitment of Chemistry Majors

A report of the group discussing this topic at a meeting of the Midwestern Association of Chemistry Teachers in Liberal Arts Colleges, held at Grinnell College, Grinnel, Iowa on October 29 and 30th, 1954.

~~Submitted~~ by Mark C. Paulson, Secretary

Membership of the group was as follows:

Arild J. Miller, Chairman, Carleton College, Northfield, Minn.
Mark C. Paulson, Secretary, Bradley University, Peoria, Ill.
Howard Burkett, De Pauw University, Greencastle, Ind.
J. B. Culbertson, Cornell College, Mount Vernon, Iowa.
Bennett C. Howard, Western Illinois State Teacher's College, Macomb, Ill.
Don N. Marquardt, University of Omaha, Omaha, Nebraska.
Ben H. Peterson, Coe College, Cedar Rapids, Iowa.
Theodore L. VanderPloeg, Hope College, Holland, Mich.
Harry R. Weimer, Manchester College, North Manchester, Ind.

I. The Nature of the Problem of Recruitment of Chemistry Majors

The group in general recognized that the supply of chemistry majors is at low ebb, and that this is not only detrimental to the national interest, but a matter of concern for the various departments represented, placing them in the weak position of acting primarily as service departments for other curricula.

Some of the factors contributing to the shortage which were suggested by various members of the group were:

(1) Students have been conditioned by modern educational methods to choose the path of least resistance, and since the subject of chemistry may require a greater effort than some other subjects, they believe it should be avoided.

(2) Some high school chemistry teachers are unqualified and are not interested in teaching the subject. This type of teacher will not inspire the choice of chemistry as a career.

(3) The world situation tends to lead students to the choice of easy subjects, so they can have some fun before they go into the armed forces, or so they can keep their grades up to keep out of the draft.

II. Means of Attacking the Problem of Recruitment of Chemistry Majors

A. At the College Level.

(1) The first year chemistry course should be sufficiently stimulating to keep the majors from straying and also to win over some of the undecided students to a career in chemistry. Let us not be so busy in blaming other fellows for our situation that we neglect our own self-improvement.

(2) The staff should take a genuine interest in the chemistry majors. Concentrating attention on a few top students may foster ill-will among the others. Students like the personal touch, they also like to feel that the department stands up for its majors. Departmental jobs may assist in holding a wavering major.

(3) Can we combat the adverse propoganda that chemistry is too tough? Many capable students are apparently frightened into avoiding the subject because thay have heard that a chemistry major has to be a real brain . The instructor may even be guilty of promoting this idea by his classroom attitude. The discussion group felt that more emphasis should be placed on the fact that the average student may succeed in chemistry and be employable in the profession.

(4) Counsellors should be properly informed of the opportunities in chemistry. Too many counsellors appear sold on other curricula and totally unaware of what chemistry has to offer.

(5) Some assistance in recruitment may come from the Admissions Office. They also should be properly informed of the opportunities in chemistry.

(6) Maintainence of good public relations was emphasized.

B. At the High School Level.

(1) The group concurred in the opinion that a high level of training for high school chemistry teachers was desirable. Suggestions for improving the present level included influencing legislation setting up minimum standards, salary improvement to attract more qualified people to teaching, and

summer jobs in the chemical industry for teachers. Some of the group felt that omission of the high school course was preferable to taking a poor high school course.

(2) There is a need for improved cooperation between high school and college chemistry teachers. The experience of several members of the group indicated that efforts in this direction are often regarded with suspicion if not open animosity. Workshops involving the two groups appear to be a step in the right direction.

(3) High school counsellors should be informed of the opportunities in chemistry. The recommendation was made that our own organization should consider sending suitable literature to counsellors rather than depending upon the A. C. S.

(4) Science Fairs and Chemistry Open Houses were considered of value in stimulating interest in chemistry. In this connection, the point was brought out that we should make more use of our own chemistry majors in contacts with the high schools. The chemistry major may be one of our best missionaries, since his age group is not so far removed from that of the high school student.

(5) Making literature on chemistry and the chemical profession available to high school libraries helps stimulate interest in chemistry.

(6) Advanced standing idea which is now being tried in some high schools provides some interesting possibilities. Under this scheme, students are given college credit for an approved high school chemistry course. This avoids duplication and makes the student feel like he is getting a head start if he majors in chemistry. Also, in order to secure approval, the high school will strive to attain a high standard in the chemistry course. Understandably, this arrangement would be possible only with those high schools capable of giving a course of college calibre.

C. At The Elementary School Level.

(1) Some members of our discussion group expressed the idea that an eventual decision for a career in chemistry could be influenced at the elementary school level, and that this opportunity is frequently overlooked. In modern education, and with television, the child is exposed to ideas in science at a much earlier age than formerly, and most of these children

show an intense interest along these lines which may fade out in high school. Moreover, assistance offered to grade school teachers may be more readily accepted than that offered high school teachers.

(2) There are some organized groups of young people outside of the elementary school, such as Cub Scouts, Boy Scouts, etc., which will usually welcome demonstrations or simple talks. Invitations might also be extended to parents.

D. Miscellaneous.

(1) In comparison with some other professional groups, the chémists appear to be doing a rather poor job in selling their profession to the public.

(2) Industries employing chemists have a direct interest in the problem of recruitment of chemistry majors and should be expected to take an active part in an attack upon the problem.

(3) Effective utilization of newspapers, radio and television may assist in overcoming the lack of interest in chemical careers.

Submitted by
Mark C. Paulson
Nov. 14, 1954

Discussion Group: The Chemistry Curriculum in Relation to Liberal Arts

S. F. Darling, Lawrence, Chairman; J. D. Woods, Drake, Recorder.

Participants:

Arthur Sunier, Carroll College; Sister Mary Edwards Pottebaum, Briar Cliff College; Robert W. McCreight, Westminster College; Donald J. Cook, De Pauw University; Harland D. Embree, Hamline University; Sister Editha Underhill, Rockford College; Hilda T. Myers, Kalamazoo College; W. A. Manuel, Ohio Wesleyan.

The discussion by the group may be outlined as follows:

1. <u>The meaning of liberal arts.</u>

A. A variety of opinions were expressed concerning the definition of liberal arts, ranging from strictly a knowledge of the classics to professional training. In general, there was agreement on the following points:

a. Liberal arts frees the individual from ignorance.

b. A liberally educated man has the ability to think and act with wisdom.

c. The way a course is taught often determines whether it is liberal or technical.

B. Some questions raised that need further discussion concerned the following:

a. Does the liberal arts college have a dual function of liberal education as well as specialized education of a vocational nature?

b. Is there a distinction between a liberal arts and a non-liberal arts course?

2. <u>Science for the non-science major.</u>

Discussion centering on this topic lead to several questions. Conclusions were not forthcoming in much of the discussion.

A. Can an understanding of science and the scientific method best be acquired in a "specific science" course, such as chemistry, or in a "general science" course?

Some in the group described general science courses in their schools. There was feeling that these were doing as much or more for the non-science majors as the traditional science courses. In those schools with general science courses the chemistry classes usually have only science majors, thus allowing for more depth. The danger of spreading content over too large an area in general science courses was pointed out.

The question of which department should administer such a course was discussed. One school indicated that theirs was shared by the chemistry and physics departments. Another school represented maintains a department of physical science that offers general science for the non-science majors. On the other hand, there was some opinion that science for non-science majors can best be taught in a good course in one of the sciences such as chemistry.

B. The terminal course in chemistry.

Some of the schools represented offer a terminal course in chemistry which non-science majors may elect for their science requirement. There was agreement that the terminal course should not be "watered-down" but should have enough depth to give understanding of general concepts.

C. Science majors and non-science majors in the same course.

Several of the schools offer only one course in beginning chemistry for all groups of students. Some provide for individual differences through special problems or laboratory work for the chemistry majors. There seemed to be a concensus of opinion that a course that is good for science majors in liberal arts would also be good for non-science majors.

D. Granting of credit by examination for high school courses taken.

Some of the schools grant credit to high school students in certain areas where the student can pass qualifying examinations. There was agreement that beginning courses in sequences such as langauge, science, or mathematics might well be by-passed by such procedure. However, strong feeling was expressed that granting of credit by examination to non-science majors for their only science requirement would not give them a true liberal education.

3. Curriculum for chemistry majors.

A variety of subjects were discussed concerning the problems of developing a chemistry major within liberal arts.

A. Sequence of chemistry courses.

Some schools represented offer organic chemistry during the sophomore year, while others teach quantitative analysis first. There seemed to be no strong reasons presented in favor of either order. It was felt that mathematics through calculus and quantitative analysis should be prerequisites for physical chemistry. Some indicated that physical chemistry had been taught in some instances to pre-meds in the sophomore year before calculus or quant.

B. Number of hours of chemistry for a major.

The number of hours of chemistry required for a major varies from school to school. There was feeling that a minimum number of hours in chemistry might be desirable to encourage broad training in liberal arts. It was pointed out, however, that requirements in other areas, in practice, do limit the number of hours of chemistry. The desirability of A.C.S. approval for chemistry departments was emphasized. But, the danger of professional group pressure that might lead to over-emphasis of technical courses, without regard to the total liberal training of chemistry majors was also recognized.

C. Responsibility of chemistry departments for total program of chemistry majors.

There is a need for teachers in all departments in a college to get together and discuss the total student program. Knowing more about the offerings of other departments should make for better advising of chemistry majors with respect to their required and elective courses outside the chemistry department.

D. Making the chemistry course liberal.

a. The historical approach might be used in some instances to emphasize the human effort that has gone into the development of the science. This should not exclude the logical approach but should serve to supplement it.

b. Emphasis should be placed on the limitations of a science as well as its possibilities. The public needs to understand that science is not a magic "cure-all" for the world's ills.

Chemistry Curriculum

Special Areas Group

afternoon session 10-29-54
morning session 10-30-54

Earlham College

L. E. Strong, chairman

J. E. Saunwein, secretary

~~Attended~~: Participants

	Drury College	Beloit, Wis.
M. Jerome Bigelow	St. Ambrose College	Davenport, Ia.
Bernard Bornong	Wheaton College	Wheaton, Ill.
Harold A. Chase	Parsons College	Fairfield, Ia.
Wade E. Hall	Aurora College	Aurora, Ill.
Wallis G. Hunis	Manchester College	North Manchester, Ind.
Carl W. Holl	College of St. Thomas	St. Paul, Minn.
J. D. Larson	Hamline University	St. Paul, Minn.
Perry A. Moore	Carleton College	Northfield, Minn.
Hellmut P. Penner	Barat College	Lake Forest, Ill.
Jean E. Saunwein	Grinnell College	Grinnell, Ia.
Leo P. Sherman	Valparaiso University	Valparaiso, Ind.
L. O. Smith, Jr.	Earlham College	Richmond, Ind.
Lawrence E. Strong		

Problem How much theory should be included in the first course in Chemistry?

It was felt by some that too much Physical Chemistry introduced into the first course discourages students and causes drop-outs, but the majority considered it necessary to include considerable physical chemistry as a ~~theoretical~~ background.

Discussion led to a listing of atomic theory, including valence, periodic Table, etc.; molecular theory; the rôle of concentration in reactions; ionization as necessary topics. The opinion was expressed by several that the first course should present the basic fundamental theories which would then be elaborated in later courses. It was noted, however, that the first year course often leaves the student deficient in descriptive inorganic chemistry. What is needed is: 1) the ~~fundamental~~ basic theories, 2) enough facts to offer a background for these theories, and 3) enough facts to give familiarity with commonly used chemical substances. The difficulties of accomplishing such a program were discussed. Several suggested the possibility of later work in inorganic chemistry.

Emphasis was also placed on the necessity of stirring intellectual curiosity in the student in the beginning course.

Problem: Can Organic Chemistry be given as a second course in Chemistry?

The majority feel that a background of laboratory work in Analytical Chemistry is necessary for the student who is beginning Organic Chemistry. There was some discussion of the possibility of a descriptive portion of Organic Chemistry and also of revision of current practice in the laboratory work of Organic Chemistry

Problem: <u>Should a terminal course for non-majors be given?</u>

It was the consensus of opinion that small schools cannot give such a terminal course, and that, in particular, the expense is not justified when a course in the Physical Sciences is given. About one third of the institutions present give a terminal course for non-majors. Such a course is usually descriptive, with some demonstration experiments; it often emphasizes organic chemistry and omits rigorous material of the physical chemistry type.

Question: What courses other than the four standard year courses (General, Analytical, Organic, Physical) are given?

Approximately one half of the institutions represented give Biochemistry; a like number give a course in Instruments (often called Advanced Quantitative Analysis). About one third give a course in Organic Qualitative Analysis. Senior Problems is optional in most of the schools. Courses in Advanced Inorganic, Literature, and Inorganic Preparations were also given at some institutions. It may also be noted that a little less than half of the schools give senior comprehensive examinations as a requirement for graduation.

Question: What auxiliary courses are required?

All the institutions represented require mathematics through calculus and one year of college physics of their chemistry majors. Topics such as courses in remedial mathematics, the importance of emphasis on dimensional analysis, and the relative usefulness of high school courses in chemistry, mathematics, and physics were discussed briefly.

Problem: Is [illegible]

desirable to give different courses for Chemistry majors and for students with special aims, such as pre-medical students, Home Economics majors, medical technology trainees, and nurses?

Present practice at the institutions represented was discussed. This varied from no separation whatsoever of courses to almost separate curricula for the two groups. Doubt was expressed by many as to the desirability of giving different courses for pre-medical students; it was pointed out ~~that~~ they were fully capable of handling regular courses, ~~that~~ they often asked for the such courses, and that basic theories and facts needed were the same for both groups, with perhaps different emphasis occasionally. However, it was necessary in most cases to have separate courses in Physical Chemistry, since the mathematics background was often weaker among pre-medics.

On the other hand, ~~they~~ it

(over)

was agreed, it is much more practical to give separate courses for students in the cases of nurses and Home Economics majors.

MIDWESTERN ASSOCIATION OF CHEMISTRY TEACHERS IN LIBERAL ARTS COLLEGES

THIRD ANNUAL MEETING GRINNELL, IOWA

REPORT OF GROUP WHICH DISCUSSED 'THE COURSE IN QUANTITATIVE ANALYSIS'

~~The group elected~~ S. J. Vellenga of Monmouth College, ~~as~~ chairman and R. W. Ramette ~~of~~ Carleton College ~~as~~ secretary.

It was mentioned that organic chemistry has some applications in quantitative analysis and vice-versa. This led to a discussion of the pros and cons of having the organic course in the second year, followed by quant in the third year. While it was agreed that there is some merit in the suggestion, the group as a whole did not fully endorse the idea. Reasons given in favor of having organic chemistry first were:

(1) The mathematical quant course is delayed in favor of the more descriptive organic course.

(2) The student receives a broader picture of chemistry in the first two years.

(3) The theory of indicators and organic reagents can be discussed in quant.

(4) The course in organic chemistry has more tendency to stimulate interest in chemistry, and if given earlier in the curriculum might lead to more chemistry majors.

(5) The loss of precise technique in the junior year, before physical chemistry, is avoided.

Reasons given in favor of having quantitative analysis first were:

(1) Organic chemistry is not necessary for what quant is supposed to teach.

(2) Not much organic chemistry really applies to analytical chemistry.

(3) Equilibrium theory learned in quant is valuable in organic chemistry.

(4) The student should be put on his own as early as possible.

The group then made an effort to summarize the purposes of the course in quantitative analysis. These are:

(1) To develop skill in the precise techniques of chemistry.

(2) To emphasize thinking of chemistry as a precise science.

(3) To introduce the student to some representative methods of chemical analysis.

(4) To provide an opportunity and the necessity for independent thinking and judgement.

(5) To give training in the interpretation of the results of experiments.

Typical experiments given in the quantitative analysis laboratory were listed and discussed. The group concluded that the minimum requirements for the first course in quant are:

Two gravimetric determinations

Volumetric (titrimetric) determinations involving acid-base, precipitation and oxidation-reduction reactions.

In addition the course should include a colorimetric method for students who will have no opportunity for this later in the curriculum.

The majority felt that an electrodeposition experiment is best left out of the beginning course.

The group listed the following ideas designed to vary the nature of the quant course, to introduce new principles and to make the course more stimulating and appealing to the undergraduate:

(1) Introduction of new manipulative techniques such as micro-analysis and semi-micro determinations such as Kjeldahl nitrogen.

(2) Determination of chemical constants such as solubility products and ionization constants, using standard analytical procedures.

(3) Modification of old procedures to take advantage of newer time saving techniques.

(4) Projects to illustrate the effect of varying the procedure on the

quality of the analytical results. For example, the importance of a double precipitation of R_2O_3 oxides.

(5) Simple means for the calibration of equipment, such as the Kiehl calibrator for burets.

(6) Introduction of important new reagents, such as ethylenediaminetetraacetic acid (trade name VERSENE).

(7) Illustration and use of separation techniques such as ion-exchange, chromatography, extraction, volatilization, etc.

(8) Speeding up the laboratory work, thus making the lab less tedious for the student. For example, magnetic dampers can be used to speed weighing, also helping to avoid congestion on the balances. Long evaporations and ignitions to constant weight can be held to a minimum.

The group recommends that the above possibilities be considered seriously by teachers of quantitative analysis.

The Planning of ~~Summary of Discussion on~~ Science Buildings

The discussion of the group on science buildings was centered on the plans for the recently completed science building at Grinnell, and on the plans for the chemistry-geology building now under construction at Wheaton College.

The Grinnell building, housing the departments of chemistry, biology, physics, and mathematics, contains about 37,000 square feet and cost about $750,000, or about $20 per square foot. To this was added about $250,000 for laboratory and office furnishings.

The building at Wheaton contains about 33,000 square feet, at about $ 18 per square foot. Steel laboratory furniture will be installed.

In planning a new building, the first step shoud be the gathering of information conerning,(1) the amount of floor space currently in use, (2) future needs as correlated with enrollment estimates, (3) types of equipment and materials available.

An early decision should be made regarding the type of laboratory furniture desired. The type and size of laboratory desks and hoods often influences the size and shape of the rooms. Wheaton will install small individual exhaust stacks on the benches of the general chemistry laboratory.

Before consulting the architect, a decision should be made concerning the general spatial relationships between rooms. Grinnell, deciding on one central stock room, wished to have all the labs adjacent to the one stock room, and all the offices adjacent to the labs. Since it did not seem possible to achieve all these relationships at the same time, a decision was made to have the offices somewhat separated from the labs. Both Wheaton and Grinnell have classrooms adjacent to laboratories for occasional use by laboratory sections.

Many specific details ere discussed, including the following:

1. Lights and motors should be readily accessible for maintenance and replacement. This obvious point is sometimes overlooked by architects.
2. If floor drains are not installed in each lab, a wet-dry pick up can be provided the janitor for cleaning up small floods. In addition, all pipes passing

through floors should be surrounded by a projecting metal sleeve.

3. Wall hoods should be high enough inside to accomodate the tallest set up expected.

4. It is desirable that the room ventilation reinforce, rather than oppose, the hood system. The balance room should be maintained at a slight positive air pressure.

5. At Wheaton, the saving effected by reducing all ceilings to 8 1/2 - 9 feet was used to install complete heating or cooling air conditioning equipment.

6. Including all the plumbing with the general building construction will probably save money. When the ~~building~~ general plumbing and the lab furniture plumbing are done under separate contracts, there may be trouble regarding responsibility for defective installations.

7. Wheaton is saving some money by having the laboratory furniture installed without the services of the building architect.

G. Knudson

Participating

W. C. Oelke
Grinnell College

Paul Wright
Wheaton College

Ben T. Shawver
Monmouth College

G. E. Knudson
Luther College

Glenn R. Miller
Goshen College

L. K. Freeman ?
Shurtleff College

Discussion Section on Faculty & Undergraduate Research

I Research is desirable because it

1. is an aid to student recruitment by arousing interest.

2. increases interest and therefore scholarship in college students.

3. provides an opportunity for the student to exercise creative ability.

4. rounds out and puts into practice the student's academic learning.

5. emphasized the value of a library and stimulates its use.

6. builds up a "frustration tolerance" toward research, in students.

7. provides students with motivation to continue into graduate study.

8. provides students with a good start towards graduate research.

9. may be a financial aid to needy students.

10. is a stimulus to the faculty involved.

11. adds institutional, departmental and personal prestige.

II. Origination and control of ideas or projects.

1. In most cases projects are chosen from suggestions by faculty.

2. Occasionally suggestions come from students, sometimes as the result of seminars.

3. Several institutions provide a chem. lit. course for Juniors, in which the student builds up a bibliography on a research problem suggested by the faculty. This may be the background for Senior research. The disadvantage is that this usually limits research to Inorganic or Analytical Chemistry.

4. In any case there should be ~~complete~~ close supervision and final authority by the faculty.

III. Optional nature of research.

1. Only 2 institutions represented require research of professional majors.

2. All others provide for original research or at least special projects on an optional (with limitations, see below V) basis.

IV. Time spent by undergraduates in research.

1. In most cases ca. 40 credit hours is maximum allowable toward graduation. Average was 6 sem. hrs. credit, (7-9 clock hours per week) required for honors. This 6 credit hours was essentially in excess of the 40 allowable toward graduation.

V. Who (undergraduates) shall be invited or permitted to do research?

1. Prospective honors students.

2. Minimum grade requirement is useful, but interest of student should carry more weight than grades.

3. Approval of instructor.

VI. Course sequence

1. Organic is almost essential before starting research.

2. Point was made that most students do research in Organic because Physical is not presented early enough in the course sequence. One case was cited where Phys. Chem. was presented in Junior year, and large percent of research students worked in Phys. rather than Organic.

VII. Library.

1. Concluded that this is generally not a serious problem, due partly to Chem. Abstracts and Interlibrary Loan service.

VIII. Faculty load and availability.

1. Teaching load of faculty present ranged from 13-24 contact hours/week of regular curriculum work. Those members consistently carrying on research seemed to carry from 14-17 contact hrs./week.

2. Extracurricular activities detract markedly from time available for research.

3. Question of how to ~~keep~~ handle paper work (grading of lab reports, tests, etc.) was mentioned and probably deserved more discussion.

4. Average clock hours per week in research or research counselling was ca. 6-12 among those with a regular research program.

IX. Summer Research.

1. It was felt that summer research is practically indispensable to an ongoing program.

X. Finances.

1. Sources.
   a. Research Corporation generally best to get started.
   b. National Science Fund.
   c. Government.
   d. Industry (esp. DuPont).

2. Payments to undergraduates.
   a. Not desirable if they are receiving credit also.
   b. Rate $1.00 - $1.25 per hour.

3. This will continue to be a problem to the prof. who cannot obtain subsistence from his institution while doing research.

XI Summaries of Research programs represented.

"HOW ARE WE DOING"

Harry F. Lewis, The Institute of Paper Chemistry
Appleton, Wisconsin

The Scott Paper Company of Chester, Pa.--one of the most propressive and fastest growing companies in the United States--believes in telling its employees of the progress being made by the company. They do this by means of their "How're we doing" programs, given by people who know to groups of their various plants. They employ in such reports all the latest developments in visual presentation to emphasize their points and in no small measure the vision of where they are stimulates further progress. What they are doing is not to be compared to the Stakhanovite movement of the Stalin regime--rather they try to eliminate wasteful procedures and inefficient operations and to stimulate intelligent thinking all the way from grass roots to wheels of various diameters.

My report to you today is presented as a progress report of "How We Are Doing" here among the Middle Western Liberal Arts Colleges in the matter of research. It is presented with the realization that the research activities of our college chemistry departments represent only one phase of the teaching job but one that is related to the matter of good teaching (if kept within reason), with the production by our colleges of adequate numbers of professionally trained chemists, either as such or after graduate training, with the place of chemistry in the general education of the nonchemists and with the buildup and satisfactions and with the standing in the scientific community of the members of the chemistry department who are involved in research.

Last year I tried to give you a picture of the research activities of your departments during the 1948-53 period. This was published in the report of the Appleton meeting. This report covers the past 12 months.

In a talk I gave before the Division of Chemical Education in the spring of '53, I gave figures which implied that less than half of the 1850 college teachers of chemistry were qualified to do research and of that number only 415 (1 of 4) were engaged in research [Mattill, J. Chem. Educ. 556(1952)]. These figures came from 750 colleges. Your returns to my questionnaire show that 57 colleges in this Midwestern Association report for this past summer 69 chemistry faculty members at the research bench together with nine students--during the last school year there were 60 in the former category actually engaged in research together with 126 undergraduate students. That list included about ten one-man chemistry departments and contained no schools larger than Oberlin and DePauw--the majority being two-men schools. It is probably safe to assume that one half or more of the instructors represented by these 57 schools have been working with their own hands and in their own laboratories this past year. This is real achievement; it is bound to be reflected in the over-all quality of the work of the teacher and improvement in the quality of the training received at least by those 126 undergraduate researchers. Of the 69 who worked on research last summer, 56 worked in their own college laboratories; the other 13 were either in industrial laboratories or were working in the universities.

So Point 1--you are doing research; Point 2--
so are your students.

The next bit of evidence deals with the financing of this work. In my 1953 statement for the five-year period of 1948-53 I listed an amount of $286,774 income reported by 36 schools receiving financial help. This averages $57,336 per year. The principal sources of this income included the Research Corporation, industry, the colleges themselves, and government. This past year, the comparable figure is $135,383 or an increase by a factor of 2.4 over the average year in the 1948-53 period. Unfortunately, last year I made no attempt to determine how many besides those receiving grants were researching. We now have a fair idea of the current picture. In the past year a few more colleges in total numbers have received help than in the past five-year period. This is significant for the numbers used for comparison shows grants made over five years which does not represent accurately the value for the average year of the five. But whatever the true figure for any earlier hypothetical average year, the main point is that the curve shows an upward trend in number of colleges.

In amount of support, the increase takes on real significance. In the following table I have summarized the support for '54 and the average yearly support for '48-'53 by sources, amounts, percentages, and factors of change.

STATISTICS ON FINANCIAL SUPPORT FOR COLLEGE RESEARCH

Source of Income	1948-53 Figures: 1948-53 No.	1948-53 Figures: Average Annual Amount	1948-53 Figures: % Total	1954 Figures: 1954 No.	1954 Figures: Average Amount	1954 Figures: % Total	Increase in Amount	Factor of Increase
Industry	22	$11,760	22.7	21	$60,327	45.0	$48,567	5.1
Government	3	20,040	35.1	2	24,000	17.1	3,960	1.2
Research Corporation	24	13,596	23.7	14	17,765	12.7	4,169	1.3
Other (in most cases by alumni)	9	6,130	10.7	8	13,272	9.7	7,142	2.2
College	22	5,810	10.4	19	13,195	9.6	7,385	2.3
National Science Foundation	0	--	--	3	6,824	5.0	6,824	
Total		$57,336			$135,383		$78,047	2.4

The figures in this table are interesting to me. While they show increases from the government and the Research Corporation, they show a doubling of giving by college and alumni and a five-fold increase by industry. It is gratifying to note the continued support of research in the colleges by the Research Corporation; it has been a very real catalyst among our colleges--may it long help one college after another start up and continue research programs. I know of six grants made by the Research Corporation this past year which might be called "research initiating" grants. More power to them! Again let me speak to the importance of Du Pont and Standard Oil grants. They represent almost half of the industrial giving. The pick-up in industrial support is noteworthy to say the least. I've left for last the most significant fact--the entry of the National Science Foundation in the list. That zero of last year is now three, and they have others coming up. We welcome them.

So Point 3--money is being made available and in greater amounts.

Let me quickly put to rest any suggestion that we have enough money. This is not the case. Twenty-seven of the 56 schools say they need research money; six of the 27 want to research but cannot start for lack of money, another eight have small programs going with little or no financing. These 14 need help. The majority of these are departments staffed by one man or by two men with other functions than chemistry. A number of colleges, relatively well supplied with funds for their current programs, would welcome an increase in funds so as to step up their programs. Successful programs breed confidence on the part of

Foundations, and institutions in this category should take advantage of that confidence by going out for these additional funds with programs of good promise. It is probably true to say for these schools that while increase in giving will probably result in increase in research productivity, this latter will probably not result in any outstanding increase in teaching values unless thereby they can give a taste for research to additional numbers of students. They are to be congratulated on their positions and encouraged to step out boldly in support of expanding programs.

> So Point 4--more money will put more researchers to work.

Specifically it may be said that there is still great need for the providing of living-expense money to support research in the summer, the most hopeful approach to a research experience for men in small departments. In line with the philosophy of the Research Corporation, we believe that this is an expense the colleges themselves should meet from their research appropriation, looking to the grants from industry and the foundations for chemicals, equipment, scientific society expenses, special books, and research assistants.

> Point 5--money is needed for living expenses of faculty during the summer months permitting them to research in their home laboratories. The colleges themselves should be urged to cover these expenses.

From time to time it has been suggested that the college man is handicapped in his approach to research by a shortage of ideas. The affirmative responses to that question in the questionnaire are of two kinds--the first from those who really need ideas in order to do research and the second, from those who are willing to work on others' ideas if thereby an income can result which will make the research possible. In the first category, six answered in the affirmative--namely, that they were short of ideas and that they would be interested in working with someone else. In most cases it was added that funds to cover expenses would have to become available. Four others would consider industrial projects of a basic nature, again with adequate financing, even though they themselves had plenty of ideas. It should not be impossible to provide ideas for the first group via the projects of members of this group, or from interested university researchers or from industry; then funds might develop through application for support from some established agency. Likewise it should not be too hard for the second group to fill their needs from industrial contacts.

> Point 6--Some colleges in the group need research ideas--an agency should be set up by this group to bring together men and ideas.

Another handicap cited as militating against college research is the poor chemical library in the average college in this group. Of the 56 colleges studied, only three answered with an outright yes, indicating that they were handicapped in their research activity by shortages in their library. Five others confessed that they were handicapped all the way from not much to somewhat [in the latter case, I had the feeling that they might have to go to neighboring libraries to complete their reading]. In general, interlibrary loans and the neighboring state university library (with sometimes an industrial library) meet the needs. Less than half have said that they would include a discussion of library needs and services in some future meeting. Possibly an article might be written to cover this subject by an interested librarian in a college with an active research program for publication in the JOURNAL OF CHEMICAL EDUCATION.

> Point 7--lack of a top-notch chemical library is only a very minor deterrent to the carrying-on of research by our Midwestern Colleges.

The final item in the questionnaire dealt with the question "What other suggestions have you to help others get research underway?" One set of answers is best typified by this one--"Just roll up your sleeves and start doing something, and before you know it you have more problems than you can possibly follow up." or "Start working, make contacts. Submit definite project. Industry is not likely to approach the small college unless it shows productivity."

A second set centers around the need for time and in some cases for working space. A man in a one-man department is right up against the realities of life unless he can do research with the hands and minds of his students during the school year and has time and living provided in the summer to carry on himself. One man has solved the problem for himself by requiring chemistry majors in the sophomore, junior, and senior years to give one afternoon for research. He has a half dozen publications to the credit of the school thereby. This same man is trying to farm out research ideas to nonproductive faculty members in other colleges. Maybe this can be done by others within the group--the productive schools would in this way contribute to those not now producing.

So this is "How You're Doing." Pretty well, thank you, but there's still room for improvement. If you want to do research, start it if you have any good ideas--if not, get some via a staff man in your field in your state university or a sister Liberal Arts College with an active program or talk with the research director of a local industry and get from him a problem in basic science with no limitations on publication rights. After you're underway, lay out your program to the extent possible and approach the Research Corporation, the National Science Foundation, or some other foundation for application form for grant-in-aid. Prepare your request carefully and make sure it is reasonable in program and cost. If necessary, consult with someone else who understands the problem and can help you get it started. [In this connection this conference might well consider the establishment of a standing committee in this area.] Be resourceful, optimistic, and work when you can--summer if not winter--and support will come. It's a good thing to remember that the tide turns when it's lowest.

MIDWESTERN SCHOOLS REPORTING RESEARCH PROGRAMS Sept. 53-Sept. 54.

School	Summer	School Year	Staff	Number of Students
Albion	x	x	x	1
Alma	x	x	x	5
Augustana	x	x	x	3
Beloit	x	x	x	3
Bradley	x	x	x	4
Briarcliff	x	x	x	1
Calvin	x	x	x	2
Carleton	x	x	x	5
Coe	x	x	x	--
Cornell	x	x	x	1
Denison	x	—	—	--
DePauw	x	x	x	9
Drake	x	x	—	1
Earlham	x	x	x	2
Goshen	x	--	x	--
Grinnell	x	x	x	3
Hamline	--	x	x	--
Hope	x	x	x	6
Illinois	x	--	x	--
Indiana Central	x	—	x	--
Kalamazoo	x	x	x	1
Knox	x	x	x	1
Lawrence	x	x	x	2
Loras	--	x	x	2
Luther	x	--	x	---

School	Summer	School Year	Staff	Number of Students
MacMurray	—	x	x	—
Manchester	—	x	—	1
Mt. Mercy	x	x	x	6
Millekan	x	x	x	10
Monmouth	x	x	x	6
Mundelein	x	x	x	5
Nazareth	x	—	x	—
North Central	x	x	x	3
Oberlin	x	x	x	5
Ripon	x	x	x	1
St. Ambrose	x	x	x	3
St. Norbert	—	x	x	—
St. Thomas	x	—	x	—
St. Olaf	x	x	x	3
Valparaiso	x	x	x	6
Wabash	x	x	x	4
Westmar	x	—	x	—
Wheaton	x	x	x	1
Wooster	x	x	x	24

Summaries:

During the past 12 months, research has been carried on in 43 colleges, or 76%.

Staff and students in 39 colleges participated in summer research programs, or in 68.5% of the 57 colleges responding.

Research was carried on during this last school year in 36 colleges or in 63% of the colleges responding.

Student Research has been carried on during the past year by 128 students in 32 colleges, 56%.

Chemists Have to be People Too

Dr. John C. Gerber
State Univ. of Iowa.

Some of the reasons for being concerned about the verbal facility of college chemistry students are readily apparent. Like other students, they are part of a society in which ideas and values are being shaped increasingly by the mass media. To be effective citizens and chemists in such a society, they will have to be critical readers and listeners, as well as clear interpreters of their field. Other things being equal, moreover, the articulate chemist is much more likely to be a success in his profession than the inarticulate one. It has been amply demonstrated, too, that when an instructor gives some attention to the communication skills of his students, the students do better, not only in communication, but in the subject field.

Granted that there are these long-range, middle-range, and short-range reasons for attention to the verbal skills in college chemistry classes, what can be done? The answer can probably best be broken down into four parts corresponding to the four skills of communication.

1. Listening. Most college students are not good listeners. Tests indicate that they retain about 25% of what they hear, and that in a typical class room only a minority are listening to the teacher at any given moment. Attention to listening has been delayed by several common misconceptions: that listening ability is closely related to hearing acuity, that listening ability is largely a matter of intelligence, that our daily practice in listening eliminates the need for training. Actually, listening is a complicated process that can be impaired by inadequate stimuli, by over-strong or over-weak non-verbal responses, and by the inability to verbalize because of language inadequacies or poor thinking habits. Instructors can help students to improve their listening by encouraging them to listen <u>for</u> something, to relate what is being said to their own interests, to look for the central idea and main supporting ideas, and to exploit the differential between the speaker's output and their potential intake constructively.

2. Reading. Most college students are not good readers either. Tests indicate that they comprehend about 50% of what they read and that they read at only about one half of their optimum rate. Again we labor under misconceptions: that reading rate and comprehension are closely related to vision, that the reading ability of college students is largely a matter of intelligence, and that the slow reader gets more out of what he reads. How can students be helped to read their chemistry texts? So far as rate is concerned, the best the instructor can probably do is demonstrate to the students by occasionally putting undue pressure on them in class that they can read much faster without loss of comprehension. So far as comprehension and retention are concerned, the following pattern of study has under experimental conditions produced excellent results: survey the part to be studied to get the main idea, read, recite or test yourself and check the results against the text, review within forty-eight hours.

3. Speaking. While often excellent conversationalists, college students are often weak in presenting an orderly discourse especially in a field like chemistry that demands precision. What they need is as much practice as possible talking about chemistry. Helpful in this regard are recitations, oral reports, and demonstrations in which the following are insisted upon: a clear-cut purpose, a definite organization, specific

material, and the precise use of terms. A by-product of this oral practice is better retention, for we all tend to remember best what we say rather than what the other fellow says.

4. Writing. College students are likely to write poorly in chemistry classes because of their normal difficulties with language, because they often think that less is expected of their writing in a science class, and because much scientific writing which they read is gobbledy-gook. Characteristics of student writing in general are too little attention to the reader, too little emphasis upon the central idea and the main supporting ideas, overgeneralizing, and a sprinkling of syntactical and mechanical errors. A brief survey of student writing in chemistry indicated verbosity and overuse of coordination and of the passive voice, the combination making usually for flat and sometimes for almost incomprehensible communication. The chemistry instructor is likely to achieve considerable improvement in student writing on chemistry papers simply by giving the students frequent opportunity to write and by letting them know that he will insist upon concise, orderly prose. If in addition he points out the special weaknesses in scientific writing and indicates some of the ways these can be avoided he is likely to effect dramatic improvements. Most college students in liberal arts colleges can write with reasonable effectiveness when they think the pressure is on, but they are also likely to write as sloppily as any instructor allows them to write.

For the chemistry instructor, attention to the listening, reading, speaking, and writing of his students can bring rich results, not only in increased articulateness on the part of his students but also in more effective learning within the subject field.

THE USE OF RADIOISOTOPES IN TEACHING CHEMISTRY

Dr Adolf Voigt
Institute for Atomic Research I.S.C.

Contrary to wide belief, the use of radioactivity in the college teaching program is well within the range of many small college chemistry departments.

The cost of demonstration equipment is not prohibitive, the basic units can be obtained for a few hundred dollars, or less if units could be built from their parts by physics classes or other groups.

If the amount of radioactivity is kept small, just enough to do the experiments, it can be obtained without AEC authorization from various suppliers. Larger amounts of isotopes of certain elements can be separated from natural sources such as uranium, thorium or from spent radon seeds. These materials are available from suppliers and no AEC action is necessary for their procurement. The spent radon seeds, containing radioactive lead, bismuth and polonium can be obtained from large hospitals. Obtaining larger quantities of the artificial radioisotopes requires AEC authorization, but for simple experiments, or for short-lived isotopes like P^{32} or I^{131}, such authorization may not be difficult to obtain.

The need for special facilities for handling radioactive material diminishes as the amount handled is decreased and ordinary chemical laboratories can be used with little outlay for special gear if simple precautions are followed.

Besides conventional experiments which use radioactive sources to show the characteristic absorption and scattering of the radiations a number of experiments can easily be performed to demonstrate chemical principles. Lead tracer, Pb^{212}, with a 10 hour half-life can be separated from thorium and used to demonstrate coprecipitation with or adsorption on barium sulfate precipitates. This same tracer can be used to show radioactive growth and decay relations by means of its 1 hour bismuth daughter activity. Separations by extractions into non-aqueous solvents can be demonstrated by the extraction of uranyl nitrate into ether. This also makes available a tracer solution of Th^{234} which can be used to show the characteristic hydrolysis and coprecipitation behavior of polyvalent cations. Ion exchange processes can also be demonstrated using these natural radioactive series. The various components of the thorium series can be separated using a complexing agent like thenoyltrifluoroacetone and, with properly adjusted pH, extracting the various members into a non-polar solvent. Using radiophosphorus the uptake of phosphate by plants can be demonstrated, as well as the technique of autoradiography. A small animal experiment can be done in a study of the excretion rate of phosphorus or iodine and their localization in the tissues. Many other experiments can be found in the literature or may be developed by the instructor.

Thus it can be seen that radioisotopes can be used for demonstrations at any level of college teaching or for actual class experiments in the more advanced courses to provide a new and vivid method of presenting chemical principles as well as demonstrating the typical phenomena of radioactivity.

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MIDWESTERN ASSOCIATION OF CHEMISTRY TEACHERS IN
LIBERAL ARTS COLLEGES

October 29-30, 1954

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