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GEORGE OLIVER CURME, JR.

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A Biographical Memoir by

AUGUSTUS B. KINZEL

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GEORGE OLIVER CURME was born in Mt. Vernon, Iowa on Christmas Eve, 1888. He was the third child and first of two sons in a family of rugged individualists. His father, a professor of Germanic languages and literature at Mt. Vernon's Cornell College, was to gain such recognition in the field of philology that his namesake always referred to himself as G. O. Curme, Jr. His mother (Caroline Chenoweth Smith) was one of America's early women graduates with a diploma from DePauw University, and while his parents frequently held dissimilar views on many subjects, they were agreed on rigid and high intellectual and performance standards for their children. A cardinal rule in this Victorian household was, "whatever you do, do it well," followed closely by an insistence on precision in expression.

In 1896 George's father was appointed professor of German philology at Northwestern University, and the family moved to Evanston, Illinois. There George, Jr. attended the public schools and, in keeping with his peers, played tennis, baseball, and the mandolin and studied the "classics"—science not being included in the secondary curriculum at that time. Like his peers, he watched and played baseball, but unlike them he was an individualist. For example, he set some sort of a record by walking from Evanston, Illinois to St.

Louis, Missouri to see the "World's Fair" (the Louisiana Purchase Exposition) of 1904. It was at this time that he set as his personal goal the words of the baseball player, Wee Willie Keeler, "Hit them where they ain't."*

CHEMISTRY

At Northwestern University George O. Curme, Jr. was elected to Sigma Alpha Epsilon, served on the staff of the 1909 yearbook, appeared in his junior class play, managed and was elected captain of his class baseball team, and graduated with honors in 1909. What distinguished this period of his life to George Curme, however, was his introduction to chemistry and to a vision of what it might mean. This vision was far from universally held. As he recalled: "My own interest in chemistry began in 1905. . . . A few years later when I had decided to specialize in chemistry, I was urged by friends of our family to reconsider the matter on the grounds that there was no future in chemistry."† In addition, he noted the great cleavage that existed between the study of pure science and its beneficial, profitable applications: "I recall one of my much loved professors, who stated that if it was ever found that any of his research had commercial importance he would drop it immediately."‡ However, always an individualist, he disagreed. He said: "I just happened to be a character who thought that science was so wonderful that the public ought to be given a chance to benefit by it."§

To fit himself to help provide the public with this opportunity, he spent two summers in the stockroom of the University's chemical laboratory and following his graduation

* Personal communication, George O. Curme III.

† Remarks, Willard Gibbs medalist presentation, American Chemical Society, May 25, 1944.

‡ *Ibid.*

§ Remarks, Princeton University Conference, April 14, 1958.

enrolled at Harvard for graduate study. Following the death of his Harvard mentor, he transferred to the University of Chicago. Here, as he was later to discover and admit, even his Utopian view of chemistry was short of the mark:

> I recall as a graduate student at the University of Chicago attending the lectures of Professor McCoy who was at that time one of only two professors in the country offering courses in what is *now* called "atomic energy." It was a most interesting experience and for many years thereafter I thought of this field of science as the most fundamental of all, the least likely to have any practical value.*

In 1913 he was one of four candidates to receive the doctoral degree in chemistry from the University of Chicago. In his own words, the employment potentials outside the groves of academe looked bleak, even though, to his mind, the future was unbounded: "Growth as a part of management was not conceived in these days. The attitude of all industry was that the scientist was a saboteur trying to obsolete the Company's plants."†

GERMANY

Germany, however, was taking a far more opportunistic look at chemistry and had established world leadership in synthetic organic chemistry. In addition, young Curme had often heard his father speak with great enthusiasm about German education at the time of his studies at the University of Berlin in 1890. As a result, in 1913 G. O. Curme, Jr. enrolled at the Kaiser Wilhelm Institute to study for one semester under Fritz Haber, the discoverer of a synthetic ammonia process, and Professor Nernst. According to his heirs and friends, it was obvious that George Curme recognized that this course, together with the course that he took the

* Remarks, Pittsburgh Section, American Chemical Society, December 18, 1952.
† Interview with G. O. Curme, Jr., by Ms. Marion Merrill.

next semester at the University of Berlin under Professor Emil Fischer, were high points of intellectual stimulus and especial satisfaction to him, particularly since he was the coauthor of a paper with the renowned Emil Fischer. Of this he was quite proud.

Fate, in the form of shortage of funds, intervened to get the enthusiastic scholar out of Germany before World War I was declared. He had had time, however, to see what was being done in Germany and to foresee what could be done in the field of chemistry. He was convinced that America should put this fantastic tool to use industrially as well as academically. Despite his father's opinion that he should return to the academic world and the general lack of interest expressed by most industries in synthetic chemistry, George Curme was determined to find some way to bring reality to his vision.

DISCOVERIES

Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, provided the key by hiring him as a fellow for the Prest-O-Lite Company, a firm engaged in manufacturing acetylene lamps for bicycles and autos. The purpose of this fellowship was to discover some cheaper source of acetylene than the calcium carbide that the Union Carbide Company was producing. At a salary of $3,000 a year, including apparatus, on November 15, 1914 George O. Curme, Jr. became the Prest-O-Lite Illumination Fellow at Mellon Institute.

The next year G. O. Curme, Jr. made two discoveries that were probably the most important ones of his life. The first, in point of time, was that by using organic liquids in exothermic processes, he could produce not only acetylene, but also a hydrocarbon gas rich in ethylene. The second discovery occurred at the dinner party at which he met Lillian Grace Hale, a very pretty and lively home economics teacher. They were married on June 29, 1916 and had two sons and three daughters. Recounting the fateful meeting, George Curme continually expressed surprise that such a lovely and well-spoken young lady as his beloved "Billy" should have paid any attention to him, especially since he had had a wisdom tooth pulled that very afternoon.

"WHERE THEY AIN'T"

Although he had discovered a new source for acetylene, George Curme realized that the economics of production demanded that some profitable use be found for the by-products. This obviously provided him with an opportunity to enter an area in which little academic or industrial interest was evidenced, even though ethyl alcohol had been produced in the laboratory of Michael Faraday by Hennell as early as 1828.

The need to find use for the synthetic acetylene by-products became increasingly important as the reason for his fellowship seemed to vanish in 1917 with the formation by merger of a technological combine known as Union Carbide and Carbon Corporation. Since the Union Carbide Company and Prest-O-Lite Company were joined in this new corporation, the need for an alternate source of acetylene was certainly less pressing. The combine also included the Linde Air Products Company, whose oxygen burned with acetylene to achieve high temperature in the new welding torches. The Linde people were skilled in low temperature phenomena and the separation of gases, while the other merging companies, the Electro Metallurgical Company and National Carbon Company, had long histories in high temperature and physical phenomena. Thanks primarily to the vision of John M. Price of the Electro Metallurgical Company, this combine, instead of discouraging Curme, continued to support him at Mellon. As the work progressed, Curme's belief in the potential for successful ethylene, propylene, and acetylene production increased and convinced him that a new unit of the Corporation should be formed to focus on this area.

Dr. Weidlein recalls that it was sometimes difficult to keep Curme from going straight to the Corporation's headquarters in New York to elucidate to its management the "short sightedness" of their ways in not "immediately" adopting his ideas. In a more tactful approach, Dr. Weidlein submitted to Union Carbide's management G. O. Curme, Jr.'s report on "The Possibilities of a Chemical Industry Based on the Simple Hydrocarbon Gases." The last paragraph of the introduction reads:

> In particular, ethylene, when complemented by acetylene and the by-products obtained in the production of these two substances from their various sources, provides the starting material for an organic chemical industry of almost unlimited proportions which might be extended as desired in any or all directions to cover a large part of the field of the existing chemical industry.

In the concluding paragraphs, the writer points out the obvious economics of using the plentiful supply of petroleum rather than the higher priced food and vegetable products as raw materials. In fact, George Curme visualized the petrochemical industry even before the word "petrochemical" entered our vocabulary!

Having aroused some interest on the part of management with the report, Curme went to New York with plans and estimates; with the encouragement of such men as Price of Electro Metallurgical Company, W. F. Barrett and J. R. Rafferty of Linde, and J. M. Moorhead of Union Carbide, the Carbide and Carbon Chemicals Corporation was formed on October 11, 1920. G. O. Curme, Jr., at the age of thirty-two, became manager and chief chemist of an operation he had literally inspired, even though as he later said: "We had not provided for raw materials, markets, financing, engineering, operations, shipping, publicity, accounting and a few such items . . . but we thought we were ready to go."*

ETHYLENE

The first plant of this new operation was a purchased one in Clendennin, West Virginia, and it was in this ancient, run-down gasoline compressor station that the future of the new venture was to be tried—and not found wanting. In reply to the question, "What was produced at Clendennin?" Curme's answer was, "Mostly mistakes," but he also added: "It was a revelation to realize that chemical processes functioned in a sheet-iron shack quite as well as under the best laboratory conditions."†

Selling the products that were produced was a more difficult task than had been anticipated. In a letter to his brother (December 7, 1920), he described how Rafferty and he, armed with samples, went out on selling trips: "I don't know whether I told you that we two now constitute the sales force. Well, we do . . . and I'm rather glad of it in a way, for that is the critical point of the development right now, and I'm glad to be on the firing line when the decision is made." The separation of gases provided them with a winning ticket—low-cost propane for home cooking and heating gas, and in 1922 the first tank car of PYROFAX gas was shipped from Clendennin. In 1923, J. G. Davidson was added to the staff and proved to be a remarkable salesman. He and G. O. Curme, Jr., became known as Carbide's "Gold Dust Twins."

Many products followed, particularly ethylene glycol, and by 1925 a "giant" (in terminology of the day) plant was constructed at South Charleston, West Virginia, chiefly for the manufacture of ethylene glycol, which was finding a major

* Aubrey D. McFayden, "American Contemporaries," *Chemical and Engineering News,* March, 1948.

† *Ibid.*

market under the PRESTONE trademark, the first "permanent" antifreeze for automobiles. In the language of one of Curme's many citations he was: "The father, grandfather, and great-grandfather of ethylene and her numerous progeny."*

EXPANSION

In 1929 George O. Curme, Jr. was elected vice president of research for the chemical operations. While this meant more administrative duties, his focus never shifted from the big picture of chemistry as the servant of mankind. In the thirties, while most of industry was cutting back on production, employment, and research and placing their main attention on weathering the depression, G. O. Curme, Jr. was worrying about a more distant future—one in which basic materials for production, such as rubber, would be in short supply. With this in mind, he directed the research into such areas as vinyl resins, coal hydrogenation, the production of butadiene, man-made fibers, agricultural chemicals, and toxicology studies. He took advantage of the newly completed, but not fully occupied, Linde laboratory at Tonawanda, New York to begin a research program in inorganic chemicals and persuaded the Corporation to allot monies for "blue-sky" or "seed-money" research.

In 1940, as war clouds darkened and as America's supply of essential rubber was threatened, his foresight was rewarded as he was able to make the first shipment of butadiene to Goodrich, and by 1944 Carbide had supplied over 62 percent of that needed for the war effort.† In addition, thanks to the research effort, the Tonawanda laboratory was able to provide synthetic gem bearings when war cut off the

* Willard Gibbs medalist presentation, American Chemical Society, May 25, 1944.

† Union Carbide Corporation records.

European supply, and Carbide produced quantities of vital polyethylene for the coating of radar cables within 100 days of the Navy's request. Again due to the unusual research and development experience, Carbide played a major role in the field of atomic energy. In Curme's words:

> Two weeks after the Chicago pile, I received a call from Vannevar Bush to be on a committee to get a plant going. They were interested in UCC because of the large scale development work our company had done. No one was really qualified to do the job, but we had more experience than most in jumping from experiment to full-scale operation.* [Appointed to five-man planning board, Office of Scientific R&D to be "responsible for technical and engineering aspects of the work."]

HONORS

The work of George Curme was now being recognized from all sides. By 1944, when he was elected a member of the National Academy of Sciences, he had been presented with the Chandler, Perkin, and Eliott Cresson medals, the National Modern Pioneer Award, and the Willard Gibbs Medal. Other honors and appointments followed, but the one he cherished most was his degree of Doctor of Science from Northwestern University in 1933, when his father placed the hood over his head.

In 1951 he was elected Vice-President–Research, Union Carbide and Carbon Corporation, and the following year he was elected to the board of directors. From this eminence, he was ready and willing as ever to help generate further progress. As the Corporation had grown, he had seen the necessity for improved communication and had initiated a series of mutually beneficial briefings with researchers and members of the Corporation's service groups. He retired in 1955, but served on the board until 1961. In 1976 he died in Martha's

* Interview with G. O. Curme, Jr., by Ms. Marion Merrill.

Vineyard, where his wife "Billy" had been buried two years before.

THE MAN

George O. Curme, Jr. was a trim, compact man of average height with sharp eyes and a small, neat mustache. His quiet, almost humble stance belied a personality that was friendly and given to dry wit among his close friends. He often appeared brisk, ill at ease and sometimes even terrifying to many of his acquaintances and associates, for he was a stern believer in order and self-discipline. But while all might agree that he didn't have a humble bone in his body and did not tolerate fools gladly, they would also hasten to say that he was the first to give praise, to offer assistance, and to stand behind and support others if they truly believed in what they were doing. The trappings of power and prestige meant little to him. He was sure of himself because he always first made sure of the facts. He was a scientist in the truest sense of the word, and to those who had the opportunity of working with him or for him, he was a challenging leader with an exciting, but practical view of the present and the future. He often described himself as "The last of the Victorians."*

George O. Curme, Jr. was a wide reader, an early riser, a clean desk man, and a good listener. He enjoyed privacy, and when TV first came out, he wouldn't have it with "all those people" in his house, but in his later years, he could often be found before the TV set in his son's home watching a baseball game. He was adored by his grandchildren and respected by their pets, who knew exactly how close they could come to the dining room while he was in residence. He and his wife shared a mutual wedding anniversary with two other "Georges" from Union Carbide, and this was celebrated by

* Personal communication, G. O. Curme III.

dinners followed by plays or concerts for many years. Science was very close to G. O. Curme, Jr.'s heart, but his "Billy" came first.

RECOLLECTIONS

When I came to Carbide in 1926, George Curme headed all research in organic chemistry and, without title, was truly the sponsor, promoter, and godfather of all the Corporation's research. Since I was in the metallurgical side of the business, I only saw him occasionally if I happened to be present when he made his regular trips to the various company laboratories. He was always interested in the projects and experiments and would ask truly challenging and penetrating questions. If it was something you were enthused about and believed in, he would encourage and support you. But he let *you* do the job. His attitude was, "If you run into trouble, come see me. If not, bring me the answer." He had a great view of the future and knew that the future depended on what was coming out of research.

As the chemical business grew, and as pressures and temperatures were increased, equipment requirements became more and more demanding, and chemical problems became metallurgical ones. I was fortunately able to solve one such problem.

Subsequent to the successful operation of a pilot plant to produce vinyl acetate, a full-scale manufacturing plant was built. The pilot plant had produced white material. The full-scale plant initially produced pink material! The main reaction was being carried out in a stainless steel pressure vessel, and it was thought that the stainless steel, then a relatively new article of commerce, was defective because it must be corroding to provide the iron that produced the pink color. A vessel of essentially identical composition in the pilot plant did not produce the pink color. I checked specifications, analysis, and manufacturing procedure of the vessel and decided that it was not faulty. Somehow the feed to the larger vessel must have contained traces of chlorine which attacked the stainless steel. The local chemical engineers and I studied the possibilities. We found that the large plant differed from the pilot plant in that at an earlier point in the process, a small lead coil heat interchanger was used in the pilot plant, whereas a much larger copper heat exchanger was used in the full-scale plant. The lead had reacted with the traces of chlorine in the feed material, thus removing it. Of course copper would not do this. Solution: put some lead in the heat exchanger lines of the large plant; no need to replace the large stainless steel vessel. Simple! It worked. The product now had no trace of pink. George Curme was pleased. This brought me to his attention, and many years later helped in my succeeding to his post. He strongly believed that new tools make possible new findings.

He loved challenges. I recall visiting him at his home on Martha's Vineyard and seeing his great lawn. When he and Billy moved there in the thirties, there was no grass on the island. He changed that and was the first to grow an almost "putting green" lawn. To accomplish this, he had an irrigation system and powerhouse. I well recall that the whole system was truly a first-class chemical plant.

He was a complex character—somewhere between "Cal" Coolidge and Franklin Roosevelt. He combined reserve and a desire for facts with enthusiasm and political intuitiveness. I liked and respected him and so, I believe, did everyone who worked with or for him. Those who knew him and those who didn't know him are in his debt, for it was his vision and his courage, perseverence, and ability to make it come true that has done so much to provide all of us with a standard of living we now take for granted.

IT WOULD BE FUTILE to attempt to list all of my colleagues at Carbide, past and present, who provided information on which this memoir is based, but I would particularly thank Paul Cullen, who had been George Curme's secretary for many decades, and pay tribute to Ms. Marion Merrill, then of Union Carbide's technical publicity department, who interviewed families, Carbiders, and associates of George Curme, who searched the Carbide files, and did more than assist in the writing of the memoir proper.

BIBLIOGRAPHY

1913

Thermal decomposition of symmetrical diarylhydrazines. J. Am. Chem. Soc., 35:1143–73.

With Julius Stieglitz. Transformation of hydrazobenzene into azobensene and aniline—a first order reaction. Preliminary communication. Berichte, 46:911–20.

1914

With Emil Fischer. Lactal and hydrolactal. Berichte, 47:2047–57.

1921

Importance of the olefine gases and their derivatives. Chem. Metall. Eng., 25: I. Sources and uses of ethylene and propylene, 907–9; II. With H. R. Curme, Diethyl sulphate, 957–59; III. Ethylene dichloride, 999–1000; IV. With E. W. Reid, Isopropanol, 1049–50; V. With C. O. Young, Ethylene chlorhydrin and ethylene oxide, 1091–92.

1923

With C. O. Young. Ethylene glycol: its uses and properties. Chem. Metall. Eng., 28:169–70.

1925

With C. O. Young. Ethylene glycol. A contribution of chemistry to the automobile anti-freeze problem. Ind. Eng. Chem., 17:1117–20.

1933

Synthetic organic chemistry in industry (Chandler Medal address). Ind. Eng. Chem., 25:582–89.

1935

Industry's toolmaker (Perkin Medal address). Ind. Eng. Chem., 27:223–30.

1936

With S. D. Douglas. Resinous derivatives of vinyl alcohol. Ind. Eng. Chem., 28:1123–29.

1937

Recent progress in synthetic organic chemistry. Sci. Mon., 45: 100–105.

1938

Large molecules in synthetic organic chemistry. J. Franklin Inst., 226:187–202.

1942

Research in industry. Dedication of the new building of the Technological Institute, Northwestern University, June 16.

1944

Chemistry for the many (Willard Gibbs Medal address). Chem. Eng. News, 22:900–903, 928.

1950

Industrial research. In: *Seventy-fifth Anniversary Proceedings.* New Haven: The Connecticut Agricultural Experiment Station.

1952

With Franklin Johnston, eds. *Glycols.* N.Y.: Reinhold Publishing.

UNITED STATES PATENTS*

1919

1,315,540. Electrochemical Method and Apparatus for Producing Synthetic Acetylene from Organic Liquid.
1,315,541. Preparation of Pure Ethylene.
1,315,542. Preparation of Ethylene Dichloride.
1,315,543. Methods of Preparation of Acetaldehyde.
1,315,544. Preparing Acetone from Acetic Acid.
1,315,545. Preparing Ethyl Dichloride from Ethylene.
1,315,546. Preparation of Acetic Acid.
1,315,547. Process of Making Propylene Dichloride.

1922

1,422,182. Treating Gaseous Hydrocarbon Mixtures.
1,422,183. Process of Treating Gaseous Mixtures.
1,422,184. Process of Separating Ethylene and Other Components from Gaseous Mixture Containing Same.
1,422,838. Processes of Chlorinating Gaseous Hydrocarbons and Recovering Products Therefrom.

1923

1,442,386. With C. O. Young. Process of Making Glycols.
1,456,916. With C. O. Young. Process of Making Chlorhydrins.
1,460,545. With P. E. Haynes. Production of Ethylene.
1,463,255. With H. B. Heyn. Process of Preparation of Salts of Benzoic Acid and Benzoic Acid from Dibenzyl.
1,472,294. With H. E. Thompson. Process of Purifying Chlorine and Other Corrosive Gases.

1924

1,518,182. Process of Making Alkyl Chlorides.

1925

1,524,355. With P. E. Haynes. Process of Making Olefines.
1,545,742. Process of Making Isopropyl Chloride.

*The majority of George Curme's patents were registered in Canada, and many were duplicated in the industrial countries of Europe.

1927

1,638,434. With H. E. Thompson. Process and Apparatus for Generating Fuel Gases.
1,646,349. Re: 18,148. Thermal Decomposition of Hydrocarbons.

1928

1,695,249. With E. W. Reid. Process of Making Isopropyl Alcohol.
1,695,250. Manufacture of Glycols.

1931

1,817,893. Non-Inflammable Liquids.
1,832,534. With F. W. Lommen. Process for Making Ethylene Diamine.

1945

2,378,466. Improved Diesel Fuel and Method of Improving Diesel Fuel Ignition.
2,384,816. With H. C. Chitwood. Preparation of Amino Carboxylic Acids and Their Salts.
2,384,818. (Div. of #2,384,816) With H. C. Chitwood. Preparation of Amino Carboxylic Acids and Their Salts.