7

P R O C E E D I N G S

TWO-YEAR COLLEGE CHEMISTRY CONFERENCE

Sponsored by

Division of Chemical Education

American Chemical Society

1966-1967 Academic Year

28-29 October, 1966
First Midwestern Regional Conference
University of Kansas
Lawrence, Kansas

16-17 June, 1967
Second Western Regional Conference
Columbia Basin College
Pasco, Washington

7-8 April, 1967
Seventh Annual Conference
Miami-Dade Junior College
Miami, Florida

FOREWORD TO THE PROCEEDINGS

These Proceedings constitute the published record of the three conferences held during the seventh year of the Two-Year College Chemistry Conference program sponsored by the Division of Chemical Education, American Chemical Society.

We are continually presented with evidence that the $2YC_3$ program is making a significant contribution to its four objectives: (1) to promote the interchange of ideas and information among two-year college chemistry faculty members; (2) to allow the two-year college chemistry faculty members to become better acquainted with the programs of and opportunities afforded faculty members, departments, and students by the American Chemical Society; (3) to bring to the attention of the American Chemical Society and its component groups the programs and problems of two-year college chemistry faculties, departments, and students; and (4) to increase participation in the American Chemical Society programs and affairs by chemistry faculty members and students of two-year colleges. We should make clear that the $2YC_3$ program is designed for all types of post-secondary educational institutions that include chemistry in their program but do not offer a bachelor's or equivalent degree on their campus. So among our participants you will find representatives of the private and public junior colleges, the comprehensive community colleges, some of the city colleges, the public and private technical institutes, and the extension centers and lower-division branches of the universities.

The 1966-1967 year featured two significant developments in the Two-Year College Chemistry Conference program. These were the scheduling of the three conferences in geographical areas considerably removed from any of our previous conferences and the firm establishment of a large, representative committee charged with the continuing responsibility for the operation and planning of the program.

The First Midwestern Regional Conference at the University of Kansas, Lawrence, Kansas, in October, 1966, was held in conjunction with the Midwestern Regional Meeting of the ACS. It was attended by 103 persons representing 57 two-year colleges and 17 four-year colleges or other organizations. Thirty-three two-year colleges were represented for the first time.

The Seventh Annual Conference held at the North Campus, Miami-Dade Junior College, in April, 1967, preceded the national spring meeting of the Society and was attended by 114 persons representing 74 two-year colleges and 9 four-year colleges or other organizations, with 26 two-year colleges represented for the first time.

The Second Western Regional Conference at Columbia Basin College in Pasco, Washington, in June, 1967, was our first in the Northwest. Held in conjunction with the Pacific Northwest Regional Meeting, it was attended by 62 persons from 35 two-year colleges and 13 four-year colleges or other organizations. Twenty-four two-year colleges were represented for the first time.

Of the 166 two-year colleges represented at the three conferences, exactly half (83) had not previously been represented.

The Two-Year College Chemistry Conference Committee was constituted during this year as a full-fledged operating committee of the Division. The 33 members will serve three-year terms, with 11 persons rotating annually from the committee. The committee is divided into equal representation from the Western, Central, and Eastern States Regions. The $2YC_3$ chairman will be ably assisted in the work of the committee by Mr. Robert Burham as committee secretary and by Mr. Kenneth Chapman as conference editor.

The success of the 1966-67 program has been due in large measure to the work of Ken Chapman, who served as secretary-editor during this period, and to the many section chairmen, recorders, and program participants, who made the conferences effective and these Proceedings possible.

The proceedings of the three 1966-67 conferences have been combined into a single report, so those able to attend only one conference may receive additional benefits from the conferences. Copies of the Proceedings are being sent to all who attended at least one of the three conferences and to all two-year colleges known to have chemistry programs but which were not represented at the conference. We ask all who receive copies of these Proceedings to make them widely available to their colleagues.

We invite all interested persons to attend future Two-Year College Chemistry Conferences, and we solicit your comments and suggestions as to how these might best continue to serve to improve chemical education in the two-year colleges.

William T. Mooney, Jr.
Chairman

ACKNOWLEDGMENTS

The continuing success of the Two-Year College Chemistry Conference is the result of efforts expended by many individuals concerned with the teaching of chemistry in the two-year colleges. These include the outstanding encouragement and support provided by the Executive Committee of the Division of Chemical Education of the American Chemical Society and the colleges serving as hosts to the conference sessions or allowing staff members to serve as officers and committee members. The individual contributors to the conference sessions have been too numerous to mention here but have played an important part in the improvement of chemistry instruction in the two-year colleges.

Conference attendees during 1966-1967 were deeply appreciative of the excellent facilities and good weather provided by each of the host colleges. Local arrangements were made by Dr. Clark Bricker at the University of Kansas, Mr. Edward B. Batey at Columbia Basin College and Mr. Robert Drobner at Miami-Dade Junior College. At each conference session, the college staffs made extensive efforts to provide all the desired equipment and services.

On behalf of the attendees and Planning Committee, I wish to thank the sixty-two individuals who participated as session chairmen, speakers and recorders for the $2YC_3$ in 1966-57.

As editor of these Proceedings, I must express my apologies for being unable to properly credit each individual for the full value of his contribution before, during, and after the conference sessions.

The Planning Committee wishes to thank each attendee for his contributions and the colleges, universities, and organizations that made their presence possible.

Kenneth Chapman,
1966-67 Secretary-Editor, $2YC_3$
on behalf of the Planning Committee

TABLE OF CONTENTS

CHEMISTRY NEEDS OF THE BIOLOGICAL SCIENCES

An Introductory Note

by

William T. Mooney, Jr., El Camino College

The increasing dependence of biological scientists on the concepts of chemistry and physics in their investigations and explanations of living systems suggests the need for the development of a significant dialogue among biologists, chemists, and physicists in order that the general college chemistry and general college physics courses may better serve the increasing number of biological science and health science students enrolling in these introductory level programs.

To assist two-year college chemistry faculty in becoming better acquainted with the chemistry needs of the biological sciences and to encourage them to use illustrative material related to biological systems in their teaching, two separate sessions were scheduled, at Lawrence and Miami, in which the chemistry needs of the biological sciences were presented and discussed.

Dr. Thomas Overmire of the Commission on Undergraduate Education in the Biological Sciences (CUEBS) presented a paper entitled "Chemistry Needs of the Biological Sciences" at Lawrence, and the implications of this for two-year college chemistry programs were discussed by a panel of Vincent O'Leary, Black Hawk College; Cecil Hammonds, Metropolitan Junior College of Kansas City; Sister Elaine Cranford, Donnelly College; and Howard Kivett, Fort Scott Junior College.

Dr. Alfred Chaet, Dean of Gamma College (Sciences) of the University of West Florida, an outstanding biological science educator, presented a paper at Miami on the same topic.

CUEBS has recently published a report entitled Content of Core Curricula in Biology[1], and Dr. Overmire presented an analysis of some of the chemical topics and techniques related to this study.

We have elected to include Dr. Chaet's paper in these Proceedings because we believe it contains some uniquely valuable and interesting information for two-year college chemistry faculty members that is not readily available elsewhere in such a direct and concise form.

CHEMISTRY NEEDS OF THE BIOLOGICAL SCIENCES

Presented to the Seventh Annual Two-Year College Chemistry Conference, April 7, 1967, at Miami-Dade Junior College, North Campus, Miami, Florida

by

Dr. Alfred Chaet, Dean of Gamma College
University of West Florida, Pensacola

(The following is a transcription of the recorded presentation)

The field of biology, through the Biological Science Curriculum Study (BSCS) program, has been updated in the high school curriculum for biology. It was found necessary to bring the high school faculty members to summer institutes to update them. Now, through the Commission on Undergraduate Education in the Biological Sciences (CUEBS) programs, an attempt is being made to upgrade college level instruction in the biological sciences, and the same thing has occurred again. Biology no longer consists of collections in the field, encyclopedias under the arms, cutting up specimens, and peering down a microscope; biologists today have to use a certain amount of chemistry knowledge and techniques.

---

[1] Publication No. 18, June, 1967, Commission on Undergraduate Education in the Biological Sciences, 1717 Massachusetts Avenue, N. W., Washington, D. C. 20036. No charge.

What chemistry prerequisites are emerging for the first course in biology? The contemporary "better" schools are holding off "freshman" biology until the sophomore year so that students may complete all of their physics, calculus, and general and organic chemistry before entering biology.

The University of West Florida biology program is based on the CUEBS recommendations for an experimental approach to biology more sophisticated and instrumental than the usual approach. Students entering the program will all be transfer students in their junior year, and they should have had a one-year course in organic chemistry, a one-year course in physics (engineering physics preferably), some analytical geometry and calculus in addition to general chemistry, and one year of biology before they start their junior year. If they want additional biology, it is all right, but not at the expense of the organic chemistry, physics, or mathematics.

The junior year will begin with a course in molecular biology for which the student will need organic chemistry. The program is an inverted pyramid, for it starts out on a molecular basis and builds these molecules into cells, the cells into organisms, and the organisms into populations, finally ending with evolution. One could also start with humans and end with molecular biology.

During the same quarter the student takes a course in genetics, a modern approach or molecular genetics, in which he studies enzymes and enzymatic reactions in connection with the principles of genetics, rather than talk about the color of the eye, and so forth. The modern approach is to talk about microisms and the biochemical approach to genetics.

During his second quarter the student will take cell biology, which will involve a chemical and physical approach, and developmental biology, which will be typically embryology with a more chemical approach than has usually been the case.

The third quarter includes a course in organismic biology, which is not human or mammalian physiology but a general physiology, a comparative type of physiology biochemically oriented. The third quarter also includes a course in biochemistry.

The fourth quarter includes a course in ecology from the cellular and mathematical approach. In the fifth quarter these students will take biophysics and during the last quarter, evolution, in which there will be a certain amount of chemistry involved. Here we will not talk just about things like the size and shape of the hoof; but, as in taxonomy, where one can find other ways of classifying organisms than taxonomic appearance, we will use other things, such as protein structure.

To this core curriculum will be added seminars, one per quarter, on a variety of topics depending on the interests of the faculty and the students.

Some better students will also be involved in independent study, in which a student will be doing research under a faculty member during his senior year.

[Questions were raised from the audience concerning the ability of such students to distinguish one bird and one plant from another and concerning whether or not these were the students who were going into the high schools to teach biology. Dr. Chaet responded that the prospective high school biology teachers will take the same core curriculum but they probably will not take biophysics, biochemistry, or organismic biology. They will include seminars on topics such as those suggested by the questions, if there is sufficient interest; and these topics and ideas will be able to get into the curriculum this way; but icthiology or ornithology are not among the things that a modern biology major should know. The things that he should know seem to be based on a new definition of biology as an attempt to define life in terms of physical and chemical parameters.]

The biologists find that at the junior year, when students are presented with three theories and told to take their pick, this floors the students for they have been taught that things are black and white and that what the experts say is so. We must get over the idea that all is now known or understood and that we must discuss the various theories and select from them.

Among the topics that now appear in general chemistry that are most vital to a program such as that described are electrochemistry, thermodynamics, colloids, and complex chemistry. Some of the more specific topics of interest to the biology major and of which we expect students to have a certain knowledge include those described in the remainder of this paper. These are not presented here in detail; just enough exposure is given so the teacher can work out the detail for his own course.

1. Microchemistry. Students should be involved with microchemistry rather than macrochemistry; for in chemical analysis dealing with biological materials, such as the characterization of enzymes, neuroendrocrinology, purification of a hormone, and so forth, you do not have macro amounts of materials to work with and must use microtechniques.

2. Diffusion, osmosis, and filtration. When one talks about blood chemistry or isotonics, osmosis is involved. One should talk about filtration and ultrafiltration because when the biologist talks about the capillary network or the movement of fluids into and out of the blood stream network, he is talking about ultrafiltration and is concerned with such items as blood pressure, tissue pressure, and osmotic pressure due to an increase or decrease in the amount of protein in the blood, as an example. Associated with this is the topic of membranes. Ordinarily we have talked about inert membranes; but in biology there are some exciting, living membranes to talk about, membranes that are exhibiting active transport and membranes that are involved with energy. Students should also know about semipermeable, as well as permeable, membranes.

3. Excited states and ground states. These ideas are just coming into prominence in biology.

4. Radiation chemistry. One should include radiochemistry, the use of isotopes, the use of tracers, and half-lives, because in many modern biology laboratory courses the students will start early using tracers and for this they should know about isotopes and so forth. Activation analysis is also an exciting tool for the modern biology major. Students should be exposed to both Geiger-Muller and liquid scintillation counting because some first courses in biology now use these methods.

5. Solubility. Students will be doing chromatography in the first course in molecular biology, and this can easily be related to a discussion of solubility phenomena. They should know what chromatography is before they come to the biology course, and they should have had some simple exercises in chromatographic techniques in their chemistry courses.

6. Solution concentrations. Molarity and percentage composition of solutions are important. Students should know what a molar solution is and how to prepare it.

7. Laboratory techniques. Students should know what a pipette is and how to use it.

8. What makes reactions go? In chemistry one often uses fairly drastic measures, such as hydrochloric acid and heat, to get reactions to go; but in biology we cannot use this type because the materials we work with are heat sensitive, acid sensitive, and so forth. We should discuss with the students other methods of making reactions go, in addition to the drastic means, and point out to them that such other measures are related to making reactions go in living tissues.

9. Colloid chemistry. The biologist studies and uses protoplasm, which is a colloid. Students should know about colloids and about isoelectric points, what they are, when they are reached, and what happens when an isoelectric point is reached.

10. Structure of molecules. One should talk about proteins and about the size and shape of molecules, such as proteins, because size and shape are very important as far as permeability is concerned. Another thing to discuss is how one goes about determining molecular weights; this is something we want students to do in the core curriculum. One should also talk about chains; and when discussing ways of determining molecular weights, one should include the idea of differential centrifugation, a technique used in biological laboratories.

11. Isomerization. One should include cis and trans isomerism and optical activity and d and l amino acids and point out that l amino acids are biologically active whereas d are not.

12. Gases. Respiration is one area in biology where students are expected to know something about gas molecules.

13. Kinetics. One should include enzymes when talking about kinetics. Students should know about the enzymatic chemical theory, inhibitors, and the effect of pH and the isolelectric point on enzymes.

14. A biological theme for a course. One might continuously relate to the blood system through carbonic acid and carbonic anhydrides, which can be used as examples for topics through much of the chemistry course.

15. Bonds. One should talk about ions and bonds so that students will be able to understand the various structures and reactions involving phosphates.

16. Entrapping and equilibria. In the case of $A + B = C + D$ if we can tie up or entrap A with X, then we can cause B to pile up because the equilibrium will shift to the left even though it would normally go to the right. This type of thing is often utilized in the biological sciences.

17. Simultaneous equilibria. In the nerve system there are cases where sodium ions are "pumped" out of the cell by impulses and then electrostatic attraction forces potassium ions back in to take the place of the sodium.

18. Electrochemistry. One could discuss electron transport, the cytochrome system, and the transition of metals and ions.

19. Weak acids and bases. This is the only type found in living tissues, and one should talk about carbonic acid in general and about the buffering action of blood and urine in living tissues.

20. Colorimetric techniques. These laboratory techniques are very important in biology.

21. Analytical chemistry. The biologist expects that the general chemistry course will contain enough qualitative analysis so that the students will not have to take separate courses in this. We would like to have quantitative analysis included in the first-year course so that a third course or semester would not have to be required.

22. Nomenclature. It is recommended that such designations as I and II be used in cases where there are differences in the physiological activity of similar substances so that the student may see that one is active and the other is not and why it is active.

23. Spectroscopy. One should talk about functional groups and about ways of determining these and where they are on the various molecules found in living systems, such as amino acids. Both aromatic and nonaromatic groups should be included. Ultraviolet spectra are very important in biology; thus the use of the DU spectrophotometer should be included. The students should also know the principles of operation of these instruments.

Infrared work is just coming into biology, but one can anticipate that students entering now will need this technique or find it useful.

24. Three different ways of preparing materials. One should discuss industrial ways of preparing materials, laboratory ways of preparing materials, and biological ways of preparing materials, and show how the industrial and laboratory ways are often more direct ways than those found in living tissues.

25. Stereochemistry. Include topics in this field such as enzymes and co-enzymes, specificity in enzymes, and d and l concepts. The geometry of bonds is also highly important, whether you talk about s-s or s-p bonds and so forth.

26. Proteins, carbohydrates and lipids. The amphoteric properties of proteins, how one isolates proteins, how they are degraded, and how amino acids are synthesized into polypeptides are important to biologists.

If the students coming into the biology area were to have these things, it would make life a lot easier for those of us who are involved with a contemporary type of biology.

MODERN TEACHING AIDS FOR COLLEGE CHEMISTRY

Summary Prepared by William T. Mooney, Jr., El Camino College

[The extremely heavy reliance upon visual materials made it necessary to summarize the excellent presentations on Modern Teaching Aids. Ed.]

In recent years there has been increased attention given to instructional technology and instructional systems and to the development of hardware for utilizing instructional materials. Unfortunately, the development of instructional materials and software suitable for use in contemporary college chemistry classes has not kept pace with the hardware and equipment developments. Lagging even farther behind the software development has been the establishment of an effective communications network for evaluating and disseminating information about both the hardware and the software.

Activities of the Teaching Aids Committee of the Advisory Council on College Chemistry and of several enthusiastic and imaginative college chemists around the country during 1966 and 1967 suggest that the lag in software and communications described above will be continuously decreased during the next several years.

The Two-Year College Chemistry Conference has a role to play in bringing to the chemistry faculty of two-year colleges information about and demonstrations utilizing new instructional equipment and materials suitable for use in college chemistry. The Conference also has a role in encouraging chemists in these colleges with ideas and interests in utilizing such equipment to develop materials suitable for use in the chemistry programs of the two-year colleges.

To fulfill these roles symposia concerned with modern teaching aids for college chemistry were held on Friday evening prior to the Saturday Conference at both the Miami and Pasco meetings.

At Miami W. T. Lippincott and Robert Barnard presented developments in eight millimeter single-concept films, videotape recordings, and overhead projection materials. The ideas, techniques, and materials presented were related to projects of the Teaching Aids Committee of the Advisory Council on College Chemistry and the chemistry department of Ohio State University. Lippincott was at that time chairman of the Teaching Aids Committee, and Barnard is a consultant to the committee. Both are at Ohio State University.

Carl Babski of Miami-Dade Junior College, North Campus, presented a sample of the programed audio-visual lecture presentations he has developed for use in physical science survey classes. This consists of a synchronized 35mm slide and audio-tape presentation in which a large amount of art work has gone into the preparation of the slides and in which the tape script is written by Babski but is recorded by a professional announcer.

At the Pasco session Neville Flitcroft of the new Simon Fraser University, Burnaby, British Columbia, discussed an application of audio-visual aids to the freshman laboratory course, an audio-tutorial system. Simon Fraser appears to be the most advanced institution in applying this technique to college chemistry laboratory instruction. Flitcroft also discussed the student multiple response system used in the chemistry lectures at Simon Fraser.

William T. Mooney, Jr. of El Camino College discussed the preparation of eight millimeter single-concept films by college chemistry faculty members at their own institutions and used materials developed by Wendell Slabaugh of Oregon State University and other Advisory Council consultants as examples. He also discussed the development of software for such instructional materials and specifically described the development of study guides and quizzes for use in out-of-class viewings of CHEM Study films using the Fairchild Mark IV 8 mm loop projector.

Malcolm Renfrew of the Advisory Council on College Chemistry staff (on leave from the University of Idaho) discussed the development and use of video-tape recordings by college chemistry faculty. His presentation was based on contemporary AC_3 activities. He also described the potential of overhead transparencies and explained how faculty members could prepare them for their own classes.

In summary, these teaching aids symposia will have achieved their purposes if they have presented the included instructional techniques and materials in such a way that some of the two-year college chemistry faculty present are sufficiently informed and stimulated to go home and develop and construct such materials according to their own needs and interests and using reproduction equipment, techniques, and materials that are available to them at their own institutions.

Bibliography

Many of the ideas and materials presented in these symposia are discussed in detail in the following publications, which are available free from the AC_3 office, 701 Welch Road, Palo Alto, California 94304.

1. Teaching Aids Committee, Modern Teaching Aids for College Chemistry, Advisory Council on College Chemistry, Publication No. 18, December, 1966, 46 pp.

2. A. F. Isbell, Teaching Aids Programs, Advisory Council on College Chemistry Publication No. 28, Newsletter No. 10, August, 1967, 11 pp.

3. Rod O'Connor and Wendell Slabaugh, Teacher-Produced Instructional Films in Chemistry (8 mm and super 8), Advisory Council on College Chemistry Publication No. 31, December, 1967, 33 pp.

THE ACS PROGRAM FOR TWO-YEAR COLLEGES

A Summary of Remarks Presented by Kenneth Chapman, American Chemical Society

The American Chemical Society has become considerably more aware of the importance of two-year colleges in chemical education, their problems and the desire of chemistry staff in these institutions to develop sound, reputable course work in chemistry. In several areas of the country, junior colleges' transfer programs are providing the initial chemical education for a substantial proportion of those who eventually become the graduate chemists and chemical engineers, up to 50 per cent in some of the major schools in California. Also, the Society has become impressed with the problems of the chemical technicians and the curricula from which they come. A large part of this awareness stems from the Two-Year College Chemistry Conference and individuals from two-year colleges who have been serving on a number of committees for the American Chemical Society and the Division of Chemical Education.

The proposal for establishing the ACS office for an Assistant Educational Secretary-Two-Year Colleges used statistics from the U.S. Office of Education to emphasize the importance of this educational area. These statistics showed that from 1954 to 1964 enrollment at senior institutions increased 82 per cent. In the same period, junior college enrollment increased 150 per cent. From 1964 to 1974, an increase of 52 per cent is expected in senior institutions' enrollment, with a 68 per cent increase expected at the junior college. These figures are only for the transfer programs of the junior colleges. Adding the occupationally oriented programs would increase the numbers of students enrolled in the two-year colleges by about 40 per cent and have a proportionate effect on the increase in enrollment compared with senior institutions.

The statement made in the proposal for the establishment of this office by the ACS Educational Office is:

> "Despite their rapid growth, junior colleges have been relatively neglected compared with other academic institutions: Secondary school administrators tend to lump them with colleges, college administrators tend to lump them with secondary schools and professional societies have probably failed to realize how important a factor these institutions are becoming. But chemistry is being studied and will continue to be studied in junior colleges and the Society must recognize this. It should, as a consequence, accept responsibility comparable to its role in senior colleges, and take steps to meet that responsibility. The following recommendation is aimed at that objective." "Recommendation: That a Two-Year College Program be established in the Educational Activities Office."[1]

The ACS formally began the new program in June, 1967. The Education Office has used a nine-point proposal for action:

1. Collect information and statistics throughout the nation to determine the state of chemistry in two-year institutions, the situation of the chemical technician in industry, and changes that may be expected to occur in the immediate future.

---

[1] Internal ACS correspondence -- Prepared by Dr. Moses Passer, Educational Secretary, ACS, 1966.

2. Determine the degree of difficulty with articulation between the two-year and four-year institutions and disseminate information concerning effective conferences and reports concerned with this topic.

3. Develop guidance and counseling materials for chemical technology and chemistry transfer programs to be used in the high school and in colleges of all types.

4. Develop a "public relations" program to be used locally by those promoting chemical technology programs.

5. Consider establishment of a periodical for chemical technicians.

6. Develop educational services to
   a. Assist two-year college chemistry faculty in combating obsolescence in themselves and their curricula.
   b. Improve effectiveness of chemical education in two-year colleges, particularly in chemical technology.
   c. Provide information and assistance relative to facilities and equipment.

7. Investigate the needs, desirability, feasibility and inherent problems of a pattern of minimum standards for two-year college chemistry programs.

8. Plan action to be taken on problems made evident by surveys and contact.

9. Investigate means of enabling two-year college chemistry staffs to advance professionally.

As expected, there has been considerable variation in the amount of progress in these nine areas.

The ACS Two-Year College office has cooperated closely with the Advisory Council on College Chemistry to avoid duplication of effort whenever possible. An outstanding feature of this cooperation is the vast amount of information on two-year college chemistry curricula and faculty collected by an extensive survey initiated by AC_3 in the late spring of 1967. A continuing program for collection of information on two-year college chemistry is now being organized by ACS. It is planned that information about one of three major interest areas will be collected every third year to permit use of one short questionnaire each year. The three areas are: (1) student characteristics and enrollment, (2) faculty characteristics and problems, and (3) curriculum and facilities.

In 1966, the ACS Board of Directors appointed an ad hoc Committee on Technician Curriculum to develop further the "Chemistry Core" recommended as part of a total chemical technology program by a predecessor, the ad hoc Committee on the Training of Chemical Technicians. The recommendations of the Committee on Technician Curriculum were published in the May 22, 1967, issue of Chemical and Engineering News. This provided the basis for a Conference on Chemical Technicians, which was co-sponsored by ACS and the U.S. Office of Education. The meeting was held at New York City Community College on October 27 and 28, 1967. Copies of the Proceedings are now available from the ACS Education Office.

A brochure to be entitled "Is Chemical Technology the Career for You?" is expected to be published in May, 1968. This should be of benefit to colleges desiring to acquaint potential students with career possibilities in this field.

The groundwork has been prepared for several other activities with emphasis upon improving communications among the groups that have interests in chemistry as taught in two-year colleges. The importance of communication becomes greater as the two-year colleges continue to grow at an unbelievable rate and steady pressure from changes in chemistry requires modification of chemistry curricula.

It should be noted that the above items are given as additions to the existing ACS programs of importance to two-year colleges. These include Short Courses, of benefit to college teachers; Academic Openings for seeking new faculty members; College Chemistry Faculties lists and Student Affiliate Chapters, as well as other specialized services.

THE ADVISORY COUNCIL ON COLLEGE CHEMISTRY

AND THE TWO-YEAR COLLEGES

Summary of Remarks by William T. Mooney, Jr., Chairman, Two-Year College Committee, $2YC_3$

The Advisory Council on College Chemistry was the first commission to become actively involved and concerned with the two-year colleges. We are committed to the improvement of instructional programs in chemistry in these colleges.

Some past Council activities have been directly related to chemistry in the two-year colleges by being specifically addressed to a problem of these institutions. Others, designed to improve instruction in college chemistry have also had relevancy to the problems of two-year college programs and faculty. Among the specific two-year college activities have been:

1. The 1965 appointment of two Council members from two-year colleges after inviting four two-year college representatives to meet with the Council and discuss chemistry in the two-year colleges.

2. The formation of the Committee on Chemistry in the Two-Year Colleges in 1966 and the inclusion of both councillors and non-Council members from two-year colleges.

3. The working conference on the Articulation of Chemistry Programs Among Two-Year and Four-Year Colleges, with representatives of both two-year and four-year colleges attending in 1966.

4. The publication of the summary and recommendations of the Articulation Conference as Council Report 20 and of the working papers and prepared critiques of the conference as Report 20A.

5. The holding of a meeting of organizations concerned with developing programs of assistance for two-year college chemistry programs and faculty in 1966.

Council activities for all college chemistry that have been of particular value to the two-year college include:

1. Publication of resource papers which are authoritative, succinct papers on important topics with comprehensive bibliographies.

2. Publication of major reports, developed from conferences or special projects, such as those on the content of introductory college chemistry and on modern teaching aids for college chemistry, which emphasized recent developments in films, especially eight mm single concept film loops, videotape recording, and computer-assisted instruction.

3. Development of experimental 8mm single-concept film loops made by college chemists and of videotape recordings.

4. Stimulation and sponsoring of regional conferences involving all colleges in a region to apprise the chemistry teachers of important developments and techniques on a specific topic and to obtain feedback for program planning by the Council with those of most interest to the two-year colleges on trends in teaching of general chemistry, chemistry for general education, and the balance between theory and description in general chemistry, new approaches to the teaching of organic laboratories, the general chemistry laboratory, and the introductory chemistry course.

Current AC_3 activities specifically related to chemistry in the two-year colleges are concerned with identifying suitable library resources, describing two-year college chemistry programs, characterizing two-year college chemistry teachers, developing guidelines for the development of chemistry programs in new and expanding two-year institutions, and assisting individual colleges to solve their problems.

1. The Library Resources Project. The committee is developing the Chemistry Section of the Junior College Booklist, to be published by the American Library Association, which will contain 375 titles recommended as the basic library list for a two-year college chemistry program. It is an adaptation and updating of the Guidelines and

Suggested Title List for Undergraduate Chemistry Libraries published by the ACCC in 1966. We have involved over 200 two-year and four-year college chemists in the selection and screening of the titles, and the work has been coordinated by Kent Backart of Palomar College and the committee chairman.

Other library activities will include the preparation of a list of recommended periodicals for two-year college chemistry programs; the preparation of a list of recommended titles to be added to the above list for colleges including chemical technology and chemistry for other two-year occupational groups in their curricula; and the development of a program and procedure for periodically reviewing and updating the three lists.

2. A Profile of Chemistry Programs of Two-Year Colleges. Questionnaires seeking statistical and other significant information on chemistry in the two-year colleges were sent to approximately 800 two-year college chemistry department administrators. The more than 60 per cent of the returned questionnaires are now being processed. This will be the major source of information in the development of a profile of chemistry in the two-year colleges, and it will be background information for the development of programs and materials of special benefit to these colleges. The profile will contain (a) descriptive information on the colleges; (b) relationships of the colleges to presently existing graduate programs in chemistry; (c) the administration of chemistry programs; (d) the chemistry faculty and their assignments; (e) the courses including enrollment and types of courses; (f) the number of new and replacement faculty positions in chemistry, number unfilled, and the requirement for filling such positions; and (g) information on the assistants provided to the chemistry faculty and administrator.

3. A Profile of Chemistry Teachers in Two-Year Colleges in 1966-1967. A questionnaire study of some important characteristics of teachers of chemistry in the two-year colleges in 1966-1967 is now underway and the questionnaires are being prepared for analysis. Information requested includes data on (a) age and length of service at the college; (b) educational background, in terms of degrees, date, major field of study and institution; (c) supplementary education experiences, such as course work and special summer and academic-year programs; (d) preparation for teaching chemistry in a community college; (e) current availability and suitability of graduate programs in chemistry; (f) previous professional experience in terms of teaching positions in chemistry and other fields, research, etc.; and (g) present assignment of the instructor in terms of courses, assigned workload, and unassigned workload.

4. Guidelines for Developing Chemistry Programs in the Two-Year Colleges. A document listing the important considerations that an administrator and his chemistry faculty must face in the development of a chemistry program in a two-year college is being prepared. This document will raise the basic issues in the form of questions, offer some suggestions for ways in which these questions might be answered, and refer to important references related to these considerations.

5. Consultant's Bureau for Two-Year Colleges. The Council has established a panel of qualified chemists who will provide consulting services to colleges and universities upon request and has included five individuals from two-year colleges on the panel to serve as the consultants for two-year colleges. The group will be capable of considering almost any problem that a department might have, except that of the planning of facilities.

Future activities of the Council related to the two-year colleges are concerned primarily with the development of a topical analysis of the minimum essentials for a good four-year chemistry program, with considerations of what should be in the first two years; with the development of a list of what might be reasonably expected of students who have completed a year of high school chemistry and the translation of this into screening for general chemistry programs and beginning chemistry courses for the two-year colleges; and with the identification and development of ideas for the development of programs and materials for the improvement of chemistry in the two-year colleges based on what the chemistry faculty and administrators of these colleges feel that they need to help with their problems.

A working conference on the Development of Teachers for the Chemistry Programs of the Two-Year Colleges was held January 25-27, 1968, in Dallas. The profiles of the chemistry programs and teachers and a summary of the "Ideas for Action" were presented to open the conference. Position papers were invited on the type of educational and training programs that might be suitable for those who desire to become chemistry teachers in two-year colleges and those who already are. Points of view represented included those of a two-year college president, two-year college chemistry teachers, a university college chemist, a graduate school dean, a science educator, a state-college chemist, a technical institute teacher educator, and organizational representatives. These papers were followed by prepared critiques and discussion. The papers, critiques, discussion summaries, and recommendations will be published and circulated to interested parties. Titles of the position papers were:

1. The Two-Year College Chemistry Teacher as Viewed by a Two-Year College Administrator
2. Education and Training Beyond the Bachelor's Degree Needed for Teaching Chemistry in the Two-Year College
3. Education and Training for Teachers in Two-Year College Occupational Programs in Chemistry
4. The Doctoral Program for College Chemistry Teachers at the University of the Pacific
5. New Graduate Degree Programs of Potential Interest to the Two-Year College Chemistry Faculty Member and Administrator
6. Special Programs Designed for the Continuing Education of the Two-Year College Chemistry Faculty Member
7. The Imitative Institute
8. The Role of the State Colleges in the Education and Training of Chemistry Teachers for Two-Year Colleges
9. The Role of the Colleges of Education in the Education and Training of Chemistry Teachers for Two-Year Colleges
10. The Role of the Graduate School in the Education and Training of Chemistry Teachers for Two-Year Colleges - Recognition of Special Degree Programs: The Oregon State University Case

The Advisory Council and the Committee on Chemistry in the Two-Year Colleges work closely with the Education Office of the American Chemical Society, which recently added an Assistant Educational Secretary for Two-Year Colleges; with the Division of Chemical Education of the ACS; with the Two-Year College Chemistry Conference of the Division, now in its eighth year, which holds three conferences per year involving over 300 two-year college chemists and is guided by a 35-man two-year college committee in conjunction with national and regional ACS meetings throughout the country; and with the Educational Activities Office of the Manufacturing Chemists Association.

Two projects related to this cooperation should be mentioned. First, the Two-Year Conference has prepared an up-to-date mailing list of all two-year colleges in the country offering chemistry, which includes the names of the chemistry administrative head and the chemistry faculty. The Council committee has used this list. It is available, at a nominal cost, to all having a bona fide reason for contacting two-year college chemistry departments.

The second area is the development of a set of recommendations for chemical technology curricula and for the chemistry content of such a curricula by two ad hoc committees of the Board of the American Chemical Society. Because of this activity the Council has not entered the field of chemical technology but will incorporate the ACS materials into Council work and render feedback concerning their program which arises as a result of our activity.

GENERAL CHEMISTRY FOR SCIENCE AND ENGINEERING MAJORS

A steadily increasing proportion of future scientists and engineers is beginning educational careers in two-year colleges. The students who intend to continue studies in the sciences should be able to obtain a sound foundation in chemistry at the two-year college. To examine the specific needs and problems of this group of students, the 1966-1967 Two-Year College Chemistry Conference devoted a section meeting at each of its three conferences to discussion of this area.

FIRST MIDWESTERN REGIONAL CONFERENCE

Co-Chairmen: Robert Burham, Grand View College
Curtis Dhonau, Vincennes University Junior College

THE CHEMISTRY MAJOR PROGRAM AT IOWA STATE UNIVERSITY

Summary of Remarks by Bernard C. Gerstein, Iowa State University

The chemistry courses offered to students during their first two years at Iowa State University were discussed in detail. The following outline shows the order in which students would normally take them:

Fall Quarter	Credits	Winter Quarter	Credits	Spring Quarter	Credits
General Chemistry Chem 102A*	4	Syst. Inorganic Chem Chem 103*	4	Quantitative Analysis Chem 214*	5
Orientation Chem 100	1	Orientation Chem 100	1	Orientation Chem 100	1

* Students not having had high school chemistry will take Chem. 101, 102, 103 during freshman year and will take Chem 214 and Chem 203 during fall and spring quarters of the sophomore year, respectively.

SOPHOMORE YEAR

Fall Quarter	Credits	Winter Quarter	Credits	Spring Quarter	Credits
Inorganic Chemistry Chem 203*	3	Quantitative Analysis Chem 215	5	Physical Chemistry Chem 224	3
		Intro. to Organic Chem Chem 237	2	Electives	8

* May be taken any quarter.

Most of the chemistry courses available for chemistry majors are described below:

100 Orientation. (1-0) Cr. 1. An introduction to the various fields of chemistry to assist chemistry majors in electing areas of concentration.

101, 102 General Chemistry. (3-4) Cr. 4 each. Principles of chemistry; properties of non-metallic elements. Only students who have not had high school chemistry will be classified in 101 during the fall quarter. 101 is not acceptable for credit toward graduation for students majoring in chemistry. Text: Keenan and Wood, General College Chemistry, Harper and Row.

101A, 102A General Chemistry. (3-4) 4 each. Principles of chemistry; properties of metallic and non-metallic elements. Students with one unit of high school chemistry will be classified in either 101A or 102A during the fall quarter; classification in 102A will be based on high school rank and test scores. 102A provides a recognition in the form of college credit for high school training in chemistry. Students enrolled in 102A may receive credit in both 101A and 102A. 103 is offered winter quarter and 203, 211, and 214 are offered spring quarter so that students may take full advantage of the accelerated program. 101A is not acceptable for credit toward graduation for students majoring in chemistry. 101A Test: Same as for 101. 102A Text: Slabaugh and Parsons, General Chemistry, Wiley Pub. Co.

103 Systematic Inorganic Chemistry. (3-4) Cr. 4 Prerequisite: 102, grade of A or B in 106. Extension of General Chemistry; introduction to the reactions of individual elements and to group reaction as used in the determination of the composition of matter. Texts: Same as 102A plus Margolis, Qualitative Anion-Cation Analysis, Wiley Pub. Co.

203 Inorganic Chemistry. (2-3) Cr. 3 Prerequisite: 103. Descriptive and systematic chemistry of the elements with emphasis upon the periodic table. Elementary physical-chemical principles with regard to inorganic reactions and structure will be discussed. Texts: Gould, Inorganic Reactions and Structure, Holt, Rinehart and Winston; Campanion, Chemical Bonding, McGraw-Hill.

214 Quantitative Analysis. (3-6) Cr. 5. Prerequisite: 103. Text: Diehl and Smith, Quantitative Analysis, Wiley Pub. Co. 101A, 102A provide a recognition in the form of college credit for high school training in chemistry. 103 is offered winter quarter and 205 and 214 are offered the spring quarter so that students may exploit fully the accelerated program.

224 Physical Chemistry. (3-0) Cr. 3. Prerequisite: 214, Math 212, Phys. 112 or 222. Elementary thermodynamics and theory of the gaseous state. Homogeneous equilibria. Only for students majoring in chemistry or biochemistry.

237 Introduction to Organic Chemistry. (2-0) Cr. 2. Prerequisite: 214. A survey of classical organic chemistry; aliphatic, aromatic series; functional groups; reactions of derivatives of hydrocarbons; heterocyclic compounds. Only for students majoring in chemistry or biochemistry.

One unique feature of the Iowa State University approach is the Chemistry 100 required of the chemistry majors. This was described as the "Advertising Course." This course is administered to orient and offer guidance and stimulation for the prospective chemistry major. A question was raised concerning the advisability of offering this course to the already declared chemistry majors, instead of offering it to the 3000 students taking General Chemistry who have not declared a chemistry major. It was emphasized that the larger group would be a more fertile field in which to advertise.

Dr. Gerstein concluded by stating that for a student to move smoothly into the junior year, he should have had at least one year of calculus, one year of physics, and one quarter course of introductory physical chemistry.

THE CHEMISTRY MAJOR PROGRAM AT KANSAS STATE UNIVERSITY

Summary of Remarks by William G. Schrenk, Kansas State University

The State University in Kansas faces the same problems of the open door policy that confronts the public community college.

Kansas State has an enrollment of about 1200 in freshman chemistry. About 200 of these students, the ones with no high school chemistry or those in the bottom 10 per cent on the placement test, are deferred from taking chemistry until the second semester.

The bulk of the freshman students are then split into two groups. The upper 20 per cent based upon ACT and high school transcripts, are placed in an accelerated group that completes freshman chemistry in one semester. Currently the Mahan text (University Chemistry, Addison-Wesley Pub. Co.) is being used for this course, but there is some dissatisfaction with the text. Most of the chemistry students follow the regular two-semester sequence. The second semester of this sequence is offered so that all students take the same three-hour lecture but the engineering students take a separate two-credit-hour qualitative analysis laboratory, while the chemistry majors take a four-credit-hour laboratory that provides not only the qualitative analysis but a rather rigorous treatment of chemical equilibrium. Also in the second semester the home economics majors are given a brief five-hour organic course.

Discussion indicated that many of the deferred group do not take chemistry. It was also noted that in the accelerated group the laboratory emphasizes individual quantitative work followed by a research-style report which the student prepares outside of class. In the second year, students take a traditional quantitative analysis course which has been reduced to four semester credit hours. Instrumental analysis is not offered until the senior year after the student has taken physical chemistry.

Kansas State University requires ten hours of organic chemistry for chemistry majors. In addition, during the sophomore year the student takes physics and completes the mathematics necessary to begin physical chemistry in the junior year.

THE CHEMISTRY MAJOR PROGRAM AT THE UNIVERSITY OF KANSAS AND RECOMMENDATIONS FOR PROVIDING REMEDIAL PROGRAMS

Summary of Remarks by Clark Bricker, University of Kansas

Upon entering the University of Kansas, students may proceed with the following chemistry program in the first two years. Deficiencies in foreign languages or mathematics do not affect the chemistry programs:

Freshman Year:	Chem. 21 and Chem. 22 (5 s.h. each) Text: Sienko and Plane, Chemistry, McGraw-Hill
Sophomore Year:	Chem. 162 and Chem. 163 (5 s.h. each) Text: Morrison and Boyd, Organic Chemistry, Allyn and Bacon

Recognition must be given to the problems arising as a result of open-door admission policies. For the poorly prepared student, several solutions were suggested.

1. Remedial work in mathematics should be utilized.
2. Descriptive materials should be used to emphasize fundamentals.
3. Processes must be related to principles.
4. The teaching of English should be given greater importance.
5. The enrolled students need to be taught how to become genuine students.

A research project was proposed to examine the usefulness of remedial work to improve student performance and increase the likelihood of academic success. The project would use the 800 least qualified freshmen students at a large university. One-half of the group would proceed with the standard college program and serve as a "control group." The remainder would take (1) a vigorous review of arithmetic, (2) an interpretive course in reading, (3) a self-expression course in writing, and (4) an intensive course in listening.

Follow-up studies on the two groups could be expected to provide interesting and useful data for the benefit of curriculum construction and counseling.

SEVENTH ANNUAL CONFERENCE

Chairman: Curtis Dhonau, Vincennes University Junior College

HISTORY OF THE PROBLEM OF ARTICULATION

Presented by

Robert Drobner, Miami-Dade Junior College

"Revolutionary changes are occurring in American education of which even yet we are only dimly aware. This Nation has been propelled into a challenging new educational era . . . by the convergence of powerful forces -- an explosion of knowledge and population, a burst of technological and economic advance, the outbreak of ideological conflict, the uprooting of old political and cultural patterns, and an unparalleled demand by Americans for more and better education." So stated the President's Committee on Education Beyond the High School, Second Report to the President, July, 1957.

This committee's report received little attention then, and yet it is remarkable in its foresight.

The committee went on to point out the oncoming increase in college-age population and boldly asserted that the country need not have to make a choice between quality and quantity. "The Nation needs more of both, and it can have more of both if it decides to do so." In 1957, the same year of this report to President Eisenhower, and actually preceding it by three months, another even more remarkable report was made to the Florida State Board of Education by the Community College Council. This report was called prophetically The Community Junior College in Florida's Future. Back in 1955 the State Legislature created the Community College Council and charged it with the task of "formulating a long-range plan for the establishment and coordination of community colleges."

The Community College in Florida was defined by the legislature. Its character and responsibilities were established as follows by law. The legislature defined the community college as "an educational institution offering

1. A program of general education consisting of classical and scientific courses parallel to that of the first and second years of work at a senior four-year institution.
2. Terminal courses of technical and vocational nature.
3. Courses beyond the basic education for adults."

This report was submitted to the Florida State Board of Education under the name of Allen C. Grazier, chairman, and Dr. James L. Wattenbarger, director of the Community College Conference. Dr. Wattenbarger has been and still is a leader in the community college movement in Florida and has been a source of inspiration, leadership, and encouragement in our efforts not only in the establishment of two-year colleges in Florida but beyond this in our efforts at articulation with the senior institutions as well.

Dr. Wattenbarger's Community College Council called then for the eventual creation in Florida of 31 so-called junior college areas that would serve 99 per cent of the total state population.

The following figures will show the development of the junior colleges in this state:

Year	Number of Junior College Areas	Per cent State Population within These Areas	College Credit Enrollment
1955 - 56	4	17	3,757
1957 - 58	5	19	7,224
1959 - 60	10	27	14,068
1961 - 62	14	54	28,974
1963 - 64	17	65	51,281
1965 - 66	20	70	73,716

It is estimated that by 1970 the enrollment will be doubled. In 1960, 3.5 million young men and women attended institutions of higher learning in the United States; by 1970 that figure will be 7 million. The independent liberal arts college, traditionally "the nucleus and backbone of American higher education" was challenged after World War II on one side by the great university complexes and on the other by the new community colleges which everywhere are answering an insistent demand for the collegiate experience. In New York State the motto of the State University System is "Let Each Become All He Is Capable of Being." The question of numbers is no question at all, for in characteristic American fashion the pursuit of quality and quantity has been accepted as an inevitable challenge and as a public responsibility." So writes Frederick Rudolph in his book The American College and University: A History.

The map of Florida that I have given out showing the major state universities and junior colleges shows how the people of Florida are responding to this challenge and responsibility. Along with this responsibility to carry out the mandate of the legislature to provide the first two years of college work is the concomitant responsibility to develop a smooth transition for the student from the junior college to the senior institution.

In the March, 1967, issue of the Junior College Journal there is an interesting article called "Articulation -- Florida Style," by Dr. Strawbridge and Dr. Wattenbarger. In this article Dr. Wattenbarger points out that the original 1957 report of the Community College Council (of which I have spoken earlier) called for a liaison committee on articulation. This committee is now headed by Dr. Wattenbarger in his capacity as head of the Division of Community Junior Colleges of the Florida State Department of Education. One of its responsibilities is to "establish special task forces of professional personnel to study, evaluate, and make recommendations as will improve matters of articulation."

One of the earlier task forces established was that in chemistry. Representatives from the universities and the junior colleges were selected. These faculty representatives bring to the meetings a first-hand knowledge of the subject as well as a firm personal commitment to work toward a successful resolution of articulation difficulties that may exist.

After a focusing and a clearer statement of these problems, the usual step is to call a statewide meeting for the purpose of securing an even broader understanding and to assess the reaction of all the state's institutions of higher education. To this conference all interested persons are invited: faculty members of all institutions public and private, academic officers, county and state curriculum coordinators, as well as representatives of the Board of Regents and the Division of Community Junior Colleges. In practice this usually means that over 100 people meet in large and small groups to discuss and formulate a final report. This report is then given wide distribution and becomes the basis for curriculum development and evaluation.

Specifically, the articulation conferences in chemistry will be treated by our other speakers. However, let me close by saying that one of the hallmarks of our chemistry articulation meetings has been the feeling of mutual respect and appreciation of the efforts of the junior college faculties and those of the senior institutions.

I believe I voice the opinion of all those who worked on the committees that this had an immeasurable influence for good and helped create a climate where success was all but inevitable.

JUNIOR COLLEGE -- SENIOR COLLEGE ARTICULATION IN CHEMISTRY IN FLORIDA

Presented by

Robert D. Whitaker, University of South Florida

In January of 1963, Dr. James Wattenbarger, director of the Junior College Division of the Department of Education of the State of Florida, discussed with the Council of University Presidents the need to articulate better the chemistry curricula of the junior colleges and universities. In order to plan effectively how such articulation could be realized, a committee consisting of representatives of the then existing five state universities was appointed. This small committee summarized its findings in a publication issued in July of 1963: _Articulation of Chemistry Instruction in the Public Junior Colleges and the Institutions of the University System of Florida_. This report addressed itself to six major areas:

1. Curriculum leading to a college degree in chemistry.
2. Competencies that are expected of students entering their third year of college chemistry.
3. Competencies that are expected of students entering the study of chemistry in the first two years of college (i.e., secondary school preparation).
4. Minimum facilities that should be available when a college offers chemistry courses during the first two years after high school.
5. Competencies that a department head, dean or president should look for in employing individuals to teach chemistry during the first two years of college.
6. Characteristics of general chemistry courses that should be used to serve the purposes of a variety of students who do not plan to continue beyond a first college course (i.e., a terminal course in chemistry).

The final report represented the position of the state university system of Florida with regard to these points. During the summer and fall of 1963, the report was circulated to junior college chemistry departments for their consideration and analysis.

Early in January of 1964, the committee was expanded to include junior college representatives in order to plan a general conference on articulation. The program was planned, invitations were issued to all public junior colleges and universities to send official representatives, and private institutions were invited to send observers. The conference was timed to precede by one day the Annual Florida Section Meeting-in-Miniature of the American Chemical Society. This timing was felt to be appropriate not only from the standpoint of saving in travel time for many of those who would attend both meetings, but also to emphasize the common interests of chemists in reporting on research efforts and in improving higher education in chemistry.

Thus it was that on May 7, 1964, the first statewide Chemistry Articulation Conference was held at Florida State University with 26 junior college representatives and 28 college and university representatives. The one-day conference consisted of a fairly brief morning session at which two speakers, one a junior college staff member and the other a university staff member, commented on the original university position paper from their particular points of view. Then followed a fairly lengthy afternoon session during which three separate roundtable discussion groups considered specific problems associated with general chemistry, quantitative analysis, and organic chemistry. The discussions were so arranged that it was possible for all participants to engage in each of the discussion groups if they so desired. Likewise, initial attendance by the participants at one of the groups was preassigned so that an approximately equal number of junior and senior college representatives were present in each of the discussion groups. A moderator and recording secretary presided over each group.

With the university position paper serving as a point of departure, discussions ranged from the desirability of whether or not the concept of entropy should be introduced in general chemistry to problems associated with the transfer of a student when he has completed only the first of a two-term sequence. The findings and general conclusions of the conference were summarized in the publication <u>The Record of a Chemistry Articulation Conference</u>.

The expanded committee that had actually planned the conference program is now a permanent junior college-university committee. The chairmanship changes every two years, and this committee plans articulation conferences that are held every two years in conjunction with the Meeting-in-Miniature. The second conference was held on May 5, 1966, at the University of South Florida. A summary of this conference has also been published. All of these publications dealing with the articulation of chemistry programs in Florida may be obtained by writing to the Division of Community Junior Colleges, State Department of Education, Tallahassee. During years when a conference is not held, the committee plans one session of the Meeting-in-Miniature that will be of specific interest to those involved in the teaching of chemistry--high school, junior and senior college.

We who have worked with the problems of articulation in Florida feel that our approach, although of course imperfect, is nevertheless most effective in accomplishing at least some if not most of our goals. Let me try to suggest some reasons why we feel that we have achieved some degree of success.

1. The initial planning was instituted at a very high level in state government. The standing planning committee operates under and with authority vested in it by the State Board of Education. It is thus much easier to gain the cooperation of college administrations in implementing suggestions that grow out of the meeting.
2. The position paper prepared by the university representative provided a tangible point of departure for the 1964 conference. Without the focus provided by this document it is almost certain that this initial conference would have been far less productive that it actually was.
3. The timing of the Articulation Conference and Meeting-in-Miniature was most fortunate. Many junior college chemistry teachers might never have been able to attend a Florida Section American Chemical Society meeting. The importance of emphasizing professional status as a <u>chemist</u> as well as a <u>teacher</u> should not be underestimated.
4. University chemistry departments in Florida are deeply concerned with the problems and challenges faced by our junior colleges. In ever increasing numbers, upper-division students come from the ranks of the junior college transfer. In addition, those of us heavily involved in lower-division courses in the universities almost daily give thanks to our junior college system for easing the crush of the college student explosion.
5. Junior college and university staff now realize that we need articulation not only between junior and senior colleges, but also among sister institutions. Thus in our experience, articulation is necessary and can occur horizontally as well as vertically.

Articulation is part of the higher education system of Florida. Mathematics, biology, and areas of the humanities are in various stages of articulation. I am happy that chemistry has been a successful pioneer in this important work.

THE IMPACT OF PREVIOUS CHEMISTRY ARTICULATION CONFERENCES

Presented by

Mrs. Nina Milton, St. Petersburg Junior College

This report is an attempt to correlate the recommendations of the articulation conferences with recent improvements made in the teaching of chemistry in the junior colleges of Florida. These questionnaires were designed to cover the topics recorded in the notes of the Tallahassee conference. The interest of the chemistry teachers was certainly expressed in their answers, and it is possible to draw several conclusions from the results of this tabulation.

1. Twenty-one chemistry departments responded.
2. Fifty-nine questionnaires were completed by chemistry teachers.
3. Sixteen junior colleges were represented at the conference in 1964.
4. Eighty-seven per cent at the conference gave opinions by their response to the questions.
5. Thirty per cent stated that they have made major changes in chemistry programs as a result of previous conferences.

It may appear that the impression of these meetings in less an "impact" and more of a "dull thud." Actually, there are several reasons for this low percentage score:

1. The junior college system is undergoing such rapid growth that five of the departments responding do not have classes completely staffed or planned. Certainly these conferences are needed to help in the process of planning new departments.
2. The personnel involved change so rapidly that it is difficult to assess the value of these meetings to individuals. This makes guidelines from the AC_3 conferences even more important to us; they are established on a national level.
3. The course outlines, prepared prior to the 1964 conference and studied by departments, were in line with the thinking of teachers. Therefore, <u>the conference represented a meeting of minds and not the instigation of new ideas</u>.

It is encouraging to note that regardless of how it comes about the development has been along the exact lines recommended by these previous conferences. Ninety-two per cent of all departments have upgraded the teaching of general chemistry and laboratory procedures.

In spite of the fact that members agreed that "within the usually limited facilities available, it does not seem possible to offer a variety of courses for different types of needs," they did the impossible.

1. Sixty-two per cent have added introductory chemistry.
2. Thirty-eight per cent have added remedial courses.
3. Seventy-seven per cent offer general chemistry in a three-term sequence.
4. Thirty-three per cent stated that they have improved testing. Many of these added ACS tests as part of their evaluation data.
5. Ninety per cent, as would be expected, have added new laboratory equipment. At least 60 per cent of these additions were along recommended lines.
6. Twenty-three per cent of the instructors have taken advantage of in-service training courses.
7. Nineteen per cent are working toward higher degrees. More help from higher state institutions might be indicated here. There were comments that the trimester system has interfered with the scheduling of some NSF institutes.
8. Eighty-six per cent believe that there is good correlation between laboratory and lecture courses.
9. Eighty per cent believe that more correlationis desirable. The reference here seems to be a desire for lecture instructors to teach corresponding laboratory sections.

The assignments in chemistry for the teachers reporting vary from 6-21 contact hours. Although the average is 15, it is shocking to note the number of chemistry instructors having 21 contact hours because of the custom of allowing less credit for a laboratory load.

It is certain that these instructors are in the position to evaluate the improvements made in junior college chemistry over the past few years. The outlook appears to be quite optimistic insofar as our keeping in step with other institutions is assured. It would certainly be unfair to assume that the articulation conferences have not been of tremendous help in improving chemistry. teaching.

Form No. I. Answered by Coordinator of Chemistry Instruction

	Number Answering	Per cent of Answers Yes	Per cent of Answers No
1. As a result of the articulation conferences, has your institution made significant changes in the total chemistry curriculum?	19	47	53
2. Were significant changes made in upgrading the content of general chemistry?	13	92	8
3. Were significant changes made in upgrading quantitative analysis?	10	30	70
4. Were significant changes made in upgrading organic chemistry?	11	27	73
5. Were significant changes made in upgrading laboratory procedures?	14	93	7
6. Were significant changes made in upgrading testing procedures?	12	33	67
7. a. Have honor courses been added?	13	0	100
b Has an introductory level chemistry been added?	13	62	38
c. Has remedial chemistry been added?	13	38	62
d. Is general chemistry available in a three-term sequence?	13	77	23
e. Have topics been considered in more detail than formerly?	13	85	15
8. a. Is qualitative analysis taught as part of the general chemistry laboratory course?	16	88	12
b. Is qualitative analysis taught as part of the organic chemistry laboratory course?	11	45	55
c. Have the number of qualitative experiments been increased?	15	40	60
d. Have you made changes and additions in laboratory equipment?	15	90	10
(1) Do your laboratories use standard taper glassware?		50	50
(2) Do you have electrometric pH meters available for student use?		81	19
(3) Do you have spectrophotometers for student use?		62	38
(4) Are students using automatic one-pan balances?		75	25
e. Are lecture courses running concurrently with laboratory?	--	62	38
f. Is separate credit given for laboratory and for lecture courses?	--	19	81

Form No. II. Answered by Chemistry Instructors

		Number Answering	Per cent of Answers	
			Yes	No
1.	Have you participated more actively in professional activities since May, 1964?	55	50	50
2.	Do you attend the meetings of the Florida sub-sections of the American Chemical Society?	56	41	59
3.	Do you read the section publications, FLACS?	56	64	36
4.	Have you participated in in-service training courses offered by senior institutions?	56	23	77
5.	Have you attended an NSF institute since 1963?	57	40	60
6.	Are you now studying for a more advanced degree?	55	19	81
7.	In your courses do you cover these specific topics to a greater depth than you did prior to 1964?	55		
	a. Thermodynamics	36	61	39
	b. Phase equilibria	38	55	45
	c. Crystal structure	38	44	56
	d. Kinetics	40	75	25
	e. Reaction mechanisms	40	75	25
	f. Quantum chemistry and structure	38	66	34
	g. Molecular orbitals	42	77	23
	h. Infrared, ultraviolet, nuclear magnetic resonance spectra	26	48	52
8.	Do you use appropriate current paperbacks for special topics?	67	45	55
9.	Do you use any of the ACS examinations to evaluate your teaching?	56	52	48
10.	Do you feel that your laboratory courses are correlated with lecture courses?	56	86	14
11.	Is more correlation between laboratory and lecture courses desirable?	56	80	20
12.	Do you assign technical reports as part of your courses?	56	30	70
13.	Do you assign individual research as part of your laboratory course?	57	16	84
14.	Have you been assigned courses that you felt inadequately prepared to teach?	45	9	91

SUCCESS OF ARTICULATION IN FLORIDA

A SENIOR COLLEGE VIEW

Presented by

Richard Dresdner, University of Florida

For those of you who are relative strangers to the Florida State Education System, a short summary of its statistical character is in order. For a student to enter one of the senior state universities, he or she requires a total 12th grade percentile rank sum in five examination categories of 300, which in a given year may be equivalent to a raw score of not more than 50 per cent (250 total). In the future even a score of 300 will be no guarantee for entrance to the University of Florida, where the top students whose scores range from 495 downwards will be selected to fill the 2,800 vacancies in the freshman class. This means generally that the state schools are privileged to accept the top 30-40 per cent of the students on the basis of 12th grade tests.

The junior colleges are legally bound to accept all students who have earned a high school diploma in the state regardless of their 12th grade placement scores. This is not an enviable pedagogic position, and the associated growth of the junior college system has required it to compete for personnel throughout the country, not infrequently attracting to its several doors the better high school teachers in the area by being able to offer slightly higher salaries, lower apparent workloads and a step up the pedagogic ladder. As might be expected, the rate of personnel turnover tends to be high, especially today as the competition for good teachers is fierce.

All students who successfully complete 64 transferable semester hours with an honor point average of 2.0 in a junior college can apply for entrance at a senior state school and generally must be accepted if they meet all other requirements for entrance. These junior college graduates who enter the senior state schools at the upper division level are in competition with the senior school students who have completed 64 hours of lower division work with a 2.0 honor point average and with a small number of other students with similar credentials who come to the senior school from other private junior colleges in the state, other private or public state universities or colleges, or other schools from outside the state of Florida.

A recent study made by Dean Ernest H. Cox of the College of Arts and Science at the University of Florida shows that for the 1,801 upper division full-time students enrolled in the College of Arts and Science the following is pertinent:

Fall, 1966

1,801 Students, College of Arts and Science

From	No.	Per cent	12th GPS (median)	HPA	Per cent Problems
UCUF	1,098	61	448	2.67	69
FJC	488	27	371	2.14	43
Others	215	12	433	2.56	63
Totals	1,801	100	434	--	--

These data imply that when we compare the caliber of students who enroll at the junior colleges with that of those who enroll at the senior universities, we find that standards have been maintained in the junior colleges and the performance of junior college graduates is equal to or better than that predicted for them on the basis of placement scores alone.

Now let us focus on the area of chemistry. Again, mainly for the visitors, the University of Florida offers two equivalent sequences in chemistry that are designed to allow any student completing them to proceed to advanced chemistry courses. The two sequences differ only in length of time required to complete them and in order of material presentation. They do not differ in quantity of material or degree of comprehension demanded. The students with proven poorer backgrounds are required to take the more leisurely sequence of three trimesters. Others may elect to take it. The criteria for enrolling for the faster two-semester sequence are (1) 410 12th grade testing program, (2) 80 in mathematics portion of test, (3) three years high school mathematics, and (4) one year high school chemistry with a passing grade. Failure to meet any of these criteria restricts enrollment to the slower sequence.

The average mortality rate in any semester of either sequence is about 10 per cent due to dropping, 8 per cent due to failure, and 20 per cent due to D grades, or an average of 38 per cent. The mortality rate of students who are required, as a result of having failed to complete chemistry in a junior college, to enroll in an advanced general chemistry course at the University of Florida is about 55 per cent. However, those who can be prevailed upon to "retreat" to a lower-level course will perform at the same level as their class.

Furthermore, the longer-sequence student has a 12th grade placement-score average of 413, whereas the shorter-sequence student has an average score or 451 compared to the junior college entry, who has a score of less than 400 average. Again the results tend to agree with what was said above concerning the performance of junior college students in the liberal arts college.

As for junior college graduates who have completed a course in chemistry and who enroll at Florida for organic or analytical chemistry, their grade average in Cy 301 and Cy 331 is about 2.2 compared to 2.6 for Florida students; but in more advanced chemistry courses Cy 302, Cy 318, Cy 401 transfers are not long distinguishable. The same trend has been observed in the College of Engineering.

All factors being considered, despite differences in housing, books, and background of instructors, junior college students in the light of their earlier performance characteristics are performing in chemistry at the University of Florida (and elsewhere) as well as Florida students with similar performance backgrounds. Thus one may conclude that the general practice of articulation is working.

Questions and Discussion of Guidelines

Moderator: Curtis Dhonau, Vincennes University Junior College

Resource Panel composed of Robert Drobner, Robert Whitaker, Nina Milton, and Richard Dresdner

One of the major problems confronting the chemistry departments in the two-year institutions is concerned with the articulation of the general chemistry courses for the science and engineering majors with the four-year institutions. Since 1963, the state of Florida has been working seriously on this problem. We were fortunate to have the Florida articulation program presented and discussed.

It was pointed out that the Florida four-year institutions accept high school graduates with a higher score than the average for junior colleges; but after the initial adjustment upon transfer, the former junior college students cannot be identified; the first semester of transfer may show about 0.4 GPA drop.

Is qualitative analysis an essential course? If the college can afford the course, it is a good teaching device but no longer of practical value. Some feel that it is a valid course if for no other reason than interest. It keeps some descriptive chemistry in the program. Caution was raised about grading so the "cookbook" chemistry would be avoided.

Should the organic chemistry be a four- or five-hour course? In general, it was agreed that there should be three hours of lecture and a three-to-four-hour laboratory for four credit hours; however, many four-year schools vacillate between a four- and five-credit-hour course.

Should the general chemistry be taught without a laboratory program? Most opinions expressed were negative; but it was felt that if the course were taught over a period of three semesters, the first course might be without laboratory work.

Should a standard test for all students entering the junior year be used in evaluating the student's progress whether or not he is a transfer? Some felt this would be a good idea while others felt that it would stifle experimentation and creativity and would curtail freedom in teaching. It was agreed that the use of ACS tests is helpful in evaluating a course and students.

Should a calculations course be offered? This is valuable for students; slide rule should be taught first.

The opinion was expressed that freshman chemistry students are less well prepared now. For a study see "Test Achievements of Chemistry Students: A Comparison of Ach vement of Students in CHEMS, CBA, Conventional and Other Approaches," by Pye and Anderson, The Science Teacher, Vol. 34, No. 2, Feb., 1967.

Is there a good placement test to validate the student's knowledge of chemistry? The Flint Community Junior College has successfully used the Toledo Placement Test. Copies of a report on "Screening Students for General Chemistry" may be obtained from Kathryn P. Caraway, Flint Community Junior College, Flint, Mich.

Discussion time was too brief, but the general opinion was expressed that all chemistry departments would be aided by an articulation program similar to the Florida plan. It was agreed that the AC_3 committee working on guidelines for chemistry for the two-year school should study closely the Florida plan.

SECOND WESTERN REGIONAL CONFERENCE

Chairman: C. Herbert Bryce, Seattle Community College
Recorder: Keith Biever, Bellevue Community College

TEACHING CHEMISTRY IN THE EMERGING METROPOLITAN COMMUNITY COLLEGES OF WASHINGTON

Presented by

Paul E. Jacobson, Tacoma Community College

The task I have set for myself today, after five years' experience as a community college chemistry instructor and junior administator, is to review some of the complexities that I believe pertain to the teaching of chemistry in the emerging metropolitan community colleges of Washington and to state some possible methods of living with these complexities. By doing so, I hope to provide some insight that will be useful to neophytes in the business of organizing and teaching community college chemistry courses and also to stimulate thinking about the various possible approaches to some of the instructional problems that community colleges are facing.

In order to proceed to my thoughts, I would like to make some remarks about community college chemistry, as well as I can from the differing viewpoints of students, teachers, and administrators.

To begin then, let me give my opinions of how the average metropolitan community college student views the subject matter called chemistry. I think he finds it both difficult and somewhat less than vitally interesting. I think that by and large chemistry courses appear to him to be unreal in many of their aspects, disjointed, and often unexciting. The lecture demonstrations are informative and interesting, but normally they are not as meaningful or as interesting as those experiences encountered outside of class or in physical education, history, drama, sociology, political science, or psychology courses. This student tends to feel that the laboratory work requires too much preparation, is difficult to understand, and is too dry and theoretical. These feelings partly stem from the fact that the community college student is a daily commuter from his home. Family, car, television, and established friends all compete for his interest. Also, the average metropolitan community college student has not been a high achiever in high school. Open enrollment is the factor that has made it possible for him to attend college. Thus, he is not as ready to accept intellectual heroes or to dedicate himself to academic life as is his four-year school counterpart. In addition, he probably has a job that reduces the amount of his time available for study. In summary, I think the average metropolitan community college student finds his chemistry classes to be demanding, finds himself relatively unprepared, and finds his environment hostile toward study. If these conclusions are valid, then in many ways such students are coming face to face with even more abrupt experiences than those of us gathered here today faced when we first encountered the full impact of our professional studies.

I keep using the word "metropolitan" because it seems to me that there is the danger of over-generalizing when speaking about the average community college student. In Seattle, the University of Washington and other institutions are so convenient that students who are qualified to attend them are reasonably able to do so. Thus, the community college student tends to be the student who, more often than not, can't qualify for one of the senior institutions. I imagine that the same is true, perhaps to a lesser extent, in Tacoma and Spokane. In more remote areas, where travel costs become significant, there may be more of a tendency for all students to attend the community colleges. From the outset then, I wish to qualify my remarks in such a way as to indicate that they pertain to areas where public or private senior institutions are also available. Someone else must speak for other places.

Having thus qualified my remarks pertaining to students, let me now switch my viewpoint to that of the community college chemistry instructor. Here I will point out the problem areas only, neglecting the positive aspects as not pertinent to my purposes. The lack of supporting personnel in the laboratory is one problem usually encountered; the horrendous results that accrue from an essay examination are another. Poor student preparation is everywhere in evidence, and there is a lack of motivation and established academic ability in many of the students. Local red tape and state-wide purchasing regulations constantly work against the best interest of the school and the student. The administration always seems to place more emphasis on program than on academic excellence.

The instructor must quickly face such basic issues as:

1. How will the administration react to massive failures in my course?
2. Who will register for the sophomore course, if the draft, jobs, transference to senior institutions, and failures curtail the development of qualified students?
3. How can the freshman-level course at the community college take an underprepared student and help him play catch-up with his motivated, more capable, university counterpart?

And now I would like to turn to an administrator's viewpoint, in order to focus attention on an important question. The question is whether or not the community college should feel obligated to offer two full years of chemistry courses. Of course, any chemistry instructor worth his salt would answer "yes." One factor in making such a decision, however, must be economics; and, as I will attempt to show, therein lies a problem.

Suppose that for a given institution, the second-year course is to be a three-quarter sequence in organic chemistry, and that an instructor is to teach a survey course and the organic sequence. Let us assume further that the survey course contains 28 students, at the cutoff date each quarter, and that the organic course varies from 12 students in the fall to 8 in the winter and 6 in the spring--not unreasonable figures considering existing practices in Washington and available data. Using 1966-67 state support figures, the funding of these courses would be:

Quarters x students x credit x (State Reimbursement + Tuition)

3 x 28 x 5 x ($12.50 + $5)	= $7,350	(Three Quarters of the Survey)
1 x 12 x 5 x ($12.50 + $5)	= $1,050	(Fall Quarter--Organic)
1 x 8 x 5 x ($12.50 + $5)	= $ 700	(Winter Quarter--Organic)
1 x 6 x 5 x ($17.50)	= $ 525	(Spring Quarter--Organic)
Total	$9,625	

With the average 1966-67 salary of Washington community college instructors running about $9,000, and with building, equipment, utility, supply, administration and capital improvement costs being what they are, this instructor load is uneconomical. We must combine this lack of economy with the fact that some of the students involved, even in the second-year class, are not bonafide science (let alone chemistry) majors.

Now one might reply that you have to look at the whole program. Other instructors who are carrying the first course will help offset this lack of economy. In reality, though, the picture is not always favorable. Let us say there is one other chemistry instructor and that he is carrying the first-year sequence plus a survey course. The funding his efforts bring into the institution is, if he handles 60 general chemistry students in fall, 45 in winter, and 30 in spring, as well as a full survey class each quarter:

60 x 5 x	$17.50	=	$5,250.00	(Fall Quarter--General Chemistry)
45 x 5 x	$17.50	=	$3,937.50	(Winter Quarter--General Chemistry)
30 x 5 x	$17.50	=	$2,625.00	(Spring Quarter--General Chemistry)
3 x28 x 5	$17.50	=	$7,350.00	(Three Quarters--Survey)
	Total		$19,162.50	

Thus, the two instructors together are funded by about $29,000. This sum is not enough to support two average-salaried instructors, plus overhead; or if enough under some circumstances, then just enough, and let's not look for a lot of equipment, such as U.V. and infrared, to come from the proceeds. I suspect, furthermore, that for many of our smaller community colleges, my enrollment figures have been liberal. Also, new institutions, having lower enrollments generally, will find their cost figures less favorable. Add to these cost projections the implications of other high-cost programs, both academic and occupational, that are being encountered in the community colleges, and the picture becomes still less clear.

My remarks so far have been meant to demonstrate that the small and developing metropolitan colleges are situations of complexity and conflict, and that the teaching of chemistry is intimately involved in both of these aspects. I have long ago concluded that in such cases there are no clean-cut answers to the many questions that are posed. There are several operating rationales, however, that I think are possible at this time, and which I think should be contemplated seriously by new instructors and new institutions where difficulties of the kind that I have mentioned are being encountered.

1. As one approach, a community college's chemistry effort could be consciously molded in the image of general education. An effort that would be less intensive and less comprehensive than those found in four-year institutions could be made. More students of low achievement could be tolerated within the classes in order to maintain enrollments and improve financing. The advantage of such an approach would be that a full program could be offered more easily. Criticisms of this approach would be that (a) the more able chemistry students would be deprived of the intellectual enrichment and the competition that they need and deserve; (b) the effort would be inconsistent within the institution unless other disciplines were committed to the same approach; and (c) some of the recipients of such an education would tend to be downright embarrassing to both the instructor and the institution, and there would be those who would be improperly motivated to continue the study of chemistry only to fail later when the full impact of the discipline was felt.

Several measures could be taken, however, in order to offset partially some of these disadvantages. For one thing, special topics courses, honors sections, or whatever you want to call them, could be offered to the better students in order to increase their skills and experience. For another, special advising efforts could be made to help students adjust their goals within the realities of their achievements. Also, instructors who could tolerate a low-level success threshold, while still recognizing and striving for an excellent educational experience for the better student, could be selectively recruited for the community college choosing to operate in this manner. This latter endeavor is probably easier said than done.

2. Another kind of rationale involves reduction in the scope of the program. It would be possible for a college to base its effort primarily on the freshman aspects of chemistry and thus alleviate some of the problems mentioned earlier. In general, large enrollments in freshman courses seem to be possible in the community colleges. This situation, as it applies to chemistry, is conducive to adequate funding for equipment and salaries. As the academic year proceeded and student attrition occurred, sections could be coalesced and new beginning sections could be started. In addition, remedial courses, probably of a high school equivalency nature, could be instituted in order to feed more capable students into the introductory course. The advantages of such a rationale would be high academic standards and the potential for better instructional equipment and instructor salaries. The disadvantages would be that good chemistry students

might tend to avoid or transfer prematurely from the institution, and that capable instructors might not be as easy to obtain and retain because they would not find assignments as challenging or rewarding.

Still, other disciplines have to some extent accepted this approach without disastrous results. The following data indicate the accentuation of remedial- and freshman-level work found in English and mathematics at Highline College during 1966-67. (Comparison figures for chemistry are included.)

Subject	Credit Hours		
	Fall 1966-67	Winter 1966-67	Spring 1966-67
English			
Remedial and Terminal	85	41	34
Freshman	93	126	129
Sophomore*	20	20	20
Mathematics			
Remedial and Terminal	97	98	75
Freshman	55	45	43
Sophomore	5	8	16
Chemistry			
Remedial and Terminal	0	0	0
Freshman	25	23	28
Sophomore	5	5	5

*Also open to freshmen.

3. A third rationale would include (a) tolerance of the low enrollment levels presently found in second-year chemistry courses; and (b) reliance on heavily enrolled classes in other areas, the social sciences for example, to provide the necessary funding. This rationale is, at least to some extent, presently employed in Washington community colleges, but it works hardships on the supporting effort. One might well ask where the fundamental need for our times really lies. The answer would cause come concern, I think, when overcrowding of and inattention to social sciences classes are contemplated.

Of course, more adequate state financing of academic laboratory and studio courses would be a great help in this matter, and should be sought vigorously. In Washington, help of this nature is already extended to the occupational areas where, because of need, funding is based on class contact hours rather than on credit hours. As a matter of interest, the difference between the present quarterly funding of a typical chemistry course and that which would be available if vocational funding regulations applied, is exemplified by the following:

For one student a chemistry class involving three hours of lecture and four hours of laboratory per week:

1. Academic Reimbursement:

Students x credit x (state reimbursement + tuition)

(1) x (5) x ($17.50) = $87.50

2. Vocational Attendance Reimbursement:

State Funding + Tuition

$$\frac{(1 \text{ student}) \times (7 \text{ class hours/week}) \times (12 \text{ weeks}) \times (1.5 \text{ reimbursement factor}) \times (\$12.50 \text{ state reimbursement})}{20 \text{ (Factor)}}$$

$$+ (1 \text{ student}) \times (5 \text{ credit}) \times \$5 \text{ tuition}) = \$103.75$$

The community colleges in Washington area are, in short, faced with the common dilemma of living within their incomes. Chemistry programs are unavoidably affected. This basic problem is complicated by the fact that the typical entering student is academically well behind his four-year school counterpart, without there being a recognized difference in accepted instructional goals.

In summary, I have tried to indicate some of the problems confronting the chemistry program at the community college level and some possible rationales under which instruction in chemistry may be carried out. Other rationales will undoubtedly suggest themselves to my listeners. In order to cope with its individual situation, each community college must evolve its own rationale, which accounts for such factors as lack of adequate preparation on the parts of many students, low institutional ability to finance small classes, and emphasis on remedial work. Chemistry instructors must operate within this framework and must address to the same problems, which in the author's opinion can only lead to a series of relatively satisfactory answers at best. Although each community college is different, depending upon such factors as budget, community influence, proximity to a public or private four-year institution, and administrative orientation, the composite picture for chemistry within the emerging metropolitan Washington community colleges indicates the need for much compromise in terms of costs, standards, equipment, and instructional goals. As these community colleges grow larger and/or more affluent, chemistry instructors may look forward to more intellectually satisfying solutions to their problems. Instructional rationales must evolve as the colleges evolve. While such evolution occurs, students, instructors, administrators, and national organizations must remain cognizant of the fact that student preparation, college size, and college financing are critical variables in the community college effort, and that what can be done at a particular time and at a particular location is strongly dependent upon these variables.

GENERAL CHEMISTRY FOR SCIENCE AND ENGINEERING MAJORS

IN THE TWO-YEAR COLLEGES

Summary of Remarks by Donald J. Knepp, Portland Community College

A major advantage of the community college is also its major liability. Its average student is a poorly disciplined, poorly prepared, and poorly motivated individual, frequently with an undeveloped and unrealized potential. Putting a student like this through the standard academic curriculum is like putting a straw through a brick wall.

Portland Community College has been forced to use the two general chemistry courses that are rather universally used throughout the Oregon system.

One is the science major chemistry course, which is open to any student who has had high school chemistry. There is very serious attrition in this course. Of forty beginning students, ten finished. These ten were very good students, one of whom was an unusually good student, capable of getting a degree in one of the science fields. The remainder were capable of getting a four-year degree in one of the science or para-science fields.

This quarter the course was divided into segments, one-third theory, one-third application, and one-third descriptive. The laboratory program is the weakest part of the curriculum because of lack of facilities. New laboratories should soon be available.

The second course is chemistry for the non-science majors. This is a terminal course and is open to the student who has never had a chemistry course.

There is no honors course since the college does not have the honors students. Out of the class of forty, there was one student who would have been considered an honors student but not a superior honors student. The reason for this is our rather unique physical location. Portland Community College is literally adjacent to Portland State College. The scholarship programs available eliminate any reasons the academically superior but financially poor student would have for going to the community college. When the community college moves to its new location, a few more of the superior students will probably attend.

At the present, no sophomore chemistry courses are offered. It is expected that a course in quantitative analysis will soon be offered. We have been authorized to offer a one-quarter course of three or four credit hours. Students completing this course will then be able to compete with the student who has taken the science program.

Consideration is being given to a series of changes to take students who would normally go into the freshman terminal course and offer a beginning one-term remedial chemistry course. This would not be a high school course; it would be even lower, but the student would actually go into the laboratory and physically do things. He would actually measure and learn the basic principles of mensuration in order to bring him to the point where he could compete in a more sophisticated course.

Another idea is that a two-year freshman chemistry course should be offered. Classroom time would be approximately one-half of the student's credit hours per week but would extend over twice as long a period of time. This would enable the student to have twice as much laboratory time, consequently twice the amount of instructor contact, which is badly needed by this type of student.

This two-year course would be offered as a rather rigid program for two reasons. One reason is that the student would have to take certain peripheral materials such as starting out with remedial mathematics (which in some cases would be eighth grade arithmetic) and continuing to the point where he would complete the freshman course in mathematics. The students would also take a two-year physics program, using the same structure. Thus the students would be able to obtain a two-year program to increase their chances of success in freshman chemistry and freshman physics.

The other reason for the rigid structuring is that most of the students attending the community college are lacking in self-discipline, consequently students must be taken in lockstep through the chemistry course. They must obey the rules or they are severely disciplined within the course. We find that the student who has this total lack of self-discipline seems to acquire some measure of it as soon as he is disciplined from the outside.

As was previously mentioned, Portland Community College has a weakness in the laboratory program. This is partly because the traditional laboratory teaching in chemistry is perhaps the most archaic and ill-structured system of education in existence in the United States. Much of the chemistry instruction in the laboratory appears unchanged since the last century. The student rebels against this.

There are several problems with finances in trying to make the laboratory program more meaningful. A large number of changes cannot be made at the same time. When Portland Community College moves into its new facilities, it is hoped that the laboratory program can be made into a more modern form.

The breakage fee has proven costly to administer. It was found that the breakage fee is normally between one and two dollars per student, but it costs five dollars per student to administer the breakage fee program. Thus the breakage fee program is being eliminated.

There are problems at the state level. There is no standardization of courses. Transfer of credit problems do exist. The college has excellent potential in its program, and it is expected that an excellent chemistry curriculum will be developed at Portland Community College.

GENERAL CHEMISTRY FOR SCIENCE AND ENGINEERING MAJORS IN THE TWO-YEAR COLLEGES

Summary of Remarks by J. Victor Griel, Centralia College

Centralia College is an established (forty-two year old) two-year college. The present enrollment is 1,145 full-time equivalent students. The chemistry department is composed of two full-time instructors who have some laboratory assistants available and one student who is available two hours per day.

The first chemistry course for science and engineering majors is Chem 145. This course has four class hours, three laboratory hours, and five quarter-credits. The text used for this course is College Chemistry by Nebergall and Schmidt. The laboratory manual is College Chemistry in the Laboratory, by Malm and Frantz. A special problems book, Chemical Calculations, by Sackheim is also used. The general organization of the course is as follows:

Topics

- Atomic and molecular structure
- Periodicity
- Bonding, nomenclature
- Hydrogen
- Gaseous state and kinetics
- Gram molecular volume, equivalent weight
- Water and hydrogen peroxide
- Solutions
- Redox and electrochemistry

Laboratory Experiments

- Chemical separation of a mixture, sterling silver
- Synthesis and formula of a metal oxide
- Group relationships and the periodic table
- Molecular weight of a gas, Freon, chloroform, butane, carbon dioxide
- Molar volume of a gas, per cent potassium chlorate in a mixture
- Equivalent weight of a metal, Mn, Mg, Al, Zn
- Ionic and covalent compounds; conductivity, fractional crystallization of potassium nitrate from crude sodium nitrate and potassium chloride
- Oxidation and reduction
- Electrochemical cells and electrolysis

A hurdle exam is used for simple valences. The students either pass this exam with 100 per cent accuracy or receive a failing grade. A number of problem batteries are used in the course for quizzes and evaluation purposes. An examination is given to specifically cover the laboratory exercises. Laboratory reports must be approved, compiled, and submitted at the end of the quarter.

Students have withdrawal privileges until the final two weeks of the quarter, and 50 to 60 per cent of the students complete the course with passing grades.

The second course in the sequence for science and engineering majors is Chem 155. This consists of three hours of lecture, four laboratory hours, and five quarter-credits. The general outline of this course is as follows:

Topics	Laboratory Experiments
Equilibria	Acids, bases, neutralization
Dilute ionic solutions	Equivalent weight of a solid acid
Ksp	Reversible actions, equilibrium
Coordination compounds	Weak acids and bases, indicators, pH meter
Halgens and oxides	Ka, pH meter
Sulphur and oxides	Hydrolysis
Nitrogen and compounds	Carbonic acid
Phosphorus and compounds	Complexes
Carbon	Ksp
Nuclear chemistry	Chlorine and compounds
	Chromium and manganese
	Titration to determine the equivalent weight of an unknown reducing agent with potassium permanganate

The American Chemical Society standardized examination is used for the final in this course. Approximately 90 per cent of the students receive passing grades.

The third course in the sequence for science and engineering majors is Chem 160. This consists of three hours of lecture, no laboratory, and three quarter-credits. The topics in this course are as follows:

Colloids
Crystals, metals, alloys, phase diagrams, models
Boron and silicon and compounds
Traditional metals of qualitative analysis
Other metals
Elementary thermodynamics

This course makes use of the films available from International Nickel Company, which emphasize corrosion, mining of nickel, milling and smelting, the Sudbury ores, refining nickel and refining precious metals. Handouts are used for the thermodynamics. These are Macwood and Verhoek, "How Can You Tell Whether a Reaction Will Occur?", _The Journal of Chemical Education_, 1961, p. 334; and Sanderson, "_Principles of Chemical Reaction_," _Journal of Chemical Education_, 1964, p. 13.

Approximately 90 per cent of the students complete this course with a passing grade.

A fourth course is available for students. This is Chem 170, Qualitative Analysis, which consists of one hour of lecture and six hours of laboratory work for three quarter-credits. No specific textbook is used; but this is a rather traditional qualitative analysis course using both H_2S and thioacetamide. Bismuth, cadmium, arsenic, antimony, cobalt, nickel, and strontium are omitted from the scheme for the first two general unknowns. Students incorporate these elements into the scheme for the last two unknowns. An exotic unknown is included to encourage use of library materials. This unknown consists of one element of the classical 24, and one other, such as tantalum, lithium, titanium, platinum, gold, or zirconium.

An American Chemical Society examination is used as the final for this course.

GENERAL CHEMISTRY FOR SCIENCE AND ENGINEERING MAJORS

IN THE UNIVERSITIES

Summary of Remarks by H. H. Batey, Washington State University

Washington State University has revised its general chemistry offerings in the past year. The following discussion emphasizes the revised program.

The first course for chemistry majors is Chemistry 111 and 112. This course is given five semester hours of credit for three lecture hours, four laboratory hours, and two tutorial sessions. It requires one year of successful high school chemistry and a mathematics preparation allowing students to enroll immediately in analytical geometry and calculus. This course is supposed to take the students through traditional quantitative analysis in ten semester hours.

There is a general chemistry course, Chemistry 105 and 106 that is given for four semester hours credit and is composed of two lecture hours, five laboratory hours, and one tutorial. Prerequisites for this course are high school chemistry and a readiness to pursue college mathematics, which means a mathematics course of college algebra, trigonometry, and some analytic geometry.

The general chemistry courses, Chemistry 103 and 104, are designed for all of the engineering students except the chemical engineers. The engineering college refused to go along with the four-hour course in chemistry. The chemical engineers take Chemistry 105.

Chemistry 101 and 102 is an introductory course requiring no high school chemistry or mathematics. It is basically a provisional course. It may take some revising if this is to become the course that would contain enough organic and biochemistry for nurses and medical technicians. It is possible that students taking the Chemistry 101, 102 sequence can arrive at the level of students taking the Chemistry 105, 106 sequence if they use an additional two hours per week for problem work.

One of the present problems is that it is difficult to determine how many students are in what courses. In planning for the fall of 1966 it was anticipated that there would be 300 students in Chemistry 101, 450 students in Chemistry 105, and 24 students in Chemistry 111. Chemistry 105 began with 320 students, according to the computer registration statistics. By the time permanent class rolls were produced, the enrollment was down to 210. Many of the students participated in a transfer from Chemistry 105 to Chemistry 101. The course following Chemistry 105, which is Chemistry 106, enrolled 127 students. This gives some indication of the attrition between the beginning of Chemistry 105 and the beginning of Chemistry 106.

One of the major problems in the courses other than Chemistry 101 is the reduction of student qualms about being able to handle the more advanced chemistry. The only solution for this morale problem is patience. A major problem with the course given to the engineering students is that there is simply not enough time for what needs to be done and students finish the course virtually exhausted.

In an attempt to evaluate student reaction to certain items in the course, a questionnaire was distributed with the final examination. Students were able to indicate whether they disliked or liked a given item by having a rating scale from 1 to 5. It was found that students did not detest thermodynamics and kinetics. A surprising feature was that qualitative analysis received the highest grade, which indicates that students still like to work with their hands.

Chemistry 105 and 106 were upgraded as much as possible in the laboratory area. Everything possible was made instrumental. There was an expenditure of $43,000 on the 300 students that started this course. The equipment did permit an increase in the reliability of data obtained, but the confusion and logistics problems presented in this laboratory program will cause it to be revised.

There seem to be two major problem areas. One deals with people; the other, with the descriptive chemistry. There is simply insufficient time to put in the desired descriptive chemistry. The number and quality of teaching assistants are insufficient. Typical of some of the new graduate students was one teaching assistant who had over half of the students in his section two-thirds of the way through their laboratory experiments before telling them that pH meters would work better if the covers were removed from the glass electrodes.

GENERAL CHEMISTRY FOR SCIENCE AND ENGINEERING MAJORS IN THE UNIVERSITIES

Summary of the Remarks by Donald F. Swinehart

Since World War II, general chemistry has changed rather slowly. Things really started happening in 1957. The launching of Sputnik was the best thing that ever happened to chemistry in this country although it is not usually looked at from that point of view. High schools started teaching chemistry at this point, and this forced colleges to teach it. The University of Oregon has been experimenting with general chemistry courses for a period of years.

The University of Oregon has three levels of freshman chemistry. The lowest level is called elementary chemistry, and this is populated almost entirely by nurses and physical education majors. The physical education majors have to take chemistry because they have to take physiology, and they are required to take chemistry before taking physiology. This course is approximately one-third organic chemistry and biochemistry and uses traditional laboratory experiments.

The central chemistry course has an enrollment of 400 or more students. Admission to this course is controlled to some degree. About 10 per cent of the students enrolled in the central chemistry course are placed in an honors section. These students have a much better mathematical background than the other students. Calculus has not yet been established as a prerequisite for this course but is expected to be in the very near future.

In the reorganization of the classical laboratories, many were elimintated. At the present time, there is a one-term course in quantitative analysis that is populated almost entirely by premedical and predental students. Otherwise, all of the traditional analytical chemistry is in the freshman laboratory.

There is no direct connection between the lecture program and the laboratory program in the freshman courses. The laboratory consists largely of analytical chemistry and was not intended to be easily connected to the lecture portion of the course.

In the qualitative analysis section of the laboratory program, students do ten special unknowns and two or three general unknowns in addition to all of the preliminaries in ten weeks.

The laboratory is scheduled for two afternoons per week, and students are not permitted in the laboratory except during the scheduled periods. This is to prevent one group of students spending extra time in the laboratory because they want to do so and thus forcing the remainder of the students to do the same thing in self-defense.

The qualitative analysis laboratory program is then followed by two terms of traditional quantitative analysis. At the present time, there is not much instrumentation used in the freshman program. Until the students have had a college physics course, they should mot be exposed to a large quantity of instrumental work.

CHEMISTRY FOR THE NON-SCIENCE MAJORS

Presented by

Joseph Nordmann, Los Angeles VAlley College

[The content of the college chemistry course for non-science majors has been receiving increasing attention in recent years. In many colleges this course affects a larger number of students than any other chemistry course. These students include the non-science liberal arts students, non-chemical technicians and nurses, and related majors.

Mr. Joseph Nordmann of Los Angeles Valley College has developed a laboratory program for this course that uses an approach considerably different from most of today's chemistry laboratory programs. The Two-Year College Chemistry Conference was very fortunate in being able to have Mr. Nordmann serve as chairman of the Chemistry for Non-Science Majors Section at each of the three conferences. A summary of Mr. Nordmann's remarks follows. Ed.]

Laboratory experiments developed at Los Angeles Valley College for use in pre-general chemistry courses were described. The feature of these experiments is the employment of "real" samples (foods, alloys, electroplating solutions, tap water, polymers, emulsions, etc.) and provision for "engineering" and "biochemical" options within each exercise. Seventeen experiments were listed as follows:

1. Measurements, Graphs and Errors
2. One-pan and Two-pan Analytical Balances
3. Using the Library
4. Quality Control of Isopropyl Alcohol by Physical Tests
5. Gravimetric Analyses
6. Qualitative Analysis of Salts by Classical Reactions
7. Qualitative Analysis of Metals by the Electrographic Technique and the Action of Acids.
8. Analysis of Baking Powder by a Gasometric Technique
9. Colorimetric Analyses
10. Acid-Base Titrations
11. pH by Buffers and the Glass Electrode
12. Precipitation Titrations with Silver
13. Complexometric Titrations with EDTA
14. Redox Titrations with Iodine
15. Electroplating and Electrogravimetry
16. Organic Chemistry: Polymerization and Evaluation of Polymers
17. Organic and Colloid Chemistry: Practical Emulsions

Experimental organization is as follows [with Mr. Nordmann's comments in parentheses]:

1. Introduction (longer than usual because non-textbook material is needed)
2. Demonstrations (lab instructor introduces techniques needed and shows related equipment he may have available)
3. Experimental (detailed to obviate students' mistakes and save time)
   a. Engineering options
   b. Biochemical options
4. Research Applications (for better students; briefer directions)
   a. Engineering options
   b. Biochemical options
5. Study Supplement (additional non-textbook summaries as needed, that broaden the understanding)
6. Sample Calculations (50 total in the 17 experiments)
7. Vocabulary (330 total words)
8. Practical Problems (150 total)

When the experiments are sequentially assembled, items 1-5 inclusive constitute a laboratory manual, and items 6-8 become an accompanying problems booklet. High school algebra is the only required mathematical preparation. Slide rule, factor-unit method and the mole concept are developed.

The general philosophy of these materials is to interest the non-science student in science by presenting a practical problem, explaining how the chemist looks at and solves this problem, then solving it in the laboratory and looking at the underlying principles that we agree, as chemistry instructors, are important. This is the opposite order from some other presentations, but a normal one in relation to the way the brain develops information. (Chemistry did not begin from theoretical considerations of first principles.)

A typical experiment is given in its entirety below (copyright by the author and Harper & Row, Publishers, Inc., 49 E. 33rd Street, New York, N. Y. 10016, and reprinted by their permission).

Experiment 13[1]

Redox Titrations with Iodine: Vitamin C in Juices; Antimony in Stibnite Ore

Introduction

Redox is a contraction of the words reduction and oxidation. In this experiment iodine will be used as a titrant and oxidizing agent (it gains electrons), and vitamin C and antimony (III) will be titrands and reducing agents (they lose electrons). An iodimetric determination is an analysis in which iodine is used quantitatively as an oxidizer. Iodine is a most useful substance in a variety of laboratory procedures and the applications here illustrate only two of many.

Since iodine is only slightly soluble in water, aqueous solutions of it are prepared with potassium iodide. These contain triiodide ion, $I^- + I_2 = I_3$ but are still called iodine solutions for convenience. Calculations are made from the weight or millimoles of I_2 involved.

One advantage of iodine as a titrant is its moderate oxidizing power which allows selective oxidations that are not possible with strong oxidizers such as potassium dichromate and potassium permanganate. One disadvantage of iodine as a titrant is the relative instability of its standard solutions. These should be stored in the dark in all-glass containers and the molarity checked once a week.

The indicator for iodine titrations is a colloidal suspension of soluble starch. It is colorless until a slight excess of iodine is present, whereupon a dark blue starch-iodine complex forms, marking the titration end point. To prevent bacteria from destroying the starch mixture, boric acid is added in its preparation.

The first part of this experiment concerns vitamin analysis. Vitamin C, or ascorbic acid, was the first vitamin to be isolated in pure form, being obtained from lemons in 1932. It is also found in other citrus fruits, tomatoes, apples, carrots, and leafy vegetables. Commercial production in the U. S., which presently is about 7 million pounds a year, is used partly to fortify or reconstitute foods such as concentrated juices during whose processing natural vitamin C is lost. Vitamin C is not stored appreciably in the human body, yet it is needed regularly to prevent an illness called scurvy, whose symptoms include sore and bleeding gums. It aids cellular adhesion in body tissue and assists in bone structure calcification. Normal adult need is about 100 mg daily.

Vitamin C (MW 176.1) is a white, odorless, slightly sour-tasting, water-soluble crystalline solid that is readily converted in solution by iodine and other mild oxidizers to dehydroascorbic acid hydrate. [For equation, see page 36. Ed.]

To prevent loss of the vitamin due to air oxidation and to minimize the use of iodine by other, slowly oxidizable substances in the samples, this analysis must be run rapidly. Because of several uncertainties, the method yields only approximately quantitative results and slide rule calculations are sufficient. In the titration reaction on I_2 reacts with one vitamin C molecule. For every millimole of iodine consumed, one millimole of vitamin C in the sample is oxidized.

Part B of the experiment concerns the analysis of stibnite, a familiar antimony mineral. The important mineral deposits in this country are in California and

[1]Joseph Nordmann, What Chemists Do, copyright © 1967 by the author.

Nevada. Stibnite is soft, dark gray in color, has a specific gravity of about 4.6 and normally is a mixture of antimonous sulfide, Sb_2S_3, and silica, although iron and arsenic are often present in small amounts. Antimony metal is obtained from this sulfide ore by roasting it in air to Sb_4O_6 and reducing with carbon. The pure metal melts at 630° C. Its alloys with lead, tin, and other soft, low-melting metals are used in bearings, type metal and battery plate.

Analysis of stibnite is begun by heating weighed samples with hydrochloric acid to which potassium chloride has been added. KCl prevents volatile $SbCl_3$ from escaping by promoting formation of the nonvolatile tetrachloro ion, $SbCl_4^-$. After hydrogen sulfide has been driven off, tartaric acid is added to convert the chloride complex to an even more stable tartrate complex. The solution is then neutralized and the acidity regulated by addition of sodium bicarbonate. Antimony (III) is then titrated to antimony(V) with standard iodine solution, using starch as the indicator. The reactions are:

$$Sb_2S_3 + 6HCl + 2KCl = 2K[SbCl_4] + \overline{3H_2S}$$

$$2K[SbCl_4] + 2H_2C_4H_4O_6 + H_2O = 2H(SbO)C_4H_4O_6 + 2KCl + 6HCl$$

$$2H(SbO)C_4H_4O_6 + 2I_2 + 2H_2O = 2H(SbO_2)C_4H_4O_6 + 4HI$$

Since these equations are mutually balanced, we see one Sb_2S_3 molecule ultimately requires two I_2 molecules, or one I_2 molecule is equivalent to one Sb atom during titration. For every millimole of iodine consumed, one millimole of antimony is thus oxidized in the sample. The calculation of % Sb is based on that.

Demonstrations

The instructor will show how to:

1. Titrate a solution of sodium arsenite with 0.1 M iodine, using starch indicator. The solutions for demonstration may be prepared as follows:

   Sodium aresenite. Dissolve about 200 mg of As_2O_3 in 2 ml of 50% NaOH, dilute to 50, neutralize with 6 M HCl using methyl orange, add 0.5 g of $NaHCO_3$ and dilute to 100 ml. Use the entire solution for one titration.

   Starch. Stir 1 g of soluble starch with 3 ml of water and pour the slurry with stirring into 100 ml of boiling water in which 1 g of boric acid is dissolved. Add 3 ml to the arsenite solution at the beginning of the titration.

   0.05 M iodine. On the analytical balance weigh to the nearest mg a small, glass-stoppered flask containing 12 g of iodate-free KI dissolved in 10 ml of water. Add 6.5 g of resublimed I_2, weighed previously in a small, dry stoppered vial on the triple beam balance. Reweigh to the nearest mg. Calculate the iodine molarity from the difference, based on dilution to 500 ml. Transfer the solution quantitatively to a 500 ml volumetric flask, mix well and dilute to the mark. Rinse and fill a 50 ml buret with this and titrate the arsenite-starch mixture. The reactions are:

$$As_2O_3 + 2NaOH + H_2O = 2Na(H_2AsO_3)$$

$$2Na(H_2AsO_3) + 2I_2 + 2H_2O = 2Na(H_2AsO_4) + 4HI$$

These mutually balanced equations show that each As atom requires one I_2 molecule. Thus for each millimole of iodine solution delivered from the buret, one millimole of arsenic in the sample is oxidized from As(III) to As(V).

2. Calculate the mg of arsenic in the sample.

3. Use a sodium thiosulfate solution which will be available to wash spilled iodine from the skin.

Experimentation

(Students may be asked to work as partners.)

A. Vitamin C in Juices. Prepare the data table in your notebook and leave the remainder of the page for calculations.

		Sample 1	2	3	4
1.	Final vol. of juice				
2.	Initial vol. of juice				
3.	Ml of juice				
4.	Final vol. of iodine				
5.	Initial vol. of iodine				
6.	Ml of iodine (______ molar) (Given)				
7.	Mmole of I_2 (= mmole of vitamin C)				
8.	Mg of vitamin C				
9.	Mg of vit. C per ml of juice				
10.	Mg of vit. C per L of juice				
11.	Aver. mg of vit. C per L of juice				
12.	Aver. ml of juice needed to yield 100 mg of vit. C				

The instructor will designate the canned juices to be used--lime, lemon, orange, grapefruit, tomato.

From the stockroom get two 50 ml burets and a double clamp.

On the side shelf is an approximately 0.005 M iodine solution which contains 1.3 g of I_2 and 16 g of KI per L. Copy the molarity given on the label into item 6 of the table. Using a small, clean, dry beaker transfer about 60 ml to your bench. Rinse a glass-stoppered buret with a little, then fill the buret.

In a graduated cylinder obtain about 20 ml of starch suspension.

In a beaker put about 10 ml of 6 M acetic acid. Stand a dropper in the beaker and cover with a watch glass.

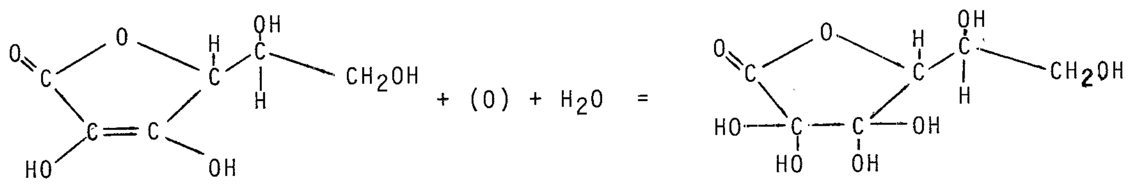
Read the label on the can of juice assigned you. Copy from it all the data you think an analyst needs. Using a small, clean, dry beaker transfer about 60 ml of juice to your bench. Rinse a buret with a little, then fill the buret, working rapidly to minimize contact of the juice with the air.

Put 25 ml of distilled water in a clean 125 ml flask. Add a dropperful of 6 M acetic acid (2 ml). Add about 5 ml of juice, reading and recording the juice buret volume before and after to 0.1 ml. Add 3-4 ml of starch. Read and record the iodine buret volume, then titrate with the iodine rapidly to a blue-purple color that persists at least 20 sec. (Caution: Although the iodine solution is quite dilute, only a few ml may be needed. This first titration is to be treated as a practice to give you a look at the end point and the approximate volume requirement of iodine.)

Wash the flask and repeat the procedure carefully with about 10 ml of juice per run. The volume taken must be known to 0.1 ml but need not be the same each time.

When you have three satisfactory runs, clean up your equipment and compute slide rule values for the remainder of the data table. Average the results that check best with each other. See the worked examples given later in the experiment for (millimole) calculation methods. Show calculations beneath your data table.

Mild Oxidation of Vitamin C to Dehydroascorbic Acid Hydrate



B. Antimony in Stibnite Ore. Prepare the data table in your notebook and leave the remainder of the page for calculations.

	B. Antimony in Stibnite Ore.	Sample No.		
		Sample 1	2	3
13.	Initial wt. of vial + ore			
14.	Final wt. of vial + ore			
15.	G of ore			
16.	Final vol. of iodine			
17.	Initial vol. of iodine			
18.	Ml of iodine (______ molar)			
19.	Mmole of I_2 (= mmole of Sb)			
20.	Mg of Sb			
21.	G of Sb			
22.	% Sb in the ore			
23.	Aver. % Sb in the ore			

Obtain a sample of powdered stibnite ore in a vial. The sample will be free of interferences such as iron. Record the number. The instructor will tell you whether or not it should be dried 1 hr at 105° in the oven, and what weight samples should be taken. (Use 1 g if about 20% Sb is present.) Number three 500 ml flasks. Take them and the vial to the balance room. Accurately weigh vial and contents. Roll an estimated 1 g (see above) of sample into flask 1 and reweigh vial and contents. Repeat to obtain two more samples of about 1 g each, weighed to 0.1 mg.

At the hood add 0.3 of KCl to each flask, then 10 ml of 12 M HCl and heat on a hot plate or gently over a burner. Swirl occasionally. Do not boil. When the samples are dissolved (harmless, white silica may remain), add 20 ml of water, heat, then slowly add 70 ml more of water. Discontinue any sample at this point in which a white precipitate of hydrolyzed antimony salts appears.

Add 2 drops of methyl orange to each flask.

Still at the hood add 15 ml of 6 M NaOH slowly and carefully to each flask, then using droppers in small beakers of HCl and NaOH carefully adjust the pH of the solutions until the indicator just turns red.

To each flask slowly add 3 g of sodium bicarbonate with swirling. If fizzing seems to continue after all bicarbonate is added, add another g of bicarbonate. To each add 3 ml of starch.

Fill a glass-stoppered buret with 0.05 M iodine solution from the side shelf. Note and record the molarity in table item 18. Titrate with the iodine to a dark blue-purple end point that endures at least 20 sec.

Calculate the % Sb (AW 121.8) in the samples using the sample weights, iodine volume and its known molarity, and average the best results. These data are capable of good reproducibility and four significant figures are justified. (For the antimony-iodine relationship see the equations in the introduction.) Show calculations in the space below your data table.

Research Projects

1. Biochemical Applications

a. Analysis of Vitamin C Tablets. Obtain a bottle of vitamin C tablets from the drugstore. Weigh and dissolve several tablets in water and make up to volume in a 250 ml volumetric flask. Using proper size aliquots of this plus starch, water, acetic acid and standard iodine as described in part A of the experiment, run a series of titrations. From the data calculate the average mg weight of vitamin C per tablet. How does your answer compare with the manufacturer's label? What main substance is compounded with the vitamin in the tablets? What is its formula? What is its commercial source? Is vitamin C commercially isolated from citrus juice or is it synthesized? Cite the references you consult.

b. Analysis of Fresh Fruit for Vitamin C. On a trip scale weigh two lemons or a large orange or a grapefruit. Working rapidly, squeeze as much juice as you can from the fruit. Filter it through several layers of cheesecloth, then centrifuge it if a centrifuge is available. As described in part A of the experiment, titrate clear juice samples with 0.005 M iodine. Calculate the mg of vitamin C per g of fruit.

We have discussed vitamin C without defining what a vitamin is. Find several definitions in the library and combine them into one of your own. Cite the references.

British sailors were called "limeys" because they used limes (actually bitter lemons) to prevent scurvy in the early days of sailing. Find a medical description of scurvy and summarize it. Cite your references.

c. Analysis of Fruit Drinks for Vitamin C. Obtain from the grocery store a bottle of noncarbonated orange or other fruit drink, or a powdered mixture for preparing the same. Measure the bottle volume or weigh the total powder sample. Analyze these. For liquids use 25 ml samples in each titration and no additional water. Express the vitamin C content first as mg/L for the liquids and mg/g for the powders, then as mg/bottle and mg/package.

d. Analysis of Cold Waving Solutions for Reductants. Obtain a bottle of solution for the cold waving of hair. Such preparations are generally aqueous mixtures containing one or more of the organic sulfur compounds whose names and formulas are shown below. They also may contain the inorganic sulfur compounds sodium sulfite and/or sodium thiosulfate, plus ammonia and/or its organic derivatives for adjusting the pH to about 9. Small amount of resins or emulsified fats may be present as opacifiers.

$HS\text{-}CH_2\text{-}CO_2H$	$HS\text{-}CH_2\text{-}CH_2\text{-}OH$	$HS\text{-}CH_2\text{-}CH(OH)\text{-}CH_2OH$
thioglycolic acid	2-mercaptoethanol	thioglycerol
MWs: 92.1	78.1	108

The sulfur compounds are all reducing agents, and in titrations the HS- groups are uniformly oxidized by iodine.

Pipet 10 ml of cold wave solution into a 100 ml volumetric flask, dilute to the mark with distilled water and shake well. Put this solution in one buret, 0.05 M iodine in another.

Run about 20 ml of sample solution into a 250 ml flask. Add 50 ml of water, 2 drops of methyl orange, then dropwise 3 M HCl until the indicator just turns red. Add 3 ml of starch indicator and titrate with iodine. Repeat several times to get checking results.

You have titrated total reducing agents. Since thioglycolic acid is usually the main active ingredient, however, express the solution's reducing power as a wt/vol. per cent thioglycolic acid. Remember in this calculation the dilution you made of the sample before filling the buret. The redox reaction produces dithiodiglycolic acid:

$$2HSCH_2CO_2H + I_2 = (SCH_2CO_2H)_2 + 2HI$$

In the library try to find how and why thioglycolic acid softens hair. (A related process is complete removal of hair from hides with more powerful sulfides, in one step of making leather.) Cite your references.

Two sulfur-containing amino acids found in hair are cystine and cysteine. Find and copy formulas for them. How do you think the former could be prepared from the latter? Cite the references.

Sample Calculations Related to Experiment 13

Example 1. (Molarity of Iodine)

A chemist prepares a liter of solution for titrations to contain 5.08 g of I_2 and 20 g of KI. What is the molarity as an oxidizer?

Solution. The oxidizer is I_2 and the calculation is based on it; KI is inert in this application and present merely to solubilize I_2 as KI_3.

The MW of I_2 is twice the AW, (2)(127) = 254. Thus one g-mole of iodine weighs 254 g. This leads to a factor-unit solution for moles:

$$? \text{ g-mole of } I_2 = 5.08 \text{ g} \left(\frac{1 \text{ mole}}{254 \text{ g}}\right) = 0.0200 \text{ mole}$$

The molarity of a solution may be defined as the number of moles of solute in 1 L of it. Since in this solution 0.0200 mole of iodine are dissolved in 1 L, the iodine molarity is 0.0200. This is also the molarity as an oxidizer.

Example 2. (Titration with I_2)

A certain poison for snails contains calcium arsenate, metaldehyde (an attractant) and inert ingredients. After proper preparation to dissolve a 1.50 g sample and convert arsenic to the As(III) state, it takes 20.0 ml of the iodine solution of Example 1 to oxidize the arsenic to As(V) and reach the starch end point. What is the % As in the sample?

Solution. Knowing the concentration and volume of titrant we can find the millimoles of iodine: MMole I_2 = (20.0 ml)(0.0200 M) = 0.400 mmole. This is also the number of millimoles of arsenic present since one I_2 molecule reacts with one As atom (see equations in the section titled Demonstrations). The AW of arsenic is 74.9. Thus 74.9 mg is 1 mmole, and by factor-unit conversion we get the weight of As in the sample:

$$? \text{ mg of As} = 0.400 \text{ mmole} \left(\frac{74.9 \text{ mg}}{1 \text{ mmole}}\right) = 30.0 \text{ mg}$$

The sample weighed 1.50 g or 1500 mg. The % As therefore is

$$\% \text{ As} = \frac{30.0 \text{ mg}}{1500 \text{ mg}} (100\%) = 2.00\%$$

The Vocabulary of Experiment 13

1. Ascorbic acid
2. Attractant
3. Citrus
4. Cold wave
5. Dehydroascorbic acid
6. Iodimetry, iodimetric titration
7. Opacifier
8. Organic sulfur
9. Redox
10. Resublimed
11. Roasting
12. Starch end point
13. Stibnite
14. Thioglycolic acid
15. Vitamin C

Practical Problems Related to Experiment 13

1. 500 ml of oxidizing solution are prepared containing 3.60 g of iodine and 25 g of potassium iodide. Find: (a) Moles of iodine per L. (b) Mmoles of iodine per ml. (c) Iodine molarity.

2. A chemist wants to prepare 5.00 L of 0.0100 M iodine. How many g of I_2 should he use?

3. 40.0 ml of a certain iodine solution are needed to titrate 25.0 mg of pure vitamin C, using starch indicator. (a) How many mmole of vitamin C are in 25.0 mg? (b) What is the molarity of the iodine solution? (c) How many g of iodine are in 1 L of the titrant?

4. 35.5 ml of 0.125 M iodine are needed to oxidize the Sb(III) in 3.00 g of dissolved Sb ore to Sb(V). (a) How many mmole of iodine are used? (b) How many mmole of Sb are in the sample? (c) What is the % Sb in the ore?

5. Sulfur-utilizing bacteria in municipal water supplies are capable of reducing sulfate to hydrogen sulfide, thus giving the water an objectionable rotten egg odor. Hydrogen sulfide may be analyzed by iodine titration:

$$H_2S + I_2 = \underline{S} + 2HI$$

If the hydrogen sulfide in 500 ml of water sample requires 1.6 ml of 0.0022 M iodine to titrate to the starch end point, how many mg of H_2S are present in 1 L of the water?

6. Certain foods such as sliced potatoes may be preserved free of blemishes for short periods of time by the addition of sodium sulfite. Sodium sulfite may be analyzed by iodine titration:

$$Na_2SO_3 + H_2O + I_2 = Na_2SO_4 + 2HI$$

20.0 ml of sodium sulfite preservative solution require 30.0 ml of 0.310 M iodine to titrate to the starch end point. How many g of sodium sulfite are in 1 L of preservative?

7. A tin-containing alloy weighing 700 mg is treated to dissolve it and convert the tin to the bivalent state. The stannous tin then requires 23.7 ml of 0.116 M iodine to titrate it to the tetravalent state:

$$Sn(II) + I_2 = Sn(IV) + 2I^-$$

(a) How many mmole of I_2 are used? (b) How many mg of Sn are present? (c) What is the % Sn in the alloy?

8. Tartar emetic, $K(SbO)C_4H_4O_6 \cdot 1/2\ H_2O$ is a poisonous salt with a sweetish, metallic taste that has found limited use in medicine. A certain preparation is labeled "5% tartar emetic." If 100 mg are dissolved and titrated with 0.100 M iodine, how many ml of titrant will be required to reach the starch end point?

Reaction to the Los Angeles Valley College Laboratory Program for Non-Science Majors.

First Midwestern Regional Conference:

Warren Kitzman, Kansas City, Kansas, Community Junior College
Delwin Johnson, Forest Park Community College
Kenneth Chapman, Temple University Technical Institute

Seventh Annual Conference:

Douglas Bauer, Mohalk Valley Community College
Samuel F. Eff, Central Florida Junior College
George Culp, Miami Dade Junior College

Second Western Regional Conference

Celia Mae Scott, Shoreline Community College
Lars Svanevik, Oregon Technical Institute
M. Ronald Johns, Spokane Community College

The following summary represents remarks made at the three conferences:

1. The laboratory program suggested should be easily adapted and be most beneficial for chemistry courses given to students in technology courses other than chemical technology. In addition, several of the experiments would be particularly useful in chemical technology programs.

2. No experiments in the thermochemistry area appear in the outlined program. It was felt that such an experiment could prove very useful in this program to emphasize the importance of thermodynamic considerations in chemical reactions.

3. It was generally accepted that the concept of practical experiments used in this program would be most beneficial for the stimulating of non-science students.

4. Several evaluators were extremely impressed by the method of presenting problems and developing theory around these problems.

5. There was concern about the matter that three hours of laboratory time per week might be inadequate. It was suggested that adequate laboratory time be provided to permit completing experiments, and care should be exercised to avoid making a given experiment take too much time.

6. Library facilities in many small or new schools will likely be inadequate to accommodate the expected work.

7. Some of the work required by this program indicates the need for rather sensitive equipment. There was concern that many schools would have inadequate equipment for all of the work. However, most schools should have sufficient equipment to allow performance of most of the experiments.

8. The poor mathematics background of most non-science majors may prove a strong deterrent to development of the concept of pH.

9. There was concern that students in nursing might not be sufficiently qualified to respond well to this program. It was suggested that nursing students be given additional practice in converting from mole to percentage compositions.

SECOND YEAR CHEMISTRY COURSES SECTION

SECOND WESTERN REGIONAL MEETING

Chairman: Edward C. Fohn, Green River Community College

The following are summaries of brief presentations describing chemistry course offerings in the second year at four colleges.

Central Oregon College--D. Eugene Marcy

Second-year chemistry courses in Oregon two-year colleges are limited to service courses. Equipment requirements limit the effectiveness of a modern course in organic chemistry.

Olympic College--John Mandak

A two-quarter sequence in organic chemistry is offered, thereby allowing for a one-quarter quantitative analysis course in the spring term.

University of Washington--W. S. Chilton

The University of Washington offers three organic sequences:

102--one quarter (nursing, home economics)
200--three quarters (service course)
300--three quarters (science major)

Those enrolled fall into the following classifications:

	Percentage Enrolled				
Sequence	Freshman	Sophomore	Junior	Senior	Graduate
200	20	45	21	8	6
300	1	57	26	11	5

Designated majors of students enrolled are as follows:

Course	Percentage Enrolled 200	Percentage Enrolled 300
Chem	3	29
Chem Eng	1	18
Pre Med	4	20
Zool	12	16
Pre Dent	26	1
Med Tech	22	--
Misc.	32	7

Oregon State University--Max Williams

The Oregon State University courses parallel the University of Washington 200- and 300-level sequences. The laboratory for the 300-level sequence, however, lags the lecture section by one quarter, finishing in the fall term of the junior year.

Summary Remarks and Comments

1. Service courses can be transferred to all four-year schools with no apparent difficulty.

2. The University of Washington will accept a 300-level equivalent sequence from a two-year college if the student has a B grade or better. With a C grade the student is generally requested to repeat the first quarter of the 300-level sequence at the university.

3. Oregon State two-year colleges are not encouraged to teach the science major sequence, and problems of transferability do exist.

4. The difference in philosophy between the Washington and Oregon schools seems to be a consequence of greater enrollment pressures in Washington State schools.

5. Two-year colleges were in agreement that a strong second-year program is essential (a) to attract competent students, (b) to provide a subject matter balance in the chemistry faculty, and (c) to keep competent faculty.

6. Approximately one-third of the Washington State two-year colleges presently have no second-year program in chemistry.

REPORT OF CHEMICAL TECHNOLOGY SECTION MEETING

Prepared by

Chairman, Arden Pratt, Bureau of Two-Year College Programs
New York State Education Department

The meeting was attended by twenty-seven individuals representing two-year colleges in fourteen states. Most of the meeting centered on a discussion of the report of the *ad hoc* Chemical Technician Curriculum Committee. This committee was appointed during the summer of 1966 by the ACS Board of Directors to develop curriculum guidelines for training chemical technicians. The chairman of the committee is Dr. Carleton W. Roberts of The Dow Chemical Company, Midland, Michigan. Other members of the committee are: Kenneth Chapman, former chairman of Chemical Engineering Technology at Temple University Technical Institute, Philadelphia, Pennsylvania, and now assistant educational secretary, Two-Year Colleges, for ACS; Dr. Fred Dietz, chairman of Chemical Technology at Merritt College in Oakland, California; Dr. William Eberhardt of Georgia Institute of Technology in Atlanta and recently on leave as the executive director, Advisory Council for College Chemistry; Henry J. Mealey of Socony Mobil Oil's Research and Development Laboratories in Paulsboro, New Jersey; Arden Pratt, chief of the Bureau of Two-Year College Program of the State Education Department, Albany, New York; Dr. Charles N. Reilley, University of North Carolina's Chemistry Department in Chapel Hill; and Dr. Arnold N. Sookne, Harris Research Laboratories, Washington, D.C. The ACS staff liaison to the committee is Robert L. Silber, director, Membership Activities Division.

The committee completed a session on April 7 at which it suggested specific recommendations to implement the recommendations on curriculum. Since the committee's report and recommendations had not been officially presented to the Board Committee on Education and Students at the time of this meeting, copies were not presented in the section meeting. However, a topical outline of the core curriculum was displayed to the group on the blackboard and discussion ensued.

The outline presented was:
1. Basic Concepts
    a. The essential notions of atoms and molecules
    b. The mole concept and stoichiometry

2. Descriptive Chemistry
   a. The chemistry of carbon and its compounds, "organic chemistry"
      (1) Basic principles and concepts
      (2) Chemistry of functional groups
      (3) Structure and stereochemistry
      (4) Natural products
      (5) Natural and synthetic polymers
   b. The chemistry of other important elements, "inorganic chemistry"
      (1) Some of the important non-metals
      (2) Some of the metals
      (3) Some of the metaloids
   c. Broad classification of substances in terms of reactions
      (1) Acids and bases in the most general sense
      (2) Coordination complexes
      (3) Nonaqueous solutions and reactions
      (4) Organic functional group analysis
3. Physicochemical principles, particularly those in analytical methods
   a. Equilibria in solution and between phases
      (1) Acid-base equilibria
      (2) Phase equilibria, solubility, and mass action
      (3) Titrations in nonaqueous systems
   b. Electrochemistry
      (1) Electrolysis and conductivity of solutions; relation to chemical reactions
      (2) Static electrochemical measurements
      (3) Dynamic electrochemical measurements
   c. Energetics in chemical reactions
      (1) Energy changes--calorimetry
      (2) Thermochemistry
   d. Kinetics--dynamics
      (1) Quantitative description of the rate at which reactions occur
      (2) The relation between "mechanisms" and over-all stoichiometry
   e. Atomic and molecular energy levels and spectra
4. Nuclear and Radiochemistry
   a. Nature of readioactive decay, rate laws, half-life, and energies
5. Instrumentation
   a. ELectronics--introductory
6. Separation
   a. Separation and purification
      (1) Melting-freezing methods (liquid-solid partitioning)
      (2) Distillation methods (liquid-vapor partitioning)
      (3) Extraction (liquid-liquid partitioning)
      (4) Chromatography
7. Characterization
   a. Electromagnetic radiation and its interaction with matter
      (1) Nature of electromagnetic radiation
      (2) Interaction of electromagnetic radiation with matter
      (3) Absorption, emission, stimulated emission, and fluorescence
      (4) Refraction and refractive index
      (5) Rotation of plane polarized light
   b. Quantitative analysis by absorption of electromagnetic radiation
   c. Applications of U.V. visible, and infrared spectrophotometry to molecular systems
   d. Applications of emission and absorption to atomic systems
   e. Nuclear magnetic resonance
   f. Electron spin resonance
   g. Mass spectrometry
   h. X-ray emission, absorption, and diffraction
8. Laboratory presentation and testing of data
   a. Elementary statistical tests for significance, accuracy, and reliability
   b. Presentation of data in tabular and graphical forms
   c. Written reports of experimental studies
9. Safety in the chemistry laboratory

In addition, the report indicated that the committee did not feel it would be a sound practice for it to prescribe a specific sequence of courses with particular content to colleges that might wish to offer the chemical technician curriculum. However, the committee did suggest one possible organization in terms of an innovative, integrated curriculum approach.

Such a curriculum was conceptualized as consisting of six, one-semester courses. These courses might be as follows:

1. Basic Chemistry
   a. Atoms, molecules, and stoichiometry
   b. Laboratory work--quantitative techniques
2. Descriptive Chemistry I. (Organic Chemistry)
   a. Functional groups, structure, and reactivity
   b. Laboratory work--synthesis, separation, purification, and characterization
3. Descriptive Chemistry II. (Organic Chemistry)
   a. Structure and reactivity, natural products
   b. Laboratory work--continuing previous studies
4. Descriptive Chemistry III. (Inorganic Chemistry)
   a. Periodic table, nuclear chemistry, and radiochemistry
   b. Laboratory work--physicochemical principles related to the above
5. Equilibria in Solution and Analysis
   a. Solubility, acid-base relations, buffers, complex formation
   b. Laboratory work in quantitative applications of these principles
6. Instrumental Techniques
   a. Principles appropriate to spectral methods
   b. Laboratory work--electrochemistry

Committee recommendations concerning implementation were:

1. That pertinent sections of the curriculum recommendations be published in <u>Chemical and Engineering News</u> and that reprints of the article be distributed from the ACS office to those individuals and organizations who might be in position to assist in disseminating this information.
2. That the Board appoint a permanent special committee interested in chemical technicians, this committee to implement the curriculum recommendations in any way possible and to do such other things as the committee finds necessary to attract students and insure adequate programs in chemical technology.
3. That the U. S. Office of Education be contacted for possible cooperative efforts in furthering the curriculum dissemination and ultimate use.

During the ensuing discussion period, comments centered around a few major areas: (1) the unconventional approach of the curriculum guidelines; (2) the difficulties that the students meet when transferring such a program to a four-year baccalaureate institution; (3) the lack of textbooks that would fit such a curriculum; and (4) the recurrent "recruiting" problem. Sheer disgust with the whole report was expressed by one individual.

Several in the group indicated that in many respects the program they were offering was very similar to the program outlined. One individual voiced concern over the level of such a program, fearing that it was not of sufficient depth and theoretical level. Another individual said he felt the students enrolled in his curriculum could not pass such a program. Another was concerned over the great stress on laboratory experience for the student and a seeming lack of theoretical depth. One individual voiced his sincere concern that his course, qualitative analysis, would "disappear" with this curriculum approach. Several (four or five) indicated that they thought the committee report was, in general, an excellent approach. However, there was no consensus in the group.

Two members of the group who, incidentally, have quite high-level programs, voiced concern that their program would cease to attract qualified students if prospective students did not see the possibility of tranferring their two years of work toward a baccalaureate degree. Several in the group rebutted this remark with comments generally aimed at the position that chemical technology need not, or indeed should not, be transfer-level work. Those with the high-level programs defended their position by stating that general, analytical, and organic chemistry could really only be given on a college level, otherwise the course simply deteriorates into a "survey."

Several times it was brought up that dropouts from these high-level programs could easily find jobs as technicians; and, since this was true, the training level must be too high. One person expressed the belief that this was building-in failure.

A major concern voiced by almost all the participants was that if such an approach as is being suggested by the committee is taken, there will be no textbooks available for any of the courses. However, several members of the group pointed out that they were, even with the common curriculum approach of defined and segmented courses, using printed materials, paperback texts, manufacturers' literature, magazine reprints, and even student-developed materials in place of textbooks. This number, however, was definitely in the minority.

The major problem as seen by the entire group was, "Where are we going to get students?" Several of the colleges represented indicated they had enrollments of only ten to twenty students and were graduating only a few. In many cases, the indications were that the enrollments were decreasing. What had been ample numbers just two or three years ago were now not enough in many cases to sustain a separate curriculum. Colleges that have just begun programs during the last year or two indicated that the numbers enrolling were not up to expectations.

The individual who expressed disgust with the report said, in effect, "Who needs it?" or "We have been doing a good job over the past several years; why should we concern ourselves with such an approach?"

The discussions, in general, pinpointed the major problems of chemical technology curriculums, and, indeed, those of most engineering technology curriculums in the two-year colleges at the present time. There was certainly more concern shown for such problems as recruiting and procurement of expensive equipment than in innovative curriculum approaches. One member of the group put it rather strongly when he asked, "What good is a good program if we haven't got the money with which to equip the laboratories?" and "What good is either if there are no students in the classroom?"

The group consensus was that the committee must concern itself with much more than simply a problem of curriculum. It must turn its attention to such matters as a nationwide attack on the recruitment problem, educate the public to what chemical technology is, and implement its recommendations in all areas including curriculum.

In addition to discussing the committee report, the proposed activities for the two-year college relating to chemical technology in the ACS Education Office were outlined for the group. Among these activities are:

1. To collect information and statistics throughout the nation to determine the state of chemistry in two-year institutions and the situation of the chemical technician in industry.
2. To develop guidance and counseling materials for chemical technology.
3. To develop a public relations program to be used locally by those promoting chemical technology programs.
4. To consider establishment of a periodical for chemical technicians.
5. To develop educational services to improve effectiveness of chemical education in chemical technology.

The group felt that the establishment of a two-year college position in the office would go a long way toward the desirable implementation, if the proposed activities are carried out.

PRIVATE COLLEGE DISCUSSION SECTION

First Midwestern Regional Conference

Chairman: Ernest Salter, Cottey College
Recorder: Joseph Sunthimer, Cottey College

Seventh Annual Meeting

Chairman and Recorder: Harrison Allison, The Marion Institute

Summary of the Discussion Sections

Among the topics discussed were library noldings, course offerings, departmental budgets, grants for research, and teaching loads.

Library Holdings. It was suggested that colleges prepare lists of library holdings related to the sciences and exchange them. One school had placed an advertisement in *Chemical and Engineering News* asking for donations of chemical abstracts and other publications. It had a very good response.

Course Offerings. Of the schools represented, most offer an eight or ten credit hour general chemistry course. Some schools specify that qualitative analysis be included in the general chemistry course. A small number of schools indicated that chemistry is offered only as a science elective and is not intended for science majors. Of the schools represented, few offer courses other than general chemistry although some specified qualitative analysis as a separate course, both one-semester and full-year organic chemistry courses, and no-credit introductory chemistry course.

Departmental Budgets. Budgets for the chemistry department ranged from $150 for a school of 200 students to $2,000 for one having 100 students. The average appeared to be about $600. In most cases, major equipment items were obtained through additional funds donated by benefactors outside the school. It was noted that administrators and possible donors need to be educated relative to the needs of the laboratory sciences. In small colleges, it is usually the responsibility of the faculty member teaching such subjects to do his own public relations work.

Grants for Research. Some companies and foundations are beginning to make small research grants available to two-year colleges. Well-written proposals for such bequests will make such sources more aware of the need for grants at this level and possibly will produce some results.

Teaching Loads. Loads among the participants in this discussion section varied from 14 to 25 contact hours, with 15 to 16 being most common. Most instructors direct their own laboratory sections.

LARGE PUBLIC COLLEGES DISCUSSION SECTIONS

First Midwestern Regional Meeting

Chairman: Mrs. John Scurlock, Metropolitan Junior College
Recorders: Dan Fischer, Metropolitan Junior College
Cecil Hammonds, Metropolitan Junior College

Seventh Annual Meeting

Chairman: Mrs. John Scurlock, Metropolitan Junior College
Recorders: Myron W. Cucci, Monroe Community College
Paul Gregg, Bloom Community College

Second Western Regional Meeting

Chairman: Lars Lervik, Everett Junior College
Recorder: Clifford Higer, Everett Junior College

FIRST MIDWESTERN REGIONAL MEETING

Summary

Standards for Hiring of Teachers. There was general agreement that teachers should have a minimum of a master's degree in chemistry.

Proper Load for Teachers. The teaching load must be closely related to class size and size and number of laboratory sections. A majority felt that small class size and laboratories supervised by the teacher provide the most effective teaching at the junior college level, especially in the large public college where individual attention is needed if the student is to achieve. Some teachers said that there was administrative pressure toward large class size. This reduces the teacher to a laboratory instructor unless some way is found to get qualified laboratory help. One school reported that a highly qualified married woman had been found. The rest of those present felt that qualified help was almost impossible to find, that this was a rare case, and wondered what would happen when this person quit and no one could be found to take her place. Many expressed the feeling that often they were able to present ideas more effectively during the laboratory period than in the classroom period, as the poorer student was better able to grasp an idea when it was applied. At another school, two sophomores are used for each laboratory section as laboratory instructors. The teachers at the school were highly pleased by the results, saying that these student assistants gained tremendously by the experience. However, they admitted that since they had to train a new set of laboratory assistants every year, little time or effort on their part was saved; and if the school were too small, a year might arrive when too few qualified students would be available for training.

It was agreed that a laboratory size of sixteen as recommended by the American Chemical Society's Committee on Professional Training was ideal. It was also stated that if a laboratory section is larger than twenty-four students, adequate supervision and teaching is impossible. One school's research found that the accident rate went up tenfold when the laboratory size was increased above manageable levels.

It was felt that each teacher should have charge of his own laboratory. In order to cut down on contact hours, there was a decided tendency for schools to schedule double sections, i.e., a lecture size of between forty and fifty students and two laboratory sections. There was general agreement that chemistry teachers for the most part are given too large a load to carry, and it was hoped that eventually loads would be assigned by contact hours rather than by credit hours, as the teachers in most colleges are responsible for preparing for the laboratory as well as for grading the laboratory reports.

Finally, there was strong feeling that three-hour laboratory sessions were more satisfactory than two-hour sessions.

Attendance at Conferences. It was felt that attendance at conferences was desirable and that colleges should defray expenses.

Effective Communication between Administration and Department Heads. Most of those in attendance said there were no difficulties in obtaining laboratory equipment or in offering those courses that the department recommends.

Course Offerings. Most people present said that their administrators did not object to small upper class size as long as the over-all student load did not drop substantially. Class size has been allowed as low as three for an instrumentation course and four for many other sophomore courses. Someone indicated that administrators felt that teachers needed the stimulation of upper-level courses. Another stated that if a course were being offered for the first time, the administration was especially willing to be lax and give the course several years to build, with the expectation that class size will eventually grow as enrollment swells. Someone pointed out that 80-100 per cent of the students in the advanced courses go on, using the material thus learned in other courses. This makes the course a useful and valuable part of the student's professional training and therefore cannot be omitted from the curriculum. Finally, it was pointed out that most administrators felt that the offering of advanced courses was important for faculty morale.

Placement and Proliferation of Courses in General Chemistry. There was general agreement that placement of students was necessary. Methods of placement at various schools were discussed, but there was no discussion as to the best method of placement. Most schools offer a variety of courses at the freshman level and use a departmental test for placement. One school uses the ACT for classification (the natural science and math scores only). A rank of 35 per cent is currently used, but it is felt that this is too low. Another school simply uses the algebra placement score, feeling that the correlation between algebra and chemistry is very good. At still another school, a study showed good correlation between the Toledo Placement Test and SCAT scores. Several "big eight" universities use a two-track system, one for chemical engineers and chemistry majors and the other for those students needing only ten hours of chemistry.

Course Content. It was generally agreed that transfer courses must be patterned after those of the colleges to which the students might be expected to transfer, so that the student will not be penalized in the transfer. Choice of subject matter in other non-transfer courses should be up to the individual school and/or instructor.

Student Affiliates. Student affiliate chapters should be encouraged, but a warning was issued by those schools having chapters, that such chapters do not run themselves; much time and energy are required on the part of the chapter sponsor to keep the chapter operative.

Research. One school reported a tendency toward research for students in their junior year.

Qualitative Analysis. It was stated that qualitative analysis as a course has disappeared in the East, is fast disappearing in the Midwest, but still exists in the West.

Technical Programs. Most teachers present felt that technical courses were as difficult as the regular courses and would not solve the need to present courses that the less advantaged could pass. One school disagreed, thinking that laboratory techniques could be taught without the theory.

SEVENTH ANNUAL MEETING

Summary

Problems Concerning Teachers. Good teaching in junior colleges depends on adequate training in subject matter. Teachers should have a minimum of a master's degree in subject matter.

Administrators should guard against pressure to hire overtrained teachers. A Ph.D. degree should not prevent a teacher from being hired, nor should it be a necessity. Most of the teaching at the junior college level, by its very nature, is at the beginning level, and patience and the ability to explain things carefully and clearly are fully as important or more so than knowledge of material higher than that obtained at the master's level.

Teachers must guard against being "outdated." Because of overloads, teachers in junior colleges find it difficult to find time to do much outside reading. Because of poor pay and lack of understanding by many administrators, most teachers are unable to attend conferences (to pick up new ideas about teaching) and/or short courses (to pick up new ideas for teaching). In most schools, regular courses at universities are encouraged by incentive pay. In chemistry, many of these courses are high level (they must be graduate courses to receive credit in most schools), and the information gained is not of much use in the courses taught.

Teachers must fight against overloads. Chemistry teachers should be assigned by "contact" hours instead of "credit" hours. The clock-hour load should be twelve hours with a reduced load of six to nine hours for department chairmen. Probably some system of equalizing the various factors would be best. Factors that might be considered are (1) number of preparations; (2) student contact hours (i.e., total number of students); (3) total class contact hours; (4) administrative duties, counseling, etc.; (5) amount of laboratory help available and anything else that contributes to the actual workload of a teacher. Best teaching occurs when there is sufficient contact with a student so that he feels he is important. This contact can be in a small class, a small laboratory, or in a small conference period.

Problems Concerning Department Chairman--Administrative Problems. Something must be done to recruit students for technical and/or vocational programs in chemistry.

Junior colleges need help and encouragement from the chemical society in their struggle to build up and maintain reasonable standards. Much junior college teaching is poor and needs upgrading. On the other hand, many colleges with good teaching are being threatened by the influx of students and the subsequent demand for teaching in large classes.

Problems Involving Students. Nearly every college has a different method of placement of students, but all have a proliferation of courses. As one teacher said, "Our president expects us to prepare students for all walks of life, not just for transfer, and this requires our offering many different courses."

For transfer courses, the junior college must gear its courses to those of the universities and colleges to which the majority of its students transfer. Non-transfer courses can be taught as the school wishes. Chemical technology programs should conform to ACS standards.

Students like quantitative analysis in the freshman lab. Teachers report that results are great in terms of student interest.

Most teachers are opposed to research as such. Research is time consuming and too much energy is spent on a specialized field of knowledge.

SUMMARY OF THE SECOND WESTERN REGIONAL MEETING

Chairman: Lars Lervik, Everett Junior College
Recorder: Clifford Higer, Everett Junior College

1. As a result of selection procedures by universities, community colleges tend to get poorer students enrolled in chemistry courses, and this frequently leads to a lower level course than that preferred by the instructor. To avoid this, some colleges offer special courses for those students who have not had high school chemistry. When placing students in specific first-year chemistry courses, some colleges rely upon a physical science examination while others depend entirely upon mathematics performance for placement.

2. Various methods are used for selecting textbooks, but this is usually left to the discretion of the instructor rather than an administrator. It was emphasized that textbooks given high ratings by instructors may not be well rated by the students using them.

3. Transfer problems are caused by senior colleges failing to offer the same number of credits for a particular course. Frequently state colleges will offer a different number of credit hours for the same course, e.g., general chemistry. Another problem is raised by the lack of uniformity in the sequence in which courses are offered.

4. It appeared common that about 25 per cent of the beginning chemistry course laboratory work is quantitative in nature, but in some schools it is nearly 100 per cent quantitative. Some instructors state preferences for the quantitative experiments and also like experiments that require the student to prepare a product which can be submitted to the instructor. An example of this would be to prepare copper by converting copper (II) nitrate to the hydroxide, then to the oxide, and finally to reduce that to metallic copper. The instructor would then grade primarily on the quality of the copper sample submitted rather than the percentage yield, which the student could easily change.

5. About one-half of those present stated that they insist on students' wearing safety goggles, but in other schools students must wear goggles only when performing certain experiments. All of those present were of the opinion that certificated personnel should be in charge of the laboratory, and that at least one such person should be present whenever students are using it.

6. Most schools represented offer separate chemistry courses for science and engineering majors. One college offers a five-credit course that is a prerequisite for science majors who have not had high school chemistry. This course carries transfer credit for non-science majors.

7. Few of those present seemed to favor an honors course in chemistry for junior college students.

SMALL PUBLIC COLLEGES DISCUSSION SECTION

First Midwestern Regional Meeting

Chairman: Robert Barclay, Allen County Community Junior College
Recorder: Barbara Rhine, Cowley County Community College

Seventh Annual Meeting

Chairman: Robert Ringer, Chipola Junior College
Recorders: Maurice Stringer, Jones County Junior College
Marshall Gilmer, Gulf Coast Junior College

Second Western Regional Meeting

Chairman: Philip Churchley, Peninsula College
Recorder: Robert Ingram, Arizona Western College

Summary of the Three Meetings

Concern was expressed about the indication that quantitative analysis is receiving less emphasis as greater attention is directed toward the use of instruments in general and organic chemistry. Considerable support was given to the concept that traditional volumetric and gravimetric analytical techniques can provide a necessary base for developing the methods of analysis, control, and standardization used with instruments.

Organic chemistry laboratory work is steadily requiring more instrumentation. The small college frequently finds it difficult to provide the necessary instruments. It was noted that proper use of instruments will decrease the number of experiments that could be performed. It was suggested that by judiciously selecting experiments it would be possible to add instruments at a slow rate and continue to give a meaningful laboratory program.

There is fear that much of the "fun" of chemistry has been removed by the steady reduction of descriptive work in general chemistry. Many small colleges find it necessary to coordinate closely their general chemistry program with nearby four-year colleges to which their students transfer.

Small colleges have a need for a multiplicity of chemistry courses but find that this is frequently impractical. Tests available from the Examinations Committee of the American Chemical Society are useful to judge the effectiveness of chemistry instruction. For placement and counseling purposes, it has been frequently found that test scores above the 50th percentile are needed on the ACT tests for science and engineering majors. Excellent students may score considerably below this, particularly veterans and girls.

Most small college chemistry treachers are in need of assistants, particularly in handling the laboratory program. Second-year students are sometimes adequate if the department can afford to use them.

CHEMICAL TECHNOLOGY DISCUSSION SECTION

First Midwestern Regional Meeting

Chairman: Albert Miller, Iowa State University Technical Institute
Recorder: Kenneth Chapman, Temple University Technical Institute

Seventh Annual Meeting

Chairman and Recorder: Howard Ayer, Franklin Institute of Boston

Second Western Regional Meeting

Chairman and Recorder: Walter Kembel, Olympic College

Summary of the Three Meetings

[A separate Chemical Technology Section was held at the Seventh Annual Meeting to discuss curriculum recommendations of the American Chemical Society's *ad hoc* Technician Curriculum Committee. A full report of this meeting is given on page 42 in these Proceedings. Ed.]

Each of the three meetings of this discussion section was primarily concerned with the development of new chemical technology programs. Problems discussed included needs and starting salaries for chemical technicians, industrial advisory committees, faculty preparation, laboratories needed and recruitment of students.

The need for chemical technicians has been documented by committees of the American Chemical Society and studies by the Engineering Manpower Commission. The rapid increase in the numbers of recruiters appearing at colleges offering chemical technology programs further attests to the need. Starting salary (1966 graduates) offer averages are now exceeding $500 per month and show evidence of starting to climb rapidly. Even students barely surviving in the program find satisfactory jobs with little effort.

Industrial advisory committees appear to work well in some schools and poorly at others. In many cases, new advisers need to be more carefully informed about the purposes of the program. It was generally felt that the committees should meet regularly and have a prearranged agenda. The committees are frequently not very helpful in curriculum design because many of the advisers feel they are poorly qualified for this activity. They are more constructive when presented with a curriculum plan and are given specific details concerning its contents so that constructive criticism can be given. Advisory committee members can frequently be very helpful in explaining career opportunities, arranging for plant trips, and seeking laboratory equipment and library donations.

Faculty for chemical technology programs are frequently required by the college administration to have industrial experience. It was frequently found that a baccalaureate degree had been considered sufficient but that today a master's degree was the most common preparation. Beyond his academic training and industrial experience, the faculty member should be sympathetic to and knowledgeable about his students and their needs.

The laboratory facilities for chemical technology were considered to be more important than for other chemistry programs. Some representatives of existing programs feel it necessary to give students experience on instruments currently in use in industry. Others thought this impractical and favored the use of modular systems with use of standard instruments being somewhat restricted but not eliminated.

The major problem faced by all existing chemical technology programs seemed to be that of recruitment of students. Colleges anticipating offering this program were strongly encouraged to call for industrial aid to develop a thorough program for informing potential students of opportunities for chemical technicians and the preparation desired.

[Interested persons may wish to obtain a report on a Conference on Chemical Technicians--Curriculum Development and Student Recruitment held at New York City Community College on October 27 and 28, 1967. This is available from Kenneth Chapman, American Chemical Society, 1155 Sixteenth Street, N.W., Washington, D.C. 20036.]

BRANCHES OF STATE UNIVERSITIES SECTION

Seventh Annual Meeting

Chairman: Anne Stearns, Columbus College

Recorder: Elizabeth Claiborne, University of Kentucky, Hopkinsville Community College

The group felt that an IR spectrophotometer is necessary for the teaching of organic chemistry today. Various such instruments were mentioned, with particular discussion of the Beckman IR Microspec ($3500) as being both economical and satisfactory for use in the introductory organic chemistry course.

It was indicated that in some two-year colleges the two-semester beginning organic chemistry course was not offered. For example, at the University of Georgia organic chemistry is listed as a 300 course; and even though sophomores may take it there, the two-year colleges in Georgia were not eligible to offer it. Other colleges sometimes begin organic chemistry in the second semester of the sophomore year. This would make it necessary for the two-year student to begin the course in one institution and complete it in another. The general opinion of the group was that a student should complete a course sequence at one institution even if he should have to postpone a course until he transfers to a four-year college. Nevertheless 77 per cent of the schools replying was the largest percentage of schools offering any course other than general chemistry.

Other instruments mentioned as needed were pH meters, multimeters, single-pan balances for the first-year chemistry, possibly a polarograph and some kind of visible or U.V. spectrophotometer. Some of the group felt a gas chromatograph should also be available. It was suggested that use might be made of nearby industry where instrumentation is used. Frequently these industries are quite willing to demonstrate the instruments or make them available for limited use by the college.

Mathematics prerequisites for chemistry was the second topic discussed. Most of those present believed that most students of beginning chemistry are weak in mathematics. This seemed to be especially true of the non-science student taking chemistry. Most schools represented by the group had no prerequisites for general chemistry courses. The University of Kentucky and its community college system were the exception. ACT scores are used for placement in the beginning chemistry courses, and a student with a very low ACT score is not permitted to take any chemistry until he has passed an algebra-trigonometry course satisfactorily at the University of Kentucky.

Some of the instructors present suggested that some basic logarithms and exponents might be taught in the general chemistry class. Programed self-study reviews available in mathematics were also mentioned as a means of improving the chemistry students' mathematical background.

It was suggested that limiting pH problems to (even) multiples of 10 with non-science students might enable them to solve pH problems satisfactorily.

Some summer remedial programs were described. Special courses in English and mathematics were used as the remedial course. About half of the entering students needed this help. One person pointed out that such remedial courses usually do not carry college credit and therefore students taking these have too few credit hours and become subject to the draft.

It was stated that the problem of mathematics difficulty was a special area in which the two-year college might serve effectively. One speaker wondered if these students should be encouraged to follow a five-year program for a bachelor's degree.

The group seemed to think that transfer of credit was not as serious a problem for the two-year college with close ties to a state university as for other two-year colleges. Nevertheless, several plans were suggested to aid in making the transfer to a four-year college smoother.

A two-way visitation program between two-year and four-year colleges helps each to understand the other's program better.

Mid-term transfer should be discouraged, and students should be urged to complete a course sequence in one school or postpone taking the course until after transferring. This would avoid overlaps or gaps in the subject matter of similar courses offered at the different colleges.

It was suggested that schools in the same area or at least with university relationships might work out a list of topics to be covered each term to improve articulation. In no way, though, should the academic freedom of the institution or the instructor be infringed upon, and the instructor should be free to develop and present the material as he sees best.

Departmental examinations for colleges with several teachers teaching sections of the same course were also mentioned as a means of coordinating course content.

The AC_3 Report on the Content of Chemistry Programs was mentioned as well as the amount of theory and descriptive chemistry that should be presented. There was no general agreement on the amount of theory or descriptive chemistry that should be included. It was agreed that both should be emphasized. More physical chemistry and topics such as thermodynamics were suggested as necessary topics for the general chemistry course for science majors taking more than one course of chemistry.

This suggestion raised the question of one or two courses in general chemistry--one for majors in science fields and one for non-science people. It was stated that in small colleges with a limited faculty and small classes this was not feasible. On the other hand, it was thought desirable to have special courses emphasizing descriptive chemistry and laboratory techniques for those interested in chemical technician work in industrial laboratories or just wanting a general knowledge of chemistry.

Chem Study Films and other similar films have been found helpful, especially with large classes. The over-use of films should be avoided, and films should perhaps be shown more than once if the student is to understand fully all the material presented in a given file.

Cartridge loading projectors (Fairchild and Technicolor, 8mm) were mentioned for their possible use by the individual student on his own time for additional study.

Inquiry was made as to the cost of visual equipment as related to number of students. In general the group seemed to agree that for large classes the value of visual aids in presenting a concept or demonstration to the group outweighed the cost. For small classes where students had laboratory space and equipment available the need for the more expensive visual aids was less, and possibly the expense would outweigh the value. Self-study programs and visual aids of the less expensive type used by the individual students could be used even in small classes.

CAMPUSES OF MULTI-CAMPUS JUNIOR OR COMMUNITY COLLEGE DISTRICTS DISCUSSION SECTION

Seventh Annual Meeting

Chairman: Ethelreda Laughlin, Cuyahoga Community College
Recorder: Jura N. Gailiusis, Cuyahoga Community College

The correlation and coordination of chemistry courses at multi-campus junior colleges were discussed. In one college district composed of four colleges each college is autonomous and has its own catalog. The chemistry departments are independent of each other and do not necessarily correspond with the chemistry departments in the other colleges. At another junior college having two campuses in operation, each is autonomous, but only one catalog is used. At a third junior college district, the chemistry departments in various campuses are very different from each other. The caliber of the chemistry courses is matched to the type of student that attends the individual school. Textbooks are selected at the individual campuses, and there is no effort made at coordination.

To improve communications among the various campuses, one college district holds biannual meetings of the physical sciences faculty to discuss course content and other problems that may exist at the time. The chairmen of the departments are expected to remain in communication throughout the school year. Schedules of courses and examinations are made cooperatively, and the same final examination is administered at all campuses.

At another two-year college district, the chemistry departments have informal discussions throughout the year. These informal discussions make it possible to transfer equipment and chemicals as needed.

Applicants seeking faculty positions in multi-campus districts usually send their applications to only one location. However, if the individual branch has its own dean, it tends to employ faculty separately from the other campuses.

Remedial and non-transferable chemistry courses are offered by most of the colleges represented. Frequently these are offered as preparatory courses for the curricular transfer courses in chemistry for the science and engineering majors.

Lack of space and small or inadequate budgets were cited as chronic problems by all the attendees.

APPENDIX A

THE ACTIVITIES AND SERVICES OF THE DIVISION OF CHEMICAL EDUCATION

The JOURNAL OF CHEMICAL EDUCATION occupies a highly respected position in the world's chemical literature. Its role as the "Living Textbook of Chemistry" is fulfilled by presenting review articles on new developments, innovations in classroom and laboratory instruction, book reviews, and information about new apparatus and instruments.

The EXAMINATION COMMITTEE of the Division maintains and continually modernizes a battery of carefully constructed tests for high schools, colleges and universities. College and university tests cover the various fields of chemistry at both the graduate and the undergraduate level.

The TWO-YEAR COLLEGE CHEMISTRY CONFERENCES ($2YC_3$) have been initiated and supported by the Division. These conferences have brought together teachers of the two-year colleges to discuss their common problems. Through the Division this rapidly growing segment of chemical education is represented in planning and directing the course of chemical education at the national level.

A SMALL GRANTS PROGRAM was started in 1967. Through this program chemistry teachers may apply for several hundreds of dollars for testing, developing, or evaluating novel ideas for chemical education. The program was accepted immediately with enthusiasm and a grant recently received from the DuPont Company assures its continuation.

The CHEMICAL EDUCATION PROGRAMS for the National meetings of the American Chemical Society are arranged by the Division. These programs offer members the opportunity to hear and to discuss the new, the controversial and the traditional problems and subject matter of Chemistry. Each member receives the abstracts of the papers presented in the Division program.

The COMMITTEE ON VISITING SCIENTISTS which is supported by the National Science Foundation plans and administers a program in which distinguished college and university teachers visit other institutions where they speak on requested topics and consult with the local staff on pertinent problems in chemical education.

Several working committees of the Division - the Committee on the Teaching of Chemistry, the Curriculum Committee, and the Committee on Institutes and Conferences - meet twice a year during and preceding the national meetings of the American Chemical Society. Visitors are always welcome at these working sessions. Almost any new idea or valid criticism of chemical education can be carefully considered at one or the other of these committee meetings. The meetings are indeed a forum for chemical education.

The Division has many other activities. It sponsors the DIVISIONAL DINNERS at the National meetings of the Society. It arranges a program for the high school teachers who are the recipients of the Conant Award. The speaker for the Spring Divisional Dinner, at which the Conant Awardees and their spouses are guests of the Division, has traditionally been the recipient of The Scientific Apparatus Manufacturers' Association Award. The Division maintains an interest in chemical education on the international level and supports the educational activities of the American Association for the Advancement of Science. A DIRECTORY containing the names and addresses of members and affiliate members, bylaws of the Division, reports of standing committees and a historical sketch of Divisional activities is sent to all members.

Members of the Division may vote for the person of their choice for the elective offices of the Division. They may participate in the work of the standing committees of the Division. A receipted divisional dues card makes it possible to purchase the Abstracts of the Fall and Spring meetings of the American Chemical Society at a savings of one dollar for each meeting. If you are a member of the American Chemical Society you may become a member of this active division by payment of $1.50 annual dues. Dues for the affiliate members are $2.00. Your application for membership will be welcome.

Application For Division Membership

Detach and mail to: **J. D. DANFORTH, Treasurer**
Department of Chemistry
Grinnell College
Grinnell, Iowa 50112

Date ....

Enclosed please find $.......................... check (or cash) for my dues in the DIVISION OF CHEMICAL EDUCATION for the year(s) 19..........................

I desire my status be:

$1.50, ( ) a member, as I belong to the A.C.S.

$2.00, ( ) a Division Affiliate

$5.00, ( ) Any elementary or secondary school science teacher may become a Division Affiliate and also receive **The Journal of Chemical Education** by submitting name, school and a check for $5.00 to The Treasurer.

Associate members and teacher affiliates may not vote or hold office in the Division but may enjoy and participate in all other activities.

Name ....

Address ....

....

....

Institution or company affiliation if not indicated in address:

....

APPENDIX B

SMALL GRANTS PROGRAM FOR CHEMICAL EDUCATION PROJECTS

The Division of Chemical Education has established on an experimental basis a Small Grants Program, which is being administered by the Committee on the Teaching of Chemistry.

The purpose of this program is to provide limited funds to individuals in support of chemical education projects that appear to have the potential to contribute to the improvement of the teaching of chemistry. The projects to be supported will be those that involve the preparation of specific teaching materials not currently available or that involve the study of an educational procedure for which either no information is available or for which additional information appears to be desirable. Special attention will be given to proposals that are unique and novel and that show imagination and ingenuity. The intention of the Division of Chemical Education is that the results of such projects should be made available for consideration and possible adoption by others.

The size of the grants ranges from $100 to $300 and the funds can be used for such expenditures as the purchase of materials and supplies, secretarial or draftsman's assistance, computer time, or the employment of students. The purchase of major equipment or instruments and travel expenses will not be supported. No institutional overhead will be allowed. The grant will be made directly to the individual investigator. At the completion of the grant, any unexpended funds must be returned to the Division of Chemical Education.

The proposal submitted should contain a summary cover page on which should appear the name of the investigator; the academic institution involved; address of the institution; office and home telephone number of the investigator; title of project; total funds being requested; date of expected completion of project; signature of investigator; signature of an institutional officer; and date proposal is submitted. The body of the proposal should be limited to five double-spaced typed pages. This section of the proposal should contain an outline of the project in sufficient detail so that the actual nature of the project is clearly presented and so there is evidence that sufficient thought has been given to the proposed project. A budget page should be included on which the funds requested are identified in terms of such items as specific expendable supplies, fees, and stipends. On a separate page, a brief vita of the investigator should be presented.

There is no deadline for submitting proposals; therefore a proposal can be submitted at any time. Proposals received will be reviewed and acted upon promptly. If a proposal is funded, the investigator will be required within one year after receiving the grant to submit a final report on the project, including a financial statement on the expenditure of the granted funds. Four copies of the typed proposal should be submitted to:

Professor H. A. Neidig, Chairman
Committee on the Teaching of Chemistry
Department of Chemistry
Lebanon Valley College
Annville, Pennsylvania 17003

Two-Year College Chemistry Conference Committee

Class of 1967

Mr. Myron Cucci	Monroe Community College	Rochester, N. Y. 14607
Dr. Rudolph Heider	Meramec Community College	Kirkwood, Mo. 63122
Dr. Morris Hein	Mount San Antonio College	Walnut, Calif. 91789
Dr. Jerome Holmes	Hartnell College	Salinas, Calif. 93901
Mr. Jack Howard	Cumberland College of Tennessee	Lebanon, Tenn. 37087
Mr. Walter H. Kembel	Olympic College	Bremerton, Wash. 98310
Mr. Campbell McWhinnie	Casper College	Casper, Wyo. 82601
Miss Eula Ratekin	Missouri Southern College	Joplin, Mo. 64801
Mr. John Samlin	Illinois Valley Community College	LaSalle, Ill. 61301
Mr. Paul Santiago	Harford Junior College	Bel Air, Md. 21014
Dr. Carl Scheirer	York Junior College	York, Pa. 17405

Class of 1968

Mr. Howard Ayer	Franklin Institute of Boston	Boston, Mass. 02116
Sister Bohdanna	Manor Junior College	Jenkintown, Pa. 19046
Mr. Robert Bowlus	Pasadena City College	Pasadena, Calif. 91106
Mr. Robert Burham	Grand View College	Des Moines, Iowa 50316
Mrs. Kathryn Caraway	Flint Community Junior College	Flint, Mich. 48503
Dr. Artell Chapman	Ricks College	Rexburg, Idaho 83440
Dr. J. Smith Decker	Phoenix College	Phoenix, Ariz. 85004
Mr. Curt Dhonau	Vincennes University Junior College	Vincennes, Ind. 47591
Mr. William Griffin	Hinds Junior College	Raymond, Miss. 39154
Mr. Richard Lungstrom	American River Junior College	Sacramento, Calif. 95841
Miss Anne Stearns	Columbus College	Columbus, Ga. 31907

Class of 1969

Mr. Kent Backart	Palomar College	San Marcos, Calif. 92069
Mr. Alvin Blough	Hesston College	Hesston, Kans. 67062
Mr. C. Herbert Bryce	Seattle Community College	Seattle, Wash. 98122
Mr. Kenneth M. Chapman	American Chemical Society	Washington, D.C. 20036
Dr. Fred Dietz	Merritt College	Oakland, Calif. 94609
Mr. Robert Drobner	Miami-Dade Junior College	Miami, Fla. 33167
Mr. James Edgar	Navarro Junior College	Corsicana, Texas 75111
Mr. Cecil Hammonds	University Station	Baton Rouge, La. 70803
Dr. Ethelreda Laughlin	Cuyahoga Community College	Parma, Ohio 44130
Mr. William T. Mooney, Jr.	El Camino College	Via Torrance, Calif. 90506