

M. I. T.'s SCHOOL OF CHEMICAL ENGINEERING PRACTICE

The Powerful Potential of Alumni Support ...or....How Its Graduates Matched Their Enthusiasm with Their Money

JOHN I. MATTILL

Massachusetts Institute of Technology
Cambridge, MA 02139

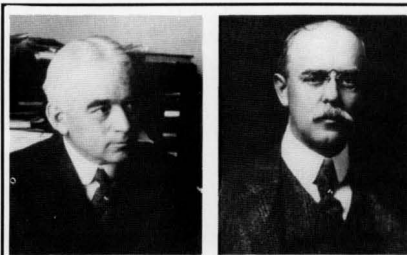
In January of 1980, Selim Senkan and J. Edward Vivian wrote an up-beat description of MIT's School of Chemical Engineering Practice (SCEP) for this journal.^[1] What they did not emphasize in that paper was that this unique educational program, then in its 64th year, had some threatening liabilities as well as the assets they so ably celebrated. When some of those liabilities materialized in the next decade, graduates of the Practice School, many of them among the top leadership of the U.S. chemical industry, moved aggressively to support this unique concept in chemical engineering education. Indeed, the School today is an example of the influence that alumni can have on professional education in chemical engineering.

To tell this story is, in fact, to tell a brief history of the School. What follows is a radical condensation of the history prepared by the author as a complement to SCEP's 75th anniversary celebration in 1991.^[2]

From the beginning of instruction at the Massachusetts Institute of Technology in 1865, there was an option in "practical and industrial chemistry," and by 1888 it had become the nation's first four-year curriculum in chemical engineering. Beginning in 1884, its head was William H. Walker, an entrepreneurial analytical chemist trained at Penn State and the University of Gottingen.

One of Walker's major concerns in teaching chemical engineering was to help students understand how chemistry was different when scaled up to industrial dimensions. For many years, he gave his students a sense of the industrial environment by

taking them on week-long tours of major chemical plants in the Northeast. But by 1914 enrollment had become so large that the difficult logistics of such tours proved insoluble, and they were terminated.

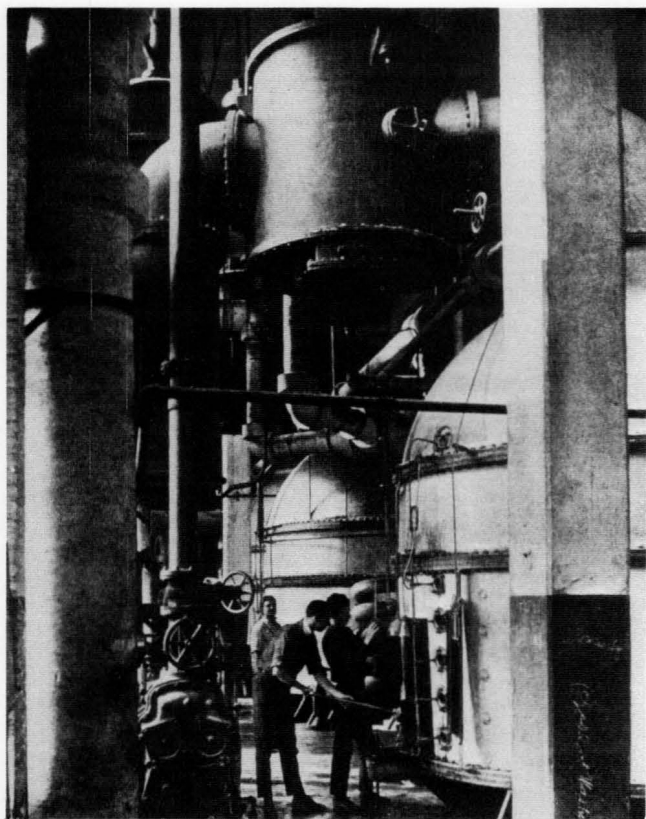


The School of Chemical Engineering Practice was conceived jointly in 1915 by William Walker (L) and Arthur D. Little (R), whose own career proved that even young people without chemical degrees could contribute significantly to the chemical industry.

Photographs courtesy M.I.T. Museum

Walker, however, remained concerned about how to best introduce his students to chemistry in industry. His friendship with Arthur D. Little, who had entered

M.I.T. in 1881 to study industrial chemistry, was to eventually lead him to the solution to that problem. Little never finished the four-year curriculum—financial needs and his impatience with academics led him to go to work in 1884 as assistant chemist in



Photograph courtesy M.I.T. Museum

In the early years, the Practice School was concerned as much with teaching the scale as the sophistication of industrial chemistry. These students in the School's first post-World-War-I class were photographed at the Revere Sugar Refinery near Boston.

a small paper mill in Rhode Island where, despite his modest academic credentials, he almost single-handedly perfected the plant's sulphite papermaking. Soon thereafter, Little became a pioneering and successful consultant, and he presently was chosen for membership on M.I.T.'s Corporation—its board of trustees.

As Little's success demonstrated, the country's fast-growing chemical industries were desperate for technical help—just as Walker was desperate to give his students industrial experience. The logic was inescapable, and Little and Walker devised an elegantly simple exercise of it. M.I.T. would establish branches (they were called "stations") at several chemical plants. Faculty would be augmented so that two teachers could be in residence at each station, and groups of Master's students would visit the stations to learn plant operations under supervision of the resident faculty. In between terms and during summers the resident faculty would work on technical problems for the host companies; they would likely

As Little's success demonstrated, the country's fast-growing chemical industries were desperate for technical help—just as Walker was desperate to give his students industrial experience. The logic was inescapable, and Little and Walker devised an elegantly simple exercise of it.

be the companies' most sophisticated research and development people, and if they needed even more expertise, it could be obtained from M.I.T. colleagues. The companies would meet the stations' operating costs, and M.I.T. would pay the faculty salaries.

Little solicited a \$300,000 gift (a prodigious sum in 1916 dollars) from George Eastman to build the needed stations. As it turned out, the companies in their enthusiasm built the needed stations themselves (offices, libraries, adjacent small laboratories), and Eastman's gift became a useful nest-egg for the Practice School. The scheme quickly drew the approval of M.I.T.'s faculty, administration, and Corporation, and a communication to the *London Times Engineering Supplement* applauded the experiment for chemical engineering students "who have no doubt found that dexterity with flask and test tube does not create precisely the self-confidence needed by the chemist who is working with, say, 25,000 gallons of acid in a digester."^[3]

During their six weeks at each station, the students' assignments included creating and drafting a plant flow sheet, laboratory exercises using the plant's test equipment, lectures by the faculty and selected company staff followed by a series of "home quizzes," and group work on several plant problems that typically involved measuring the effects of changes in one or more process parameters. Each student served at least once as a project leader for a group of three to five colleagues, and each group was required to make formal presentations of project plans and progress reports in addition to verbal and written final reports. Students often had to devise and build the test equipment they needed, and every student worked on at least one problem that required taking data for a 16-to-24-hour period. Alumni complain that there was never enough time to do everything. But the faculty were unresponsive; they wanted the program to replicate the characteristics of professional work—the pressure for results, the need to innovate technical methods, and the problems of group leadership, project planning, and technical reporting. Alumni almost without exception suggest that this mission was accomplished;

the School gave students confidence and a powerful enthusiasm for the profession they were entering.

Some interesting comments by students in the Practice School's first class in 1917 are:

- *Every member of the group is impressed with the change from the theoretical viewpoint of the classroom to the practical viewpoint of the course.*
- *To say a Guy-Lussac tower is so many feet high is one thing but to climb it is another.*
- *We are gaining an interest in our work that has never been equalled, and we are gaining a friendship with men of importance in our profession.*

As late as 1949, Gerald Lessells, now retired, was having experiences that were typical of SCEP's earliest years: "We had been working since eight the previous morning, getting ready for a stream-flow measurement in a high-pressure steam line. After machining our own orifice and setting up for pressure-drop measurements, we stood aghast in the small hours of the next morning as our sole achievement was to blow the mercury in the manometer into the steam line. We quit, almost in tears. But we finished successfully the following day. That was forty-one years ago, and I still can remember the frustration, and later the sense of fulfillment, when we reached our goal."

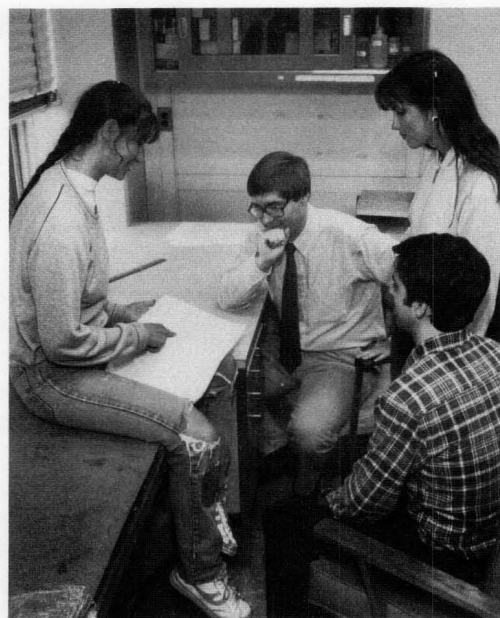
Since then there have been evolutionary changes. Today, the Practice School programs focus almost entirely on problems suggested to the resident faculty by company technical personnel who then become the students' consultants on the projects. Students' reporting sessions are, in effect, plant seminars attended by both company personnel and M.I.T. representatives; Practice School alumni are especially enthusiastic about their experiences in preparing and presenting reports, the final versions of which ended up in the host companies' proprietary files. Practice School faculty have no roles in companies' research except to help identify technical problems suitable for student projects and to help



Photograph courtesy Oak Ridge National Laboratory, from M.I.T. Museum
Reporting project results to colleagues and company hosts is cited by alumni as an important contribution of the Practice School. Shown above is Elsa Kam-Lum, the second woman to attend the Practice School, at the Oak Ridge Station, 1973.

students fulfill the companies' needs.

The students, whose role is likened to that of outside consultants, are unpaid—which gives them license to continue the traditional complaints about intense pressure and overload. But they continue to draw confidence from their work (which typically becomes company property) and to take great pride in it. Projects of Practice School students at American Cyanamid's Bound Brook plant between 1962 and 1967 were said to have saved that company an average of \$160,000 a year, and savings of millions of dollars are attributed to two student projects at Dow Chemical Company in the 1980s.



Photograph courtesy Bethlehem Steel Corp., from M.I.T. Museum
A typical student-faculty ratio and relationship: Professor George Huff ('82) with three students at the Bethlehem Station (1982-1984).

In the 1960s, as the Practice School passed its 50th birthday, however, a host of problems began to press on it:

- This was a time of growing emphasis on "engineering science," especially at M.I.T. Practical experience such as emphasized by the Practice School was out of style, and many

students (and some staff as well) thought SCEP was irrelevant. Enrollment fell.

- In order to attract students, M.I.T. asked the host companies for help with the students' expenses at the stations, and companies subsequently agreed to provide funds that could be awarded as fellowships to cover tuition and a part of living expenses. But tuition was rising faster than the rate of inflation, and companies found these rising commitments onerous.
- Despite these stipends for their semester at the



Photograph courtesy Esso, from M.I.T. Museum

Professor Warren K. Lewis ('05), who taught at M.I.T. from 1908 until well beyond his official retirement in 1948, regularly visited the stations—shown here at the Bayway Station in 1959.

stations, students found the Practice School an expensive option. Away from the campus for one semester, they were poor candidates for on-campus research or teaching assistantships that were available to most other graduate students.

- The Practice School was clearly a cost center for M.I.T. as well as for its host companies. With two members of the faculty at each station, Practice School students enjoyed the Institute's lowest student-faculty ratio, and higher housing costs resulted from the arrival of women and married students. The Eastman funds were long gone.
- More and more foreign students came to M.I.T., and far more in proportion than American students sought out the Practice School as a way to learn about American industrial practice. But to the companies foreign students were vexatious—unlikely to be available for employment after graduation and very likely to carry American methods back home to overseas competitors.

For all these reasons, by the late 1970s SCEP began to look to the M.I.T. administration more like a liability than an asset, and its termination seemed likely.

But its alumni had not yet been heard from, and almost

from the year of its founding the Practice School was distinguished by the enthusiasm of its former students—an esprit probably greater than among the alumni of any other graduate-level program at M.I.T. Fully ninety percent of the funding for the department's new building in Cambridge, dedicated in 1976, had come from Practice School alumni or companies that they founded. When queried in 1991 (in anticipation of the School's 75th anniversary), an extraordinary number of them wrote enthusiastic recollections, saying that their Practice School experiences had been pivotal in shaping their careers.

Peter Melnick ('52, Hercules, Inc.) credited SCEP with "a hands-on practical experience that opened up the real world of industrial manufacture, revealing how everything in engineering is tied together." Ralph Landau ('41) said, "I never worked so hard in my life, but I really learned how to concentrate and get a job done under forced draft." Vernon Bowles ('33) remembers the Practice School as "the greatest experience of my educational encounters."

Because they were prominent in the profession, SCEP alumni were prominent in the councils of M.I.T.—including especially the Corporation's Visiting Committee to the Department of Chemical Engineering. Unmoved by an estimate that \$180,000 a year might be needed to overcome the problems that beset the School, they stonewalled any suggestion of terminating what Professors Senkan and Vivian had called "a continuing catalyst in engineering effectiveness."^[4]

One of the trump cards was played by Charles Reed ('37), whose doctorate in chemical engineering from M.I.T. had not included SCEP experience. In 1977, as General Electric's senior vice president for corporate technology, he had invited SCEP to open a station at GE's chemical plants in Waterford and Selkirk, New York; he thus rescued the Practice School from the embarrassment of a two-year search to replace its station at Bound Brook, New Jersey, terminated when American Cyanamid found the escalating costs too high. Upon hearing the project reports by the first class at the Schenectady station, Reed wrote M.I.T. that the students "did an extraordinarily good job of presenting (their) results and recommendations. I was really delighted." Returning to his office from Schenectady after a similar session the

The decisive event was the commitment by John Haas ('42), then vice-chairman of Rohm and Haas, to head a fund-raising effort among companies in which SCEP alumni held major posts. Haas had come to M.I.T. from a liberal arts background, and he says "I didn't know what a reactor was until I went to the Practice School."

next year, Reed reported to M.I.T. President Jerome B. Wiesner, "I was tremendously impressed with the great range and high quality of the projects being worked on (The students') studies have resulted in recommendations expected to (yield) savings of \$400,000 to \$700,000 a year (The Practice School provides) a most important type of experience that many of us wish we could have had at an early age. In my opinion, this is really unusual and highly valuable graduate education."

The decisive event was the commitment by John Haas ('42), then vice-chairman of Rohm and Haas, to head a fund-raising effort among companies in which SCEP alumni held major posts. Haas had come to M.I.T. from a liberal arts background, and he says "I didn't know what a reactor was until I went to the Practice School." He, Landau, and twelve other prominent alumni, establishing themselves as "Friends of the Practice School," in 1980 completed a \$600,000 fund for fellowships for Practice School students while in Cambridge. Donor companies received only one "perk" as an incentive—they had first review of the resumes of all M.I.T. chemical engineering graduate students about to receive their degrees.

But the Friends' fund was a wasting grant that would soon enough be exhausted and plunge SCEP back into uncertainty. So in 1981, Haas made a new proposal. The Phoebe Hass Charitable Trust, he said, was considering a \$500,000 grant to M.I.T. If he persuaded his M.I.T. undergraduate classmates to match that gift for their 40th M.I.T. reunion, would the Institute commit the resulting \$1 million Class of 1942 Professorship to a member of the faculty who would have the goal of stabilizing SCEP operations within five years? After some frustrating months of indecision, the Institute administration accepted this proposal, and Jefferson Tester ('71) was recruited from Los Alamos to be Class of 1942 Professor and director of the Practice School. Tester never studied in the Practice School, but he had served two years as a station director after completing his doctorate at the Institute, and his enthusiasm for the Practice school was unbounded.

During his first year as director, Professor Tester

- Changed the SCEP curriculum so that the School



Photograph by Barry Hetherinton, from M.I.T. Museum

At the Practice School's 75th anniversary celebration in 1991 are (left to right) David Koch ('63) of Koch Industries, Inc., Jean Leinroth ('48), director of summer stations at Syntex Chemicals and Chevron, and Professor Jefferson Tester ('71), Practice School director from 1980 to 1989.

could serve three groups of students: outstanding undergraduates who would study for five years at the Institute, including one term at the Practice School, and receive both bachelor's and master's degrees; M.I.T. doctoral students, who would study for a one term at the Practice School in order to gain a sense of industrial practice available to few ScD and PhD candidates; and graduate students who, after completing undergraduate degrees elsewhere, would come to M.I.T. for master's degrees in chemical engineering practice, studying for two terms in Cambridge and one summer at the Practice School stations and thus making SCEP a year-round activity.

- Raised the salaries of Practice School station directors so that they related not to faculty salaries at M.I.T. but to industrial salaries for people of comparable experience in the plants in which they served.
- Increased the budgets of SCEP's stations to include travel and some of the professional/social occasions that animated the Practice School of the 1930s and 1940s, when the Eastman funds had been available.
- Raised the visibility of the Practice School by a variety of strategies that reflected Tester's confidence in and enthusiasm for the program.
- Worked with alumni and M.I.T.'s fund-raising apparatus to catalyze two separate fund-raising efforts. The first reactivated the Friends of the



Photograph by Carole Williams, from Chevron Focus

Shown here on their first day at the Richmond (California) Station, students tour the Chevron Refinery, 1989.

Practice School organization (Robert Richardson, '54, then executive vice-president of Du Pont, became chairman) to fund for several more years the corporate-sponsored fellowships first established in 1980. The second—and far more ambitious—effort was to raise from individual donors (corporate gifts were not solicited) an \$8 million endowment to permanently underwrite fellowships for SCEP students during their Cambridge studies. This task was accepted by the Corporation's Visiting Committee, whose chair was Jerry McAfee ('40), retired chairman and chief executive officer of Gulf Oil Company.

Though it is far easier in the telling than it was in the doing, the final result was celebrated late in 1990 when the endowment was completed with a major gift from David H. Koch ('63) executive vice president of Koch Industries, Inc., leading to the School being renamed in his honor. "There was nowhere else in my M.I.T. experience," Koch told me, "where I had the chance to test my technical abilities, and I figured any educational experience that was this powerful for me might be of similar value to others."

With the endowment complete, the David H. Koch School of Chemical Engineering Practice entered the 1990s with its annual funding of about \$1.3 million coming roughly in equal parts from endowment income, host companies, industrial fellowship grants renewing those obtained by the Friends, and M.I.T. resources. The endowment income and industrial grants cover stipends for Practice School students while studying in Cambridge; the host company funds are used by M.I.T. for fellowships for students at the stations, and Institute funds cover SCEP faculty salaries and benefits and administrative expenses.

As of 1993, the David H. Koch School operates year-round stations at Dow Chemical Company and neighboring Dow-Corning Company, Midland, Michigan, and Merck and Company's pharmaceutical operations at West Point, Pennsylvania. Annual enrollment is typically between thirty and forty, and the waiting

list extends well into 1994. Each student spends eight weeks at each station, normally working on two four-week projects in two different groups. Thus each student has the experience of group leadership once during his or her term at the stations.

Essentially all M.I.T. Master's candidates in chemical engineering attend the Koch School, and two-thirds of all Doctor's candidates do so. Its director is T. Alan Hatton, Chevron Professor of Chemical Engineering at M.I.T., whose enthusiasm for the Practice School was developed as a station director during the summers of 1983 and 1984.

Perhaps the best recent summary of the School's status was given by Professor Jeffrey Feerer, associate director of SCEP from 1989 to 1992, at a 1990 conference on national materials policy: "For almost seventy-five years this chemical engineering internship program has directly transferred innovation and technology from the universities to the production floor, and it has educated chemical engineering students to the specialized and complex problems of chemical manufacturing. In doing so, it has provided a unique link between the narrowness of graduate chemical engineering education and the breadth of activities in which chemical engineers participate in the workplace.

"The Practice School is today more vibrant than at any time in its history, thanks in part to a legion of alumni/ae who celebrate the value that the Practice School experience has had in their careers."^[5]

REFERENCES

1. Senkan, Selim M., and J. Edward Vivian, "MIT School of Chemical Engineering Practice," *Chem. Eng. Ed.*, **14**, 200 (1980)
2. Mattill, John I., *The Flagship: The M.I.T. School of Chemical Engineering Practice, 1916-1991*, Dept of Chem. Eng., M.I.T. (1991)
3. Quoted in *Tech. Rev.*, **18**, 885, November (1916)
4. Senkan and Vivian, *op cit.*, 200
5. Feerer, Jeffrey, "The M.I.T. Practice School: A Unique Partnership of Education and Industry." Unpublished paper for the Workshop on Education for National Materials Processing Efficiency, 11th Biennial Conference on National Materials Policy, Federation of Materials Societies, June (1990) □