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### **Completing the Program with a Division of Chemical Education**

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The traditional divisions within the field of chemistry may be incomplete. One school's approach to the question is to form a division of chemical education.

The Dept. of Chemistry at Purdue University was reorganized in August 1982, formally establishing a division of chemical education to supplement the long-established divisions of analytical, inorganic, organic, physical chemistry and biochemistry. This new division consists of five tenured faculty members who have both rank and tenure within the Dept. of Chemistry. They teach not only general chemistry but other chemistry courses at both the undergraduate and graduate levels.

In creating a division of chemical education, the chemistry department showed a certain amount of faith that chemical education is an area of scholarship worthy of the status afforded established branches of chemistry. Simultaneously, it placed upon members of the new division the burden of proving that this faith was deserved.

Only time will reveal whether what we have done represents a significant step in the growth and development of chemical education or merely an unimportant administrative reorganization in a single institution. In this article we intend to review the thinking and events that led to this reorganization and to discuss plans for the new division.

### **What is "Chemical Education"**

The nature of the individual to whom the term "chemical educator" can be applied has evolved over the years. The term was once used to describe people who were first and foremost chemists, but who made contributions in many areas, including the teaching of chemistry.

The term has also been used to describe individuals who primarily teach what others have discovered and who serve the multitudes who study chemistry as part of their education. These people are less likely to generate new knowledge in chemistry, although most could, once did, and occasionally still do.

Recent years have seen the emergence of a generation for whom the term chemical educator can no longer be used exclusively to mean "those who teach chemistry." These individuals are still concerned with teaching, but they are also likely to focus their attention on research about the teaching and learning of chemistry at all levels. This research is based on certain assumptions that some chemists might be reluctant to accept: (1) that

developments in cognitive psychology and education make it feasible to approach chemical education as a scientific discipline and (2) that there are certain principles that govern the teaching and learning of chemistry that can be elucidated and applied to improving the mastery of technical skills by students with a wide range of aptitudes.

### **Impediments to Progress**

Readers of this journal are well aware that there are science educators, many with expertise in chemistry, who have long had the characteristics of the emerging chemical educator. Such individuals have been active in research and development for many years and regularly publish the results of their efforts in this and other journals dedicated to the improvement of science education. There have been, however, numerous impediments to research and development in chemical education:

- Support for research in chemical education has been sporadic at best. With the exception of one-shot expenditures for curriculum development and the underfunded and short-lived Research in Science Education (RISE) program, NSF support has gone for equipment and training to maintain existing programs in chemistry.
- Scholarship seldom flourishes in isolation. The individuals most likely to carry out research in chemical education are found in two places: (1) departments of science education, where they often have little contact with chemists, or (2) in large chemistry departments, where they head the general chemistry program. In light of the administrative and teaching loads associated with large general chemistry programs, it is not surprising that the individuals who head these programs are likely to pursue research in chemistry that is understood, appreciated, and supported by their colleagues.
- Research in chemical education often requires a team effort. One person seldom has the broad knowledge of chemistry, the practical teaching experience, and the knowledge of educational technology and cognitive psychology needed to find new ways of teaching sophisticated ideas to students with varying aptitudes and abilities.

By creating a division of chemical education within a major research-oriented chemistry department, we hope to establish two conditions essential for promoting chemical education as an important field of research: (1) a group of faculty with a long-term commitment to (and, we hope, long-term support for) research in chemical education and (2) strong ties between this chemical education group and other faculty members who are committed to research and teaching in chemistry.

### **Why Purdue?**

Purdue University is the land-grant university in Indiana, and it has a heavy commitment to science and technology. Over 80 percent of the entering freshmen take general

chemistry, more than 5,000 students each fall. A significant number of these go on to take additional chemistry courses, and about 8,500 students are enrolled in undergraduate chemistry courses each fall.

The Dept. of Chemistry at Purdue is necessarily concerned about teaching chemistry, and teaching it well. The large number of students enrolled in courses in other science disciplines has also led to the creation of strong programs in math, biology, physics, and geoscience education.

Purdue has a long-standing interest in the preparation of secondary school science and mathematics teachers. From 1965 until 1972 (when publicity about an oversupply of teachers began to take effect), Purdue graduated an average of 12 chemistry teaching majors each year, with a comparable number receiving minor certification in chemistry. This program continues, but with fewer students. From 1960 until NSF phased out support for such programs in 1972, Purdue also ran a summer institute program for high school teachers. Approximately 120 secondary chemistry teachers from across the United States received M.S. degrees in chemistry under that program.

Purdue has a large graduate program in chemistry, both in terms of the number of entering students and the number of graduate degrees awarded each year, and it has been ranked as one of the top chemistry graduate departments in the country.<sup>1</sup>

Our history of involvement in chemical education at the secondary, tertiary, and graduate levels; our commitment to research in chemical education; and our growing concern over what appears to be a deterioration of science and mathematics education throughout the country were important precursors to establishing a separate division of chemical education.

### **Where Are We Headed?**

As with any other chemistry division, our success will depend on our ability to attract students and funding. Still, we have high hopes for significant progress in the following directions:

- We hope to expand our research efforts in chemical education, taking advantage of the wide range of training and experience found among the chemical education faculty at Purdue, and to foster implementation of research findings in instruction.
- We hope to obtain funds to enable faculty from other institutions to spend a sabbatical year working in chemical education at Purdue.
- We hope to expand our graduate program in chemical education. We now offer M.S. degrees in science education, but lack of financial support for students engaged in thesis research limits the number of students in these programs.

- We hope to provide elective chemical education courses for graduate students in analytical, inorganic, organic, physical chemistry, and biochemistry who wish to teach at the tertiary level.
- We hope to increase the number of undergraduate chemistry majors pursuing careers in secondary teaching.
- We hope to develop a program of continuing education for practicing secondary chemistry teachers.
- We hope to work with practicing chemistry teachers and professional organizations to overcome political and financial impediments to improving science education in schools.
- We hope to provide improved instructional materials at all levels and for individuals of varying abilities and career teaching goals.

### **Evidence for Progress Thus Far**

We have seen some progress toward several of our goals in the two years since this reorganization took place. The most significant progress has been in the size of our graduate program. We now have 15 students pursuing M.S. or Ph.D. degrees in chemical education or science education at Purdue. We used to have two or three.

1. *An Assessment of Research-Doctorate Programs in the United States.* *Mathematical and Physical Sciences*. Washington, D.C.: National Academy Press, 1982. See also, *Chemical and Engineering News*, September 27, 1982; p. 4.