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Something in Common: Eastern Manufacturing Company, Massachusetts Institute of Technology's School of Chemical Engineering Practice, and the University Of Maine

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SOMETHING IN COMMON: EASTERN MANUFACTURING COMPANY, MASSACHUSETTS INSTITUTE OF TECHNOLOGY'S SCHOOL OF CHEMICAL ENGINEERING PRACTICE, AND THE UNIVERSITY OF MAINE

By Pauleena MacDougall

Part of Eastern Manufacturing Company's innovative history in the field of fine paper production was the development of a unique cooperative arrangement with Massachusetts Institute of Technology's Chemical Engineering Department, which was focused on the practical application of chemistry to industry. To further its goals, the MIT department formed Practice Schools that partnered with chemical-using industries across the nation to bring academic chemists and their students into manufacturing plants to solve practical problems in chemistry. Eastern Fine's pioneering role in this project was a model for the Chemical Engineering Department at the University of Maine.

IN THE course of our oral history research with former employees of Eastern Manufacturing in Brewer, Maine, the Maine Folklife Center retrieved an extensive collection of architectural and mechanical drawings dating from 1895 to 2005. Among these were some labeled "MIT Lab." Curious, I asked Professor of Chemical Engineering Joe Genco at the University of Maine if he had heard of the MIT-Eastern Manufacturing connection, and he said, "Yes, of course. You should talk to Bill Ceckler, who used to be an instructor at the lab."[1] Following his advice, we interviewed retired Chemical Engineering Professor William Ceckler, who related his experiences at the MIT Practice Schools connected to the Eastern Corporation in Brewer and to Bethlehem Steel in Lackawana, Pennsylvania. Ceckler went to MIT in the fall of 1951 as a graduate student and finished up in the summer of 1952. After working as a student in the Practice School, he then took a position as an instruc-

Eastern Fine Paper Corporation innovated in a variety of ways to maintain its edge in an extremely competitive market for fine papers. In one instance, it partnered with Massachusetts Institute of Technology's chemical engineers to provide work experience for their students, who carried out practical projects to improve production at the mill. The result was the School of Chemical Engineering Practice. Maine Folklife Center.

tor in the program and remained through the fall and winter of 1952 and the fall and winter of 1953. He worked at Eastern for one session, but his main assignment was at Bethlehem Steel in Pennsylvania. Ceckler regards the MIT Practice School as an innovative and effective educational program — "the best technical program in the world. . . it really was tremendous."[2] We also found some journal and newspaper articles relating to the laboratory. From these sources we unearthed a fascinating story relating local industrial history to the history of science and education.

At the turn of the twentieth century, the United States had several chemical industries, including pulp and paper, rayon, and steel. These industries relied heavily upon Germany for the chemicals they needed to make these goods. When World War I began, a blockade was placed on imported German goods. Industry leaders realized they needed a domestic pool of industrial chemists. As a result, they turned to the chemistry department of the Massachusetts Institute of Technology in Cambridge, Massachusetts for help. A partnership began that brought university-trained chemists into manufacturing facilities to study the chemical processes of pulp and paper, steel, and rayon making.

The partnership came to be called the School of Chemical Engineering Practice. One of the initial three sites for the practice school was Eastern Manufacturing in Brewer (working closely with The Penobscot Chemical Fibre Company of Old Town). The others included a Boston Practice School, which served the Merrimac Chemical Company, the Revere Sugar Refinery, and the Boston Rubber Shoe Company. The third was located in Buffalo, New York, and served the Lackawanna Steel Company and the Larkin Company. The products served by the practice schools were pulp, paper, caustic soda, chlorine, heavy acids, chemicals, sugar, rubber, iron, steel, gas, coke, soap, and glycerol.[3]

Although today chemical engineering is one of the four large engineering disciplines, together with civil, mechanical, and electrical, the discipline was in its infancy at the beginning of the twentieth century. Each of the four branches sought to separate themselves from their associated sciences and form their own professional groups. Chemistry had a limited tradition of industrial employment, a trend that continued until World War I. Chemists who worked in production — either as managers or as consultants and troubleshooters — were the forerunners of chemical engineers. However, most industrial chemists who conducted analysis of materials during manufacturing processes engaged in a daily grind of routine chemical testing. They were held in low regard and received little compensation for their work. Chemists made considerably less money than skilled artisans in industrial plants. Therefore industrial chemists wanted a new professional designation separating them from analytical chemists and placing them in managerial roles within industry. In 1907 and 1908, a number of industrial chemists met to discuss the formation of a new society of chemical engineers and established the American Institute of Chemical Engineers. In 1915, Professor Arthur D. Little of the Massachusetts Institute of Technology defined Chemical Engineering as a science, the basis of which is "unit operations that take place in an industrial scale" — that is, extracting, crystallizing, grinding, air drying, and so on. Once defined in this manner, the practices of chemical engineers naturally led to management positions in industry. Chemical Engineers embraced administrative skills and management in addition to chemistry. Some spoke of themselves as "chemical managers."[4]

Due to the growing demand for chemicals in American industry, between 1890 and 1930 the number of industrial research laboratories in America grew from four to over one thousand, and by 1921 the number of chemists employed in research in these institutions totaled more than 3,800, some four times the number of chemists teaching in American colleges and universities.[5] Meanwhile, the economic and social demands of World War I brought a surge in American industry, even while the Allied blockade of German shipping created shortages of essential chemicals such as industrial alcohol and gasoline. These shortages encouraged American chemists to develop new chemical processes.

Prior to the war, the United States industrial sector created more practical items and produced markedly fewer specialized products. For example, American producers made glass for bottles and windows, but not high-quality glass for lenses. Americans created large volumes of sulfuric acid, alkalis, and chlorine but imported most fine chemicals, such as synthetic dyes, aromatics, and organic reagents. American industry had not yet developed more technologically sophisticated processes.[6] The new demand for industrial chemists brought on by the blockade of Germany helped to spur the development of chemical engineering. Increasing numbers of chemists enrolled in chemical engineering programs, which led to better-paying jobs in industry.

MIT was an innovator in developing physical chemistry and creating the first chemical engineering program. After WWI, MIT chemical engineering professor Arthur Amos Noyes insisted upon physical chemistry in the curriculum in chemical engineering, and by 1902 a course in theoretical chemistry was made a requirement for students of chemical engineering at MIT. William H. Walker, a chemical engineer with experience in business, preached the dignity of the engineer's calling and the necessity of specialized instruction in engineering practice and principles.[7] Walker was instrumental in setting up industrial research laboratories to train his students.

The School of Chemical Engineering Practice.

MIT developed a network of industrial research laboratories in several industries, which became known as the Chemical Engineering Practice School. The school's design helped industry utilize contemporary scientific knowledge. It also served small companies that could not afford their own research laboratories. Each of the three laboratories employed a member of MIT's teaching staff, who was responsible for instructing students and conducting research helpful to the host company. In 1916 Walker, together with his younger colleague Warren K. Lewis, established the first School of Chemical Engineering Practice. Basically a cooperative extension program, the School sent faculty members and students from MIT to select industrial plants where they had, for part of the school year, the direct contact with production that Walker advocated. The program gave MIT's chemical engineers access to the costly facilities necessary to illustrate classroom instruction in unit operations. The School of Chemical Engineering Practice was a notable and widely emulated success. Between 1905 and 1909, the majority of MIT's undergraduates in chemistry took their degrees in basic chemistry. However, by 1920-1924, 419 chemical engineers graduated compared with only 52 chemists.[8]

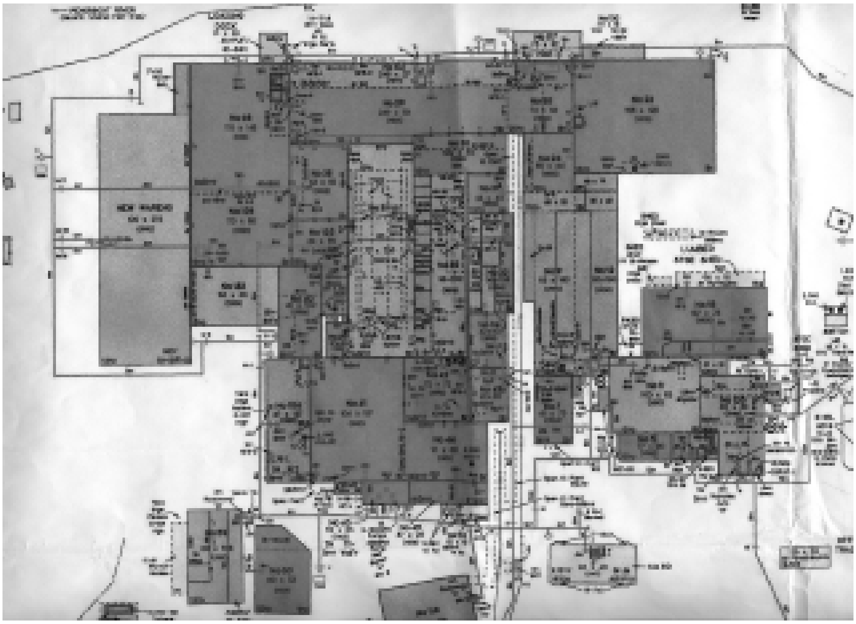
The program at MIT developed under the auspices of three pioneers in American chemistry: Arthur D. Little, A.A. Noyce, and Warren K. Lewis. All three received advanced education in the famous high schools of the German industrial complexes, came back to the United States, and taught at MIT.[9] There they discovered a need for a formal program in industrial chemistry focusing on the practical application to industry and accordingly formed a chemical engineering department in conjunction with the practice school. At the practice schools, students would develop and then apply the technical knowledge they received in the classroom. Little, Noyce, and Lewis established three separate programs at three different sites: Eastern Fine Paper in Brewer and Old Town; at Bethlehem Steel in Lackawanna, Pennsylvania; and Hercules Powder, formerly Hercules Chemical Company, in Parlin, New Jersey. The latter made cellulose acetate, chlorinated rubber products, nitric acid, and sul-

Chemical Engineering Professor William Ceckler remembers his days as an MIT student attending the Chemical Engineering Practice School at Eastern Fine. He later taught briefly for the school in another location. University of Maine Fogler Library Special Collections Department.

furic acid. At that time cellulose nitrate was used for gunpowder, ammunitions, and photographic film. MIT also had a practice school at Oak Ridge National Laboratory, where students spent an entire semester.

At the Eastern laboratory, students attended six weeks training at each location: Eastern Fine Paper in Brewer, and Old Town Chemical Fiber. Each plant's safety team provided a safety lecture as an introduction during the first week, and the director of the mill's testing lab helped design problems for the students. The practice school lab itself was separate from the lab where technicians tested pulp and paper samples, and it included a chemistry lab, an office, a library, a study area, and a machine shop. The program was not cooperative: students were not paid for their work but rather they paid tuition to join the program. The program maintained two staff persons: the director, who was an assistant professor in the department at MIT; and an assistant director, who was an instructor. The students' first week involved plant familiarization. They were given a set of questions and told to interview plant people, after which they prepared a detailed flow sheet of the plant. They then had to ink and letter the plan — a lengthy process in the pre-computer age.

Typically, this was followed by two one-week projects with students working in groups of three or four. When Ceckler attended as a student, Eastern had recently installed an ammonia-base sulfate cooking liquor process, which necessitated the efficient recovery of ammonia. The stu-

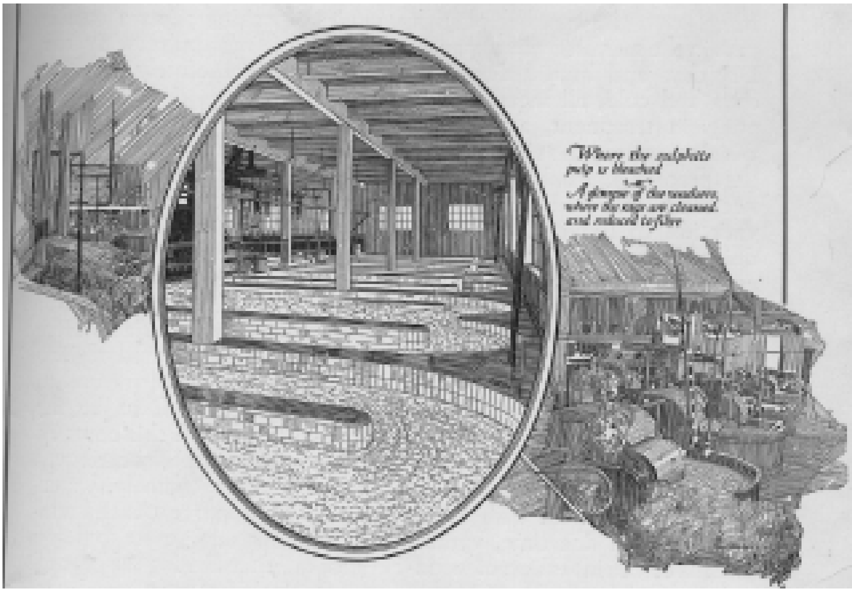


Students in the Practice School, usually seniors or graduate students, were given a practical problem worked out by the school's directors in consultation with the plant's engineers. As this mill flowsheet suggests, the problems could be complex and difficult, but in the main they benefitted both the students and the mill operators. Fogler Library Special Collections Department.

dents measured the flow velocity and the concentration of various chemicals in the blow-out stacks from the pulp digesters and wrote a report. The projects were one week long, assigned on Monday. Students had to devise a plan by Tuesday, then prepare a report on what they did; the report was usually due Friday morning. On Friday afternoon, they delivered a ten-minute presentation about the project, and the people in the plant who were involved with the particular process would attend.

Although the participants were either graduate students or seniors, they usually had to rewrite their reports several times. In the day of the typewriter, re-writing was no easy task, and by the time students reached the third station in this program, they were well motivated to make their first draft a finished, final copy. Although rigorous, the training advanced students' skills in both chemical engineering and in their ability to communicate, giving them a clear advantage over students in a typical technical undergraduate program.

The director and the assistant director, in consultation with the tech-



Paper-making is a chemical-intensive process, and MIT students learned a great deal from their practical experience in the mills at Brewer and Old Town. A side benefit was their annual overnight hike to the top of Katahdin. Maine Folklife Center.

nical people in the plant, chose the problems for students to solve. Ceckler thought that the companies received an even deal. The problems varied in difficulty and relevance to the plant's operation, but the plant management and workers liked the program, and the students had full run of the mill. They were asked to wear hard hats and safety glasses, but they were allowed to snoop around the whole plant in order to construct their flow sheets and work on their assignments.

Ceckler explained that the practice school always featured at least three visits by senior faculty. Professor Lewis, the founder of the MIT Practice School, visited Eastern Corporation's school when Ceckler was a student. His visit added to the students' perception of the intellectual exercise; he challenged everyone, constantly interacting with students through a dialogue of questions and answers. Ceckler found this a highlight of his experience as a student there.

Irene Mossbacker, a World War II widow from Bangor, ran a boarding house on Forest Avenue for the MIT students. She was able to accommodate about fifteen students, although some had to share beds. Mossbacker also retyped reports for students and put them on a mimeograph and copied them in final form. The Chemical Engineering Department in Cambridge keeps those reports. One tradition at the Eastern Corporation school was a climb up Mt. Katahdin with makeshift sleeping bags fashioned bags out of used paper-machine felts. Every group of students climbed the mountain — one even tried it in the winter! Back in those days the students didn't have sleeping bags or camping equipment, so they fashioned bags out of used paper-machine felts. International students made up a third of this student body, and it was quite an experience for them to climb the Chimney, cross the Knife Edge, and scramble back down to the base carrying all their gear. According to Ceckler, many students still remember the Katahdin trips as part of the Eastern Corporation experience.

Each of the mills — Eastern, Old Town, and Penobscot Chemical Fiber — had electro-chemical plants. They had their own turbines and generators, and they generated their own chlorine and caustic materials. They also absorbed the chlorine back into caustic, forming sodium hyper-chloride, which was then used for bleaching. They had their own sulfur burners, and Old Town had recovery furnaces. In the 1950s Eastern developed a way of making pulp from mixed hardwoods using an ammonia base, becoming the first US company to perfect the process. They also made rayon pulp, producing this early synthetic fiber for the DuPont Corporation, the primary manufacturer of rayon. These processes provided a substantial number of problems for students to solve.

At the end of the program, students spent an additional three weeks at the institute doing a large design project. For example, a student would have to design an ethanol plant in substantial detail. This process had a competitive element as well, as two or three groups would work on different projects. The experiences students gained at the MIT Practice Schools prepared them for the best jobs in the industry. They became senior executives of chemical process companies around the world, as the program expanded internationally. Although Eastern Corporation has closed, it was among the pioneer industrial companies providing training for chemical engineers.

After completing his program at MIT's Practice School at the Eastern Corporation, Ceckler returned to MIT, finished the experimental work on his thesis, and went to direct the practice school at Bethlehem Steel in Lackawanna. He later worked for the steel industry for a number of years and then, always having wanted to teach, applied for a job at the University of Maine.

The University of Maine began to build its first chemical laboratory, known as Chemical Hall, in 1867. Students conducted much of the work, including making the bricks for the building, but it was not until 1871 that the University hired faculty to teach chemistry.[10] In 1913, Ralph McKee offered two courses in pulp and paper technology. In the 1940s, Lyle Jenness, a professor in the chemistry department, and Edward Allen Whitney, a trustee of the University from 1948 to 1956 who incidentally was a practice school director, proposed a separate chemical engineering department at the University of Maine. Industry supported the faculty and students through the Pulp and Paper Foundation, which was established in 1950.[11]

According to Ceckler, every teacher who went through the practice school tried to incorporate similar ideas into their methods. Ceckler took his University of Maine students to Old Town when the flat dryer was first installed, and they measured dryer efficiency. They also did some bleaching problems and foaming problems. The University of Maine department has followed in the tradition of doing experiments for the paper industry, using a small-scale paper machine in the pilot plant and helping to create value for companies in the state. In earlier years about seventy-five percent of the graduating seniors went to work for pulp and paper companies, many of them within Maine.

At the end of the interview with Bill Ceckler, I showed him a photograph from the *Bangor Daily News* taken on March 10, 1952. It accompanied an article about the MIT graduate students. The journalist had spelled Bill's name "Ceckla," reflecting the way his name would have been pronounced in Bangor. Ceckler recognized the other students in the picture: "Yes, Les Case, oh yes. Sully Santos, oh Sully was obsessed with Bar Harbor and Sully just wanted to get down to Bar Harbor as soon as he could. Yes, there's Irene Mossbacker's place."[12]

NOTES

1. Personal communication.

2. William Ceckler to Pauleena MacDougall, Tape-recorded Interview, May 10, 2007, Maine Folklife Center, University of Maine.

3. R.T. Haslam, "The School of Chemical Engineering Practice of the Massachusetts Institute of Technology," *The Journal of Industrial and Engineering Chemistry* 13 (May 1921): 465.

4. Terry S. Reynolds, "Defining Professional Boundaries: Chemical Engineering in the 20th Century," *Technology and Culture, Special Issue: Engineering in the Twentieth Century*, 27 (October 1986): 694-716.

5. John W. Servos, *Physical Chemistry from Ostwald to Pauling* (Princeton, New Jersey: Princeton University Press, 1990).

6. Servos, *Physical Chemistry*, p. 212.

7. Servos, *Physical Chemistry*, p. 247.

8. Servos, *Physical Chemistry*, p. 259; Christophe Lécuyer, "Academic Science and Technology in the Service of Industry: MIT Creates a 'Permeable' Engineering School," *American Economic Review* 88, *Papers and Proceedings of the Hundred and Tenth Annual Meeting of the American Economic Association* (May 1998): 32.

9. William Ceckler to Pauleena MacDougall, Tape-recorded Interview, May 10, 2007. Maine Folklife Center, University of Maine.

10. David C. Smith, *The First Century: A History of the University of Maine, 1865-1965* (Orono: University of Maine Press, 1979), pp. 12-13.

11. William Ceckler to Pauleena MacDougall; Smith, *The First Century*, pp. 173, 240-241.

12. William Ceckler to Pauleena MacDougall; *Bangor Daily News*, March 10, 1952.