WRITTEN SUMMARIES FROM DISCUSSION GROUPS

1964 MACTLAC Meeting

Group 1. USE OF COMPUTERS IN THE UNDERGRADUATE CHEMISTRY CURRICULUM
Leader: William A. Deskin, Cornell College

This discussion group was well attended and many interesting and valuable problems were discussed. Some general observations of the discussion indicate that no universal method of involving students with the computer has evolved. Some institutions had rather extensive curricula in which students were involved in computer programming; in other cases the students with a minimum of instructions used existing programs to obtain data and/or solutions to particular problems. With respect to Chemistry Departments in particular, some institutions required all majors to have the experience of work with the computer and in other cases only certain advanced students on particular research problems were involved in the use of the computer.

It was generally agreed that the use of the computer could be a meaningful experience for the student and that more involvement was necessary. One of the problems which came out in the discussion was the need for more examples where the use of the computer was required. Simple problems may be necessary for an introduction but meaningful problems were necessary to point out the real value of using a computer. Whenever an example is chosen, the most rigorous or exact equation should be used and not one that involves simplifying assumptions. Programs which are used, whether written by the student or not, should be capable of taking the data in the rawest possible form -- that is, just as it is obtained from the experiment without any prior processing.

There are many available books on the market with published programs. However, it was generally agreed by those with experience on the use of the computer that an individual was generally better off to write his own program, to use his individual logic, and to have the output in a form of his own choosing.

Below is a listing of some problems which were discussed.

1. Acid-base titrations as function of equilibrium constants, concentration and other variables.
2. Polarographic equations to include viscosity for non-aqueous solvents.
3. Adiabatic flame temperatures.
4. Spectrophotometric data for mixed complexes.
5. Fitting data to involved conductance equations.
6. Least-square treatment of data.
7. Calculation of geometric parameters for various molecules.
8. Solution by trial and error of kinetic measurements.
9. Matrix operations and calculations.
10. Calculations of p-orbitals which include the radial function.

Group 2. ROLE OF BIOCHEMISTRY IN THE UNDERGRADUATE CURRICULUM
Leader: Olaf Runquist, Hamline University

A poll showed that of the 27 schools represented, five do not offer a biochem course and nine others do not currently include laboratory in their biochem courses.

The following purposes were suggested for the biochem course:

1. Serves to introduce the area of biochemical principles to special groups (premed, med. tech., biologists, nutrition students).
2. Provides an opportunity to cross boundaries between fields and to integrate disciplines.
3. Affords an interest for those not satisfied with other branches of chemistry.

It was agreed that organic and physical chemistry should be prerequisites for biochemistry if the ACS requirement is to be met. This would eliminate many biology and nutrition students who would otherwise gain at least some insight into the chemical workings of biological systems. (Only ten of the participants now require organic and only three require physical chemistry.) The possibility of offering two levels of biochemistry was proposed as a solution to the problem.

An effort was made to define the unique contribution of a biochemistry course. All agreed that the study of metabolism is the largest single contribution, but differed as to whether it could be taught elsewhere. Some thought that the applications and synthesis of principles of organic and physical chemistry is the major contribution. Still others claimed that many techniques used in the biochemistry laboratory are best taught here even though they may be used in other fields also. There seemed to be a consensus that problem solving can be superbly carried out in bichemistry where boundary lines between fields are erased.

Group 3. CONTENT OF THE ADVANCED INORGANIC COURSE
Section A-Leader: James Finholt, Carleton College

During the discussions of the group several questions were raised. These will be listed with a brief summary of the discussion which followed.

1. What are most of the schools here represented offering as an Advanced Inorganic Course? Most offer a two or three credit lecture course in the junior or senior year. A few offer either a one or two credit laboratory session to accompany the lectures. These laboratory courses are mostly inorganic preparations with emphasis on different techniques of synthesis.

2. Is Physical Chemistry a prerequisite for the Advanced Inorganic course? Most schools answered yes. It was pointed out that this seemed to be a necessity in view of the requirements of the ACS Committee on Professional Training. It was further pointed out that this prerequisite usually prevents any major other than chemistry from enrollment.

3. What topics from Physical Chemistry are considered essential prerequisites? Most agreed that a thorough knowledge of thermodynamics was needed before studying Advanced Inorganic. Some felt a knowledge of quantum mechanics was a necessity; others felt that merely an acquaintance with the symbolism and vocabulary of quantum mechanics was enough.

4. Is there not over-lap in the topics covered in Physical Chemistry and Advanced Inorganic? Most felt there was an over-lap, e.g. quantum mechanics, chemical bonding, kinetics and mechanisms, redox considerations. Some, however, felt that this was necessary since these topics are treated from a different point of view in each course.

5. What texts are being used for these courses? The inorganic texts of Gould, Cotton and Wilkinson, Sienko and Plane ("Physical-Inorganic Chemistry"), Heslop and Robinson were all mentioned. Many, however, supplement a text with other references, including journal references.

6. What main topics should be covered in an Advanced Inorganic course? Atomic Structure, Chemical Bonding (Ionic and covalent), Redox, Coordination Chemistry, Mechanisms, Ligand Field (spectra), Acid-Base, Solid state (crystallography), Radiochemistry, Synthetic Methods.

7. Should any of these topics be given higher priority than others? Many felt that an answer to this question would vary with each teacher since the topics considered important by an individual teacher are usually those he knows best. Perhaps Solid State and Radiochemistry could be given lower priority than others on the list.

8. Does not the Advanced Inorganic course include too much Physical Chemistry? Where is descriptive inorganic chemistry now taught in the undergraduate curriculum? This question prompted much discussion and it was felt that there is a definite lack in the teaching of descriptive chemistry. It would seem that students entering graduate schools are penalized on inorganic qualifying exams because of this lack. One school offers Inorganic Chemistry, mostly descriptive chemistry of the elements, the second semester of the freshman year followed by the more theoretical Advance Inorganic in senior year. One suggestion was made that the descriptive chemistry of the elements in at least one of the Groups of the periodic table be covered in complete detail; others thought such specialization could wait until graduate school.

9. Should areas of reseach currently being covered in the scientific journals influence the topics to be discussed in Advanced Inorganic? Some felt this investigation of current research should be left for graduate school, that undergraduate courses should merely prepare for such specialization by giving students the necessary vocabulary. Some schools cover current research in a Special Topics Seminar.

10. Is there not a greater need for Advanced Inorganic laboratory work? It was pointed out that often laboratory assistants get greater practical knowledge of laboratory procedures, e.g. preparing solutions, than any course teaches. Perhaps the Advanced Inorganic laboratory course should fill this need for those who are not laboratory assistants. The laboratory text by Jolly was strongly recommended to encourage independent laboratory work. Some felt that this practical knowledge was best gained through an undergraduate research project.

Group 3. CONTENT OF THE ADVANCED INORGANIC COURSE
Section B-Leader: Earle Scott, Ripon College

The question was first raised of a descriptive as opposed to a theoretical advanced inorganic course. It was noted that the trend toward teaching principles on the elementary level increases the need for chemical facts to be presented later in the undergraduate program. The group tended to divide into "descriptive", "theoretical", and "combined" factions. Many members expressed the necessity of adequate theoretical preparation for successful graduate work. Proponents of the descriptive viewpoint emphasized the necessity of familiarity with substances and their reactions. It was noted that descriptive chemistry cannot be presented most effectively by interspersing theoretical topics. The emphasis in graduate inorganic courses on quantum mechanics was pointed out. The response was divided as to whether undergraduate inorganic courses should likewise emphasize quantum mechanics. Some members support the teaching of quantum mechanics for its own merit; some support it as necessary for preparation for graduate school; some continued to question whether this is not more appropriately left to the graduate schools.

The advantages ofaphysical chemistry prerequisite were generally agreed upon, with particular mention of such topics as bond energies, lattice energies, and kinetics being useful in the presentation of descriptive chemistry.

Laboratory work is not included to a large extent as a part of the advanced inorganic program in the schools represented. The few who did include laboratory prefer to combine inorganic preparations with measurements of characteristic physical properties of the compounds.

Group 4. FACULTY AND STUDENT RESEARCH IN LIBERAL ARTS COLLEGES
Section A-Leader: Richard Ramette, Carleton College

The following questions were raised by the discussion leader. May intensive experimental work done by a college teacher sap his energies which might be more profitably employed in keeping abreast of chemical literature? Does the desire for continuing financial support for a research project prejudice the teacher in favor of getting publishable results rather than providing the best experience for his students? Do students have to fit in to a research project in a way which narrows their outlook on chemistry as a whole? Can a professor in a liberal arts college make a truly worthwhile contribution to the discovery of new knowledge?

As a basis for discussion, the leader suggested a spectrum of the purposes of scholarly work ranging from great emphasis on research (on the left) to maximum emphasis on professional growth in field, non-provincial experience, self-respect as a chemist, setting a scholarly example for students, carrying over into one's teaching the knowledge and attitudes developed from research, emphasizing research on subject matter consistent with courses taught, using the results of research in courses taught, directing one's efforts only toward teaching (on the right).

There was general agreement that scholarly work might well include writing textbooks, revising course notes and syllabi, and devising new laboratory experiments as well as seeking for new knowledge in the laboratory. No teacher can engage in all of these activities and each must determine the ways which will be most valuable to him in keeping his intellectual vitality at a high level.

Experience in research is valuable to a student if he can become fairly intensively involved -- one afternoon per week is generally not much good, while full-time summer programs are especially successful. Undergraduate research is good preparation for graduate work, though the former has quite different goals from the latter. Though publishable results are of little import to the student, the teacher must have them if he is to get continuing financial support from granting agencies. Getting a part of a chemistry teacher's salary paid by a research grant may enable a college to have a larger staff in chemistry.

In summary, every chemistry teacher in a liberal arts college must struggle to keep intellectually alive. If he likes research for its own sake, he should do it; if he likes involving students in research projects, he should get them into his lab; if he prefers to use his extracurricular time to read current literature and to revise his courses, he should do this. The prime requisite is that he keep growing in his understanding of chemistry. Groups such as MACTLAC should seek new ways of supporting all such activities.

Group 4. FACULTY AND STUDENT RESEARCH IN LIBERAL ARTS COLLEGES
Section B-Leader: Quentin Petersen, Wabash College

The meeting opened with a consideration of whether experimental work by a faculty member can adversely affect his teaching function, either by consuming time which would be more appropriately devoted to his teaching function or by directing his activities to inappropriate areas because of the need for research funds. A general, but not unanimous, opinion was expressed that faculty research could only be justified if it made some contribution to the education of the student. Situations were discussed in which educational function could be justified without actual student participation in the research activity.

Some time was devoted to an examination of the way in which teaching load affected research and, as would be expected, there was wide variation of opinion, particularly of what time needs to be devoted to a stated teaching "load". A discussion of financial support centered about the need for financing released time, summer salary, and student participant pay. This is in interesting contrast to previous years' discussions in which need for equipment and space occupied the majority of the discussion. Dr. Swenson reviewed the present state of NSF support of the Research Participation program in a most encouraging way.

The nature of the particular research problem held the attention of the group repeately throughout the discussion. Opinion ranged from one extreme which would demand anticipated journal publication to the other extreme which would try to generate research attitudes and activities in the performance of the classical course experiments.

Mr. Pratt discussed the program of DuPont aid to liberal arts college chemistry departments and answered questions. In general, the program is designed to reward excellence, but the philosophical basis of the program is regularly reviewed. In view of the discussion's centering about the need for financial need for research, it was interesting to note that the four individuals who reported on their institution's use of DuPont grants all emphasized that the grants were not used in a direct way for support of research.

Group 5. USE OF PAPERBACKS IN TEACHING CHEMISTRY
Leader: Theodore Benfey, Earlham College

Several questions were asked at the start: Are paperbacks supplementary or do they replace the regular texts? How many should a student be required to buy? In what areas are they needed? What about programmed texts? Some of the comments in the discussion were the following:

1. Paperbacks usually cover in depth but not breadth, and therefore may miss important areas.
2. Paperbacks give the opportunity for experts to write brief volumes on their specialities.
3. A collection of paperbacks will lack unity, but have the advantage of permitting a teacher to custom design a course
4. Every course should treat atleast one topic in depth. The paperbacks make this possible.

Group 5. (continued)

5. With regard to questions and problems, the paperbacks are quite spotty. Good problem books are available, and programmed material can help fill the gaps.
6. The cost of textbooks is a very small percentage of a student's cost of attending college.

Mention was made of several schools which now use paperbacks in general chemistry. At Lawrence College the chemistry-physics course uses the following: Sherwin, Basic Concepts in Physics (Holt); Hildebrand, Kinetic Theory; Mahan, Thermodynamics; Pullman, Structure of Molecules (Dover, French translation); and King, Kinetics.

A list was assembled of approximately 30 paperbacks in chemistry which are now available, plus several programmed texts, and mention was made of several more paperbacks which are now in preparation.

Group 6. ROUNDTABLE DISCUSSION
Leader: Martin Allen, St. Thomas

The group first spent a few minutes considering the problem of promised delivery time of chemicals and apparatus by scientific supply houses. The discussion gave evidence that one supplier seemed to be the offender. The only effective remedy is to contact an officer of the company who is at high enough a level to get action.

Most of the time was spent in considering the question "Will the Liberal Arts Colleges be able to prepare qualified graduates for entrance into top graduate schools in future years?" The question was prompted by reports that some university staff members believe that in the future the only source of well-trained undergraduates will be the universities. A report from M.I.T. shows that already liberal arts colleges are not adequately preparing physics majors, and the same may soon be true in chemistry. A report from the University of Illinois indicated that the majority of liberal arts graduates failed three out of four entrance exams. Dr. Miller of the Institute of Paper Chemistry reported that as yet the liberal arts graduates are equal to the university graduates in his institution. The following comments were made:

1. Are the graduate schools expecting too much on the undergraduate level? Some members want to hold down the specialization of the student, but others believe the graduate schools are justified in expecting more because of the rapid expansion of chemistry.

2. Some believe the cause of the declining percentage of liberal arts students becoming top graduate students may be due to the fact that high tuition costs are cutting out an economic group from which large numbers of chemistry majors come.

3. One member of the group felt that the small numbers in advanced classes in liberal arts colleges did not provide the needed competition to drive students to better work.

4. Is the problem of staffing liberal arts colleges in physics and math having a bad effect on the overall training of chemists? Will staff problems in chemistry increase in the near future?

5. A difference of opinion was expressed about the need to provide broad training in the liberal arts before specialization. Some believe we are trying to force specialization too early; others believe it must be done, but still within the atmosphere of the liberal arts college.

6. Has the personal attention point, often made by liberal arts colleges as a reason for their success with students, been over emphasized? Is it possible that personal attention may prevent a student from standing on his own feet?

7. There is a constant need for curriculum review in liberal arts colleges. One person questioned the continued use of excessive time to conduct classical laboratory exercise, when what might be more valuable is an increase in time devoted to conceptual experiences.

8. If a lack of opportunity exists for students to get necessary advanced courses in the regular curriculum, would it be possible for our students to get these courses during summer sessions? The NSF has supported conferences designed for such a purpose in inorganic chemistry at Reed College.

9. Although liberal arts graduates may not pass qualifying exams as easily as university trained chemistry majors, there is no evidence that liberal arts graduates do not have as great a success in the end.

10. The liberal arts professor may have a greater tendency to get in a rut in his teaching and be slower in accepting new ideas.

11. No definite evidence is available to indicate that the well-prepared liberal arts student will not be successful in graduate school. However some attempt should be begun to obtain factual information on this question.