NATIONAL ACADEMY OF SCIENCES

PAUL DYER MERICA

1889—1957

A Biographical Memoir by

ZAY JEFFRIES

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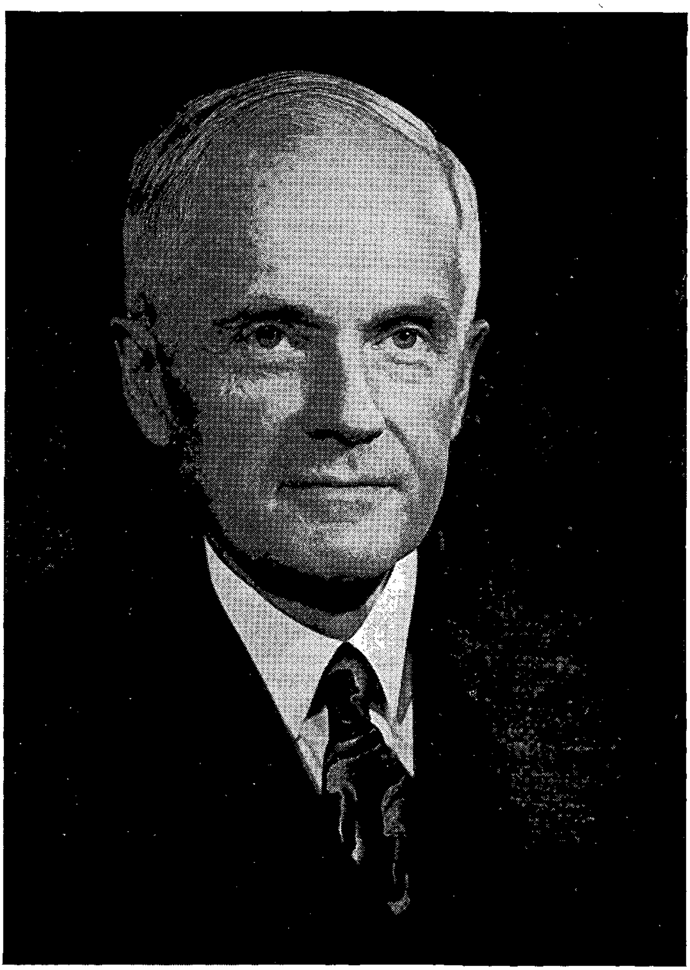

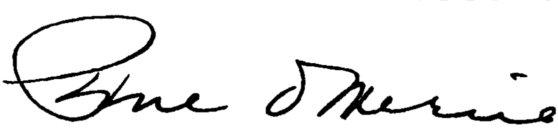

PAUL DYER MERICA

March 17, 1889–October 20, 1957

BY ZAY JEFFRIES

DR. MERICA was elected to membership in the National Academy of Sciences in 1942, as a member of the Engineering Section. He died in Tarrytown, New York, at the age of sixty-eight, on October 20, 1957, following a heart attack.

Dr. Merica was born in Warsaw, Indiana, on March 17, 1889, the son of Charles Oliver and Alice White Merica. He attended the Warsaw High School and then spent three years at De Pauw University. In 1907 he went to the University of Wisconsin, where he obtained his A. B. degree in 1908. The following school year, he was instructor in physics at Wisconsin after which he taught "Western subjects" for two years in the Chekiang Provincial College at Hangchow, China. Next he attended the University of Berlin from which he received his Ph.D. in 1914.

After his formal schooling in Berlin, Dr. Merica took a temporary post as special investigator on caustic embrittlement of steel at the University of Illinois. He then went to the National Bureau of Standards, where he remained from 1914 to 1919, holding positions as research physicist, associate physicist, physicist, and metallurgist.

In 1919 he was employed by The International Nickel Company, an association which lasted thirty-eight years. Starting at its Orford Refinery in Bayonne, New Jersey, as physical metallurgist, he soon became Superintendent of Research and subsequently Director of Research. In 1931 he was transferred to the New York office and was made Technical Assistant to the president of the parent company, The International Nickel Company of Canada, Limited, and in 1932 assistant to the president. He became a director of the parent company in 1934, and Vice-President in 1936, remaining in general charge of the company's research activities. Dr. Merica was elected Executive Vice-President in 1949 and President in 1952, retiring at his own request from the last position in 1954. He held corresponding offices in the United States subsidiary, The International Nickel Company, Inc. After Dr. Merica's retirement as President he remained on the board of directors and was consultant to Inco officers on important projects, policy, and major research and technical activities.

In 1917 he was married to Florence Young, a native of Lexington, Missouri, who died October 20, 1955.

Although Merica received his A.B. at the age of nineteen, his doctorate came at the normal age of twenty-five. Three years of teaching between the A.B. and the Ph.D. obviously resulted in an unusual degree of maturity when he was ready to begin his professional career. In fact, he could have selected either physics or chemistry instead of the field of his choice, metallurgy. He was fortunate in having the opportunity to work with some distinguished educators in the three fields—in chemistry, Professor Blanchard at De Pauw, Professor Fischer at Berlin, and Professor Parr at Illinois; in physics, Professor Mendenhall at Wisconsin, and in metallurgy, Professors Guertler and Hanemann in Berlin. His first major association at the Bureau of Standards was with Dr. Burgess, a noted physicist and metallurgist. Since metallurgical problems were both pressing and interesting during the First World War, Merica devoted most of his energy to metallurgy. The excellence of his work in metallurgy was in part responsible for his employment by the International Nickel Company.

Although Dr. Merica was at the Bureau of Standards only five years, his work there made a lasting impression on the metallurgical world. One could elaborate on his work at the Bureau, but it will suffice here to describe briefly what may be considered not only his major contribution while at the Bureau but possibly his major contribution to science and technology.

A few years prior to 1914, Alfred Wilm in Germany had produced a new wrought aluminum alloy called Duralumin, which had some strange properties that made it singularly useful in aircraft construction. It contained about 4 percent copper and ½ percent each of magnesium and manganese. When mechanically worked and cooled rapidly from a temperature near 500°C, its strength if tested immediately was around 40,000 pounds per square inch. If allowed to remain at room temperature, the strength increased gradually to about 60,000 pounds per square inch in about four days. The hardness and yield strength also increased markedly. Wilm did not know why his alloy behaved in this strange manner. The phenomenon was so puzzling, and so many metallurgists had sought in vain for a satisfactory explanation, that it presented a challenge to Dr. Merica and his associates.

They began work on the problem at the Bureau of Standards during the First World War. Their beautiful solution was given to the world in a paper, "Heat Treatment of Duralumin," American Institute of Mining and Metallurgical Engineers (AIME) Bulletin, June, 1919. The coauthors were Waltenberg and Scott. This work resulted in a new and fundamental metallurgical concept now known as "precipitation hardening," which has had a profound influence on both theoretical and practical metallurgy. It was said of this work that Dr. Merica fired the metallurgical shot heard 'round the world.

Since the publication of this work, dozens of precipitation hardening alloys, comprising nearly all of the common metals, have been developed. Merica was personally and deeply concerned in the development of hardenable nickel-copper alloys, an example being Inco's "K" Monel. New precipitation hardening alloys are being developed year after year. In fact, it may now be said that precipitation hardening is the most general of the hardening principles and that the hardening of carbon steel comes under a special classification.

When a publication like the above is authored by more than one person, there may be some question as to leadership in connection with the accomplishments. In the case of precipitation hardening, this matter is clear, as evidenced by letters from Mr. R. G. Waltenberg and Mr. Howard Scott, both of whom are metallurgists of note. Waltenberg wrote on January 18, 1938, "There is no doubt that any commendation for this work should be credited mainly to the direction and abilities of Dr. Merica. It gives me pleasure to think that my part in that work may contribute in some small measure to praise for Dr. Merica." On January 19, 1938, Scott wrote, "It is very gratifying to hear that Dr. Merica will receive the John Fritz Medal. . . . Dr. Merica proposed the theory of hardening due to precipitation of a compound, which is, of course, the major contribution. The text is his also, except as modified slightly to conform with the co-authors' views."

Before Dr. Merica's work, it was generally believed that the higher the degree of dispersion of a solvent metal in a solute metal the higher should be the hardness. Merica's contribution calls for maximum hardness when the second phase is precipitated in particles very small but of a critical size. If the particles are smaller than this critical size, the hardness is not maximum. The baffling nature of the problem arose partly because the "critical size" particles were submicroscopic, and very ingenious experiments and interpretations were required to arrive at the correct solution. The invention, many years later, of the electron microscope finally revealed the reality of these critically-sized particles.

The precipitation hardening potentiality is obtained in many alloys when one metal dissolves in another to a considerable extent at an elevated temperature but has substantially less solubility at a lower temperature. What Merica proposed in connection with Duralumin was that at 500°C most of the copper content of the Duralumin alloy was dissolved in the aluminum. Quenching, according to Merica, retained the copper in atomic dispersion, but this dispersion was sufficiently unstable that precipitation of a compound

$CuAl_2$ took place slowly at room temperature. It seems fortuitous that Duralumin was capable of undergoing this internal change at room temperature and yet was not capable of growing the $CuAl_2$ particles to larger than critical size. As work progressed, it was possible to generalize with reference to precipitation hardening principles. Sometimes the secondary precipitation would not take place at room temperature but it would take place at some specified higher temperature. It therefore became possible with many alloys to develop heat treatment procedures which would produce either maximum hardness or any degree of hardness desired between maximum and that in the as quenched condition. Nearly all of these results flow logically from the original concepts of Merica.

Dr. Merica entered the nickel business at a most critical time. Up until 1918 the prosperity of the world's nickel industry, in which International Nickel was a dominant factor, had depended mainly on armaments. When nickel demand practically disappeared in 1919–21, it was realized that great efforts had to be directed to the discovery of new peacetime uses for nickel. Dr. Merica joined in this great task with his characteristic vigor and determination.

Dr. Merica continued to make contributions in the field of metallurgy after he became associated with International Nickel. He improved the nickel melting processes and developed new alloys and combinations, such as Inconel and "K" Monel. He did notable work in connection with extensive utilization not only of nickel but also of other alloying elements in cast iron. Merica was not the first to add nickel to cast iron, but he showed how it could be used advantageously in the complex technology of cast iron. Not only did he contribute to the low nickel cast irons, but with his associates he developed a cast iron alloy called Ni-Hard with an intermediate amount of nickel which was highly resistant to abrasion, and another cast iron alloy called Ni-Resist with a large amount of nickel, which was highly resistant to corrosion. These alloys and their several modifications are still used commercially. Merica also had a hand in many other metallurgical developments in connection with nickel and gave sympathetic support to the development of ductile or nodular cast iron, a variety of cast iron made ductile at room temperature by the addition of a small amount of magnesium.

Merica always considered himself as basically a physical chemist, deflected by chance into metallurgy. But his days as a working scientist were cut short by his executive talents, which soon led to his being drafted into high management areas. From 1922 onwards his scientific position was perforce that of a leader and inspirer of others. For more than a decade he was a frequent visitor at the Inco Bayonne Research Laboratories, showing a contagious interest in all that was going on and quick to perceive the crucial issue in an obscurely unfolding research. He was a strong believer in the necessity for clear objectives, feeling that even an unobtainable goal lent force, direction, and productivity to research. His combination of scientific competence with industrial acumen led to developments which have retained their commercial utility for many years. His metallurgical inventions are represented by twenty United States patents, many of which have foreign counterparts. It is characteristic that all but two of these are jointly with others.

In his position as one of the leaders of Inco, Merica was also interested in the large-scale and complex operations of winning metals from their ores. During the last decade of Merica's life International Nickel's mines in the Sudbury District of Ontario were greatly expanded, entirely new metallurgical processes were introduced, and the recovery of the valuable metal content of the ore was improved. Nickel, copper, platinum, palladium, rhodium, ruthenium, iridium, gold, silver, cobalt, selenium, and tellurium are recovered in metallic form. Important tonnages of sulphur are also recovered in the form of sulphuric acid and liquid sulphur dioxide. Finally, iron is going to market by the hundreds of thousands of tons per year as a high grade iron ore. Merica was a key figure in this program.

Dr. Merica was also active on the Inco team in appraising the ores of the Mystery-Moak Lakes area in Northern Manitoba and in planning to bring these important properties into production.

Dr. Merica in later life spent a large part of his energy in managing, planning, and generally doing those tasks which only the captains of industry can do. However, he never ceased to be a scientist and a technologist. His professional standing can be judged merely by mentioning some of the honors he has received and some of his associations with professional societies. In 1929 he was awarded the James Douglas Gold Medal of the American Institute of Mining and Metallurgical Engineers; in 1938 he was awarded the John Fritz Gold Medal by the four founder engineering societies; in 1941 he received the platinum medal of the British Institute of Metals; in 1942 he was awarded the Franklin medal by the Franklin Institute, and in 1951 he received the gold medal of the American Society for Metals.

Among other associations he was a fellow of the American Association for the Advancement of Science, and a member of the American Iron and Steel Institute, American Chemical Society, American Society for Testing Materials, American Physical Society, Institute of Metals and the Iron and Steel Institute (both of Great Britain), and Canadian Institute of Mining and Metallurgy. He was quite active in some of the societies, having been a member of the executive committee of the American Society for Testing Materials, a member of the board of directors of the American Society for Steel Treating, Vice-President and a member of the board of directors of The American Institute of Mining, Metallurgical, and Petroleum Engineers, and Vice-President of the American Electrochemical Society.

Dr. Merica received honorary doctor of science degrees from De Pauw University in 1934, from Lehigh University in 1938, and from Stevens Institute of Technology in 1942. He was made an honorary member of the American Institute of Mining, Metallurgical, and Petroleum Engineers in 1942. In 1955, he was made an honorary member of the American Society for Metals, becoming the twenty-second person to be so honored, joining a roster of distinguished scientists and engineers, both past and present.

Dr. Merica contributed generously to the technical literature, having presented upwards of fifty papers, and in addition he gave many lectures. It is interesting to note that he gave the invitational lecture on nonferrous metals at the Institute of Metals Division of the AIME in 1932 and the Howe Memorial lecture on cast iron, sponsored by the Iron and Steel Division of the same Institute in 1937.

His ability to lecture authoritatively in both nonferrous metallurgy and ferrous metallurgy was not surprising to his acquaintances. Dr. Merica's versatility was recognized when he received the John Fritz Medal, and was presented as "scientist, engineer, inventor, teacher, executive, philosopher and benefactor of mankind." To this should have been added "one of the world's foremost metallurgists." He had a keen appreciation of music, and engaged in athletics normal to his time. In baseball he was a catcher, and one of his associates at the Bureau of Standards made the following observation about him: "It seems that I can't keep up with Merica in anything, not even tennis, at which I consider myself quite good."

Precociousness, as evidenced by the award of the A.B. degree at the age of nineteen, characterized Merica's whole life. His advice was sought by many people, because he had exceptionally good judgment on many matters. He worked very closely in the International Nickel Company with the late President and Chairman, Robert C. Stanley.

Stanley wrote of him, "Dr. Merica combines quick perception, fast thinking and accuracy in an unusual degree. He combines great scientific ability with a keen commercial sense. He can draw a contract as ably as a lawyer. He is a philosopher and a practical economist. He thinks in world terms. His studies and teachings in foreign countries, coupled with his later experience in connection with international matters, have been important factors in the development of this cosmopolitan thinking."

In formally reporting Dr. Merica's death to his fellow members on the Board of Directors of International Nickel, Chairman John F. Thompson and President Henry S. Wingate referred to his great achievements. They added that "apart from his achievements, Dr.

Merica will probably best be remembered because of his fine qualities and the depth and integrity of his character. These endeared him not only to his associates in the company but throughout the nickel industry. We have suffered a great loss." Indeed Dr. Merica had a host of friends and admirers, who are keenly conscious of the loss caused by the passing of a great man.

KEY TO ABBREVIATIONS

Bur. Standards Circ. = U.S. National Bureau of Standards, Circular
Bur. Standards Sci. Paper = U.S. National Bureau of Standards, Scientific Paper
Bur. Standards Technol. Paper = U.S. National Bureau of Standards, Technologic Paper
Can. Mining J. = Canadian Mining Journal
Chem. Met. Eng. = Chemical and Metallurgical Engineering
Ind. Eng. Chem. = Industrial and Engineering Chemistry
Intern. Z. Metallographie = Internationale Zeitschrift für Metallographie
J. Am. Inst. Metals = Journal of the American Institute of Metals
J. Am. Welding Soc. = Journal of the American Welding Society
J. Franklin Inst. = Journal of the Franklin Institute
Metal Ind. (N.Y.) = Metal Industry (New York)
Met. Chem. Eng. = Metallurgical and Chemical Engineering
Mining Met. = Mining and Metallurgy
Proc. ASTM = Proceedings of the American Society for Testing Materials
Trans. Am. Inst. Chem. Engrs. = Transactions of the American Institute of Chemical Engineers
Trans. Am. Inst. Metals = Transactions of the American Institute of Metals
Trans. AIME = Transactions of the American Institute of Mining and Metallurgical Engineers
Trans. ASST = Transactions of the American Society for Steel Treating
Trans. Can. Inst. Min. Met. = Transactions of the Canadian Institute of Mining and Metallurgy

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