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GEORGE KIMBALL BURGESS

1874—1932

A Biographical Memoir by

LYMAN J. BRIGGS AND WALLACE R. BRODE

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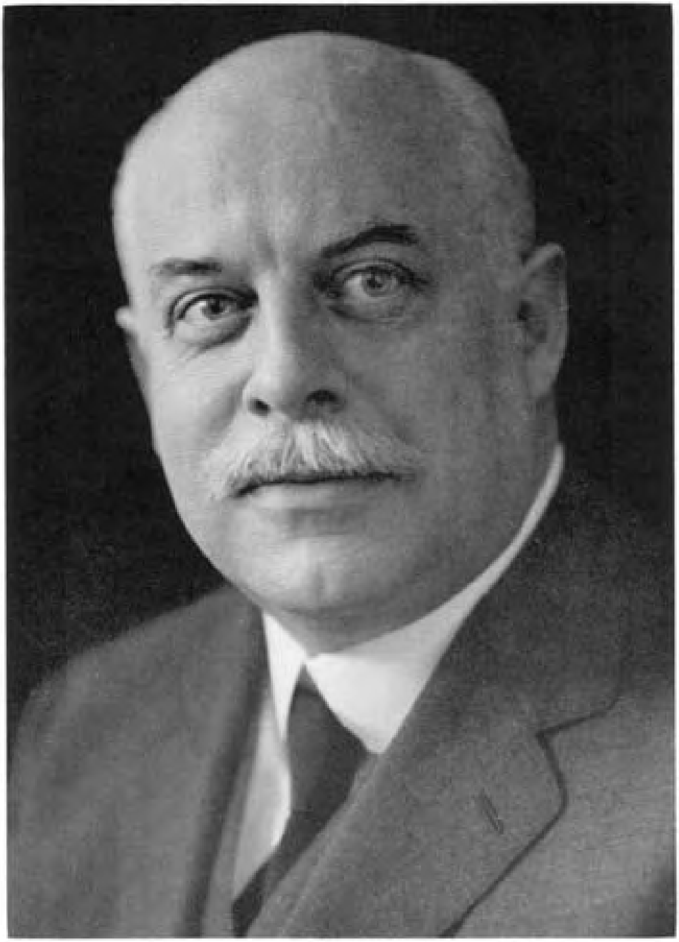

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FEW MEN LIVING today could say they knew George Kimball Burgess intimately, and yet his influence was significant upon the lives of many of his scientific associates. He was a member of a distinguished New England family, a descendant of Thomas Burgess who settled in Sandwich, Massachusetts, in 1638. He was the son of Charles A. Burgess and Addie L. (Kimball) Burgess and was born in Newton, Massachusetts, on January 4, 1874.

George K. Burgess was the eldest of five children. One of his brothers, Philip, also chose the field of science and was recognized as an engineering authority in the field of filter plants, water works, and sanitation. George K. Burgess was graduated from the Massachusetts Institute of Technology with a Bachelor of Science Degree in 1896. In the summer of 1896 he assisted in acoustical researches on "standards of pitch" and also collaborated with Professor Halman in preparing a well-known work entitled *Precision of Measurement.* The following year he served as an assistant instructor on the staff of the Massachusetts Institute of Technology. In 1898 he accepted a fellowship to work for his doctorate at the Sorbonne in Paris.

After he completed his studies in Paris in 1900 he accepted an instructorship in physics at the University of Michigan. During his first year at Michigan, on January 5, 1901, he married Suzanne Babut who was a member of the Mond and Babut families, leaders in French theology and Protestantism. In the following summer in 1901 they returned to Paris where he presented his thesis and received his doctorate degree. The following two years were spent as an Instructor in Physics at the University of California.

The following story, which has been handed down in the National Bureau of Standards, presents an interesting aspect of the scholastic and scientific attitude of Dr. Burgess during his studies in France. Professor H. Le Chatelier of the Sorbonne, as a world-famous professor of chemistry, attracted many to his classes. However, the course in advanced physical chemistry was very difficult and the students kept dropping out until about two-thirds of the way through the course there remained only one student, George K. Burgess.

Burgess regularly attended the lectures which were conducted with all the ceremony of the nineties in which the lecture assistant first appeared to dust the lecture table and then the professor in his frock coat appeared to the gentle stamping applause of the student body. Ultimately the inevitable happened and Burgess was unavoidably detained and arrived nearly fifteen minutes late. He walked into the empty lecture room and sat in his usual seat for a few minutes. Then he saw in the doorway the head of the lecture assistant which was quickly withdrawn and followed by a call down the hall, "Monsieur le Professeur, il est ici!" This was followed by the usual dusting procedure and lecture as though he had been on time. He was not late again and graduated from the Sorbonne with a Doctor of Science *tres honorable,* an unusually high distinction. His thesis was on a redetermination of the constant of gravitation using a torsion balance procedure. His apparatus was unique in that the weight of the suspended system was largely offset by floating it on mercury, thus permitting the use of a more sensitive torsional fiber. He also worked on high temperature measurements and translated Le Chatelier's book on this subject into English.

Dr. Burgess joined the staff of the National Bureau of Standards on June 8, 1903, where he achieved an international reputation in the fields of high temperature measurement and metallurgy. He developed the use of optical pyrometers for high temperature measurement and metallurgy. In 1908, with Dr. C. W. Waidner, he developed the Waidner-Burgess standard of light (brightness). The source was the black-body radiation from a hollow tube closed at its lower end and immersed in molten platinum at its freezing point. The radiation emitted was, however, extremely sensitive to slight impurities in the platinum, which were dissolved from the containing crucible. It was not until some twenty years later that the standard was practically realized through the construction of thorium oxide crucibles at the National Bureau of Standards, in which pure platinum could be melted and frozen 100 times without contamination. The Waidner-Burgess standard is now internationally recognized and adopted. For the first time it provides an exact definition of the "candle." Section 10 of the revised Statutes of the National Bureau of Standards reads as follows: "The unit of intensity of light shall be the candle, which is one-sixtieth of the intensity of one square centimeter of a perfect radiator, known as a "black body," when operated at the temperature of freezing platinum."

Dr. Burgess proved an excellent scientific attaché in World War I and spent several months in France in 1917 collecting technical military information.

On July 1, 1913, Dr. Burgess was made the head of a new Division of Metallurgy which he had organized at the National Bureau of Standards. In the decade during which he served as head of this division he produced a model of efficient organization and operation with a staff of some fifty experts, and here he developed many of the leaders of metallurgy in this country. His program included the entire range of metallurgical technology including melting, casting, mechanical working, heat treatment, and microscopical, macroscopical, physical, and chemical testing.

His research program included thermal analysis as related to structures, cooling and heating curves, critical ranges and phases, heat treatment effects on metals and alloys, studies as to the cause of metal failures, corrosion effects, and the general physical properties of metallurgical materials. Dr. Burgess was keenly intersted in developing close cooperation between the Bureau and industry. He inaugurated the use of specialized advisory groups such as the Metallurgical Advisory Committees of experts chosen from industry and academic life. He also initiated the Research Associate program with industry which proved an important contact between the government and industry.

His personal researches are many and important. They relate to the fundamental constants of metals, the properties and behavior of metals, the testing of metals, and the improvement of their quality by better control of the proportions and purity of the materials, the control of pouring temperatures, heat treatment, and by other means. His work has resulted in the development of many new methods of research and testing, and of new scientific instruments for use in such work. The scientific accuracy of his work was remarkable, when it is realized that most of the equipment available to him was crude by modern standards. In 1913 Burgess and Crowe established the values of 768° and 912° C. for A_2 and A_3 points in iron. The accepted "best" values at the present time (1956) are 768° C. and 910° C.

As an example of many activities, the work on railway materials under the direction of Dr. Burgess offers a good example of the results of systematic research. In connection with tests and specifications for railway materials, the Bureau was frequently consulted for advice, both by railway experts and by the makers of railway materials. An alarming increase in railroad accidents caused by defective rails, wheels, axles, etc., brought insistent demands to the Bureau of Standards for research and expert advice. The interest of Congress in this problem was such that investigations were promptly authorized and special appropriations made to the Bureau for this purpose. A systematic series of searching investigations covering all phases of the subject was planned by Dr. Burgess. To him is chiefly due the credit for the gratifying success of these researches. The results have justified continuing similar systematic researches in cooperation with other government departments and with the industries—a cooperation made effective through his efforts.

Dr. Burgess personally demonstrated in the steel mills that it was practicable to measure the temperature of steel rails as they passed through the rolls. Since practical men in the mills were at first incredulous on this point, he personally visited the various rail mills and with one aide measured the temperature on the regular output of rails under actual working conditions. His measurements disclosed that the rolling was completed at temperatures too far above the known critical temperature at which steel undergoes allotropic transformation. To secure the higher degree of serviceability and safety of the rails, he recommended a reduction in the finishing temperatures.

Dr. Burgess later successfully demonstrated methods of producing sound ingots. Prior to that time, fatal accidents were caused by occasionally insufficient discard of the ingot top which permitted a residual fissure to be rolled into the rail, introducing a dangerous weakness. With the cooperation of the head of the British Iron and Steel Institute, Dr. Burgess demonstrated in the presence of railroad engineers, practical metallurgists at the steel mills, and technical experts in metals that it was feasible by newly developed methods to produce sound ingots from which sound rails could be rolled. Dr. Burgess also collated and published the standard specifications for railway materials of foreign countries; this publication did much to influence American practice. The study of actual failed rails was an early task submitted to the Bureau by the railroads and by the Interstate Commerce Commision. The technical reports prepared by Dr. Burgess on the specific causes of failure, combined with constructive laboratory and mill experiments on sound ingots and finishing temperatures, were largely effective in bringing about the much higher degree of efficiency and safety in railroad travel which exists today. A successful research in the same series covered the subject of car wheels and axles. Defective wheels and axles were then causing four times more accidents than defective rails. In one investigation Dr. Burgess and his colleagues ascertained the cause of the breakage of car wheels so acurately that he could in the laboratory duplicate any type of breakage. The brake shoe was found to overheat the wheel rim locally, causing a differential expansion between the peripheral metal and the metal next adjoining. This caused a stress between the two parts of the wheel which exceeded the elastic limit of the metal, and the wheels cracked. It was found at the Bureau after investigation of all types of steel wheels that it was possible to reach higher temperatures with the steel without harmful effects. This work was of definite interest in the design and weight of wheels and in planning the weight, speed, and braking of trains. Numerous other researches on railway materials were conducted with equally successful results, and such researches are still in progress.

Upon the resignation of the Bureau's first Director, Dr. Samuel W. Stratton, who left to become President of the Massachusetts Institute of Technology, Dr. Burgess was appointed by President Harding as Director of the National Bureau of Standards effective in April, 1923. The nearly quarter century of direction by Dr. Stratton had seen the Bureau grow from a mere handful to nearly one thousand workers; yet in this period it was difficult for the Director to realize the growth beyond that of a personally directed operation, so that all correspondence for the entire Bureau was individually signed by the Director and handled by male secretaries.

Dr. Burgess was fully indoctrinated with the need for delegations of authority and the development and expansion of prestige position of his staff. He created very favorable and excellent morale among his co-workers in expanding delegated authority.

Dr. Burgess was an outstanding research worker of international reputation and recognition and was accorded many honors and held high offices in American societies. He was a member and served as President in 1927 of the Cosmos Club. He was President of the American Society for Testing Materials, American Society for Steel Treating, Washington Academy of Science, Philosophical Society of Washington, and the National Conference of Weights and Measures. He was a member of the Board of Trustees of the National Geographic Society. He served as Chairman of the National Research Council (1928-1932). He was a Treasurer (1924-1928) of the National Academy of Sciences, to which he was elected as a member in 1922. His principal research has been described in the more than 100 technical articles listed in the bibliography which deal primarily with the measurement of heat and with metallurgy. These publications were for the most part prior to his elevation to the administrative post of Director of the National Bureau of Standards and their quality is also attested to by his election to the National Academy prior to his appointment to the directorship.

Dr. Burgess keenly enjoyed foreign travel and international contacts and would have enjoyed a contact which he did not achieve, namely the post of American representative to the International Bureau of Weights and Measures. He was not personally desirous of this appointment but rather felt the need for its assignment to the National Bureau of Standards. At the present time directors of the equivalent national laboratories such as the National Bureau of Standards, National Physical Laboratory, Physikalisch-Technische-Bundesanstalt, etc., are the official representatives in the International Bureau of Weights and Measures, and they were at the time that Dr. Stratton was Director. But since the International Bureau is a self-perpetuating organization, Dr. Stratton took the membership with him when he went to the Massachusetts Institute of Technology and the American representation did not return to the National Bureau of Standards until some ten years after Dr. Burgess's death. He did attend the 7th International Conference of Weights and Measures in Paris in 1927 and was the American delegate to the World Engineering Congress in Tokyo in 1929. A posthumous portrait of Dr. Burgess by Charles Bittinger hangs at the entrance to the lecture hall of the National Bureau of Standards and his name is inscribed on the memorial sundial in the Bureau grounds. Dr. Burgess was a modest, warmhearted, sociable man, as well as a diplomat who could always see the other person's point of view.

Dr. Burgess was recognized with honorary engineering degrees from Lehigh University and from the Case School of Applied Science. He died on July 2, 1932, at the age of 58. He was survived by his wife, Suzanne Burgess, who died in 1953. They had no children.

KEY TO ABBREVIATIONS

Am. Fed. = American Federationist
Am. Gas. Assn. = American Gas Association
Am. Iron Steel Inst. Yrbk. = American Iron and Steel Institute Yearbook
Am. Mach. = American Machinist
Am. Soc. Test. Mat. = American Society for Testing Materials
Ann. Mtg. Soc. Mot. Pic. Eng. = Annual Meeting, Society of Motion Picture Engineers
Bull. Am. Photo. Assn. = Bulletin, American Photoengravers Association
Bull. Bur. Stand. = Bulletin, Bureau of Standards
Bur. Stand. J. Res. = Bureau of Standards Journal of Research
Chem. News = Chemical News
Civil Eng. = Civil Engineering
Elec. World = Electrical World
Electrochem. Met. Ind. = Electrochemical and Metallurgical Industry
Eng. World = Engineering World
Grocers Bull. = Grocers' Bulletin
Ind. Man. = Industrial Management
Int. Cong. Appld. Chem. = International Congress of Applied Chemistry
J. Chem. Ed. = Journal of Chemical Education
J. Elect. Workers Optrs. = Journal of Electrical Workers and Operators
J. Eng. Club (Philadelphia) = Journal of the Engineers Club (Philadelphia)
J. Franklin Inst. = Journal of the Franklin Institute
J. Ind. Eng. Chem. = Journal of Industrial and Engineering Chemistry
J. Iron Steel Inst. = Journal of the Iron and Steel Institute
J. de Phys. = Journal de Physique, et le Radium
J. Wash. Acad. Sci. = Journal of the Washington Academy of Sciences
Metall. Chem. Eng. = Metallurgical and Chemical Engineering
Mil. Eng. = The Military Engineer
Nat. Rep. = The National Republican
Oil Gas J. = Oil and Gas Journal
Phys. Rev. = Physical Review
Proc. Am. Assn. Dental Sch. = Proceedings, American Association of Dental Schools
Proc. Com. Brick Mfgrs. Assn. Am. = Proceedings, Common Brick Manufacturers Association of America
Res. Lab. Rec. = Research Laboratory Record
School Soc. = School and Society
Sci. Mo. = Scientific Monthly
Tech. Eng. News = The Tech Engineering News
Tech. Pa. Bur. Stand. = Technologic Papers of the Bureau of Standards

Trans. Am. Electrochem. Soc. = Transactions of the American Electrochemical Society
Trans. Am. Inst. Metals = Transactions, American Institute of Metals
Trans. Am. Inst. Min. Eng. = Transactions, American Institute of Mining Engineers
Trans. Am. Inst. Min. Met. Eng. = Transactions, American Institute of Mining and Metallurgical Engineers
Trans. Am. Soc. Civil Eng. = Transactions, American Society of Civil Engineers
Trans. Am. Soc. Steel Treat. = Transactions, American Society for Steel Treating
Trans. Royal Canadian Inst. = Transactions, Royal Canadian Institute
Typoth. Bull. = Typothetae Bulletin
Univ. Calif. Pub. = University of California Publications
World Eng. Cong. = World Engineering Congress
Zeits. Physik. Chem. = Zeitschrift für physikalische Chemie

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