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# LYMAN JAMES BRIGGS
# 1874–1963

*A Biographical Memoir by*

PETER BRIGGS MYERS AND

JOHANNA M. H. LEVELT SENGERS

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*May 7, 1874–March 25, 1963*

BY PETER BRIGGS MYERS AND
JOHANNA M. H. LEVELT SENGERS

LYMAN JAMES BRIGGS APPEARED on the Washington scene at a time when the physical sciences, especially physics, were about to expand dramatically. His graduate professor at Johns Hopkins University, Henry A. Rowland, once commented to him that they were living in the final years when one individual could be knowledgeable across the field of physics. My (P.B.M.) grandfather became a scientist in the age when it was still possible for one person to make seminal contributions in diverse areas of science. The breadth of interests and contributions of Lyman Briggs, however, was exceptional even in his days, reaching from soil and plant science to atomic physics, from navigation to aerodynamics, and to the instrumentation of stratospheric balloons. For forty-nine years he was a civil servant in the federal government. The most important characteristic of his work was the systematic application of the principles and methods of physics in a variety of other fields. During his tenure (1933-45) as the third director of the National Bureau of Standards (NBS), he amply demonstrated his skills as an administrator and director of research in the years of the Great Depression and the Second World War. He chaired the top-secret Uranium Committee, which evolved into the Manhattan

Project for constructing the atomic bomb. In an unprecedented action, Briggs was appointed director emeritus of NBS at his retirement in 1945. He returned to research and to geographical exploration, while continuing as a gifted and prolific writer on scientific topics for science magazines.

## PERSONAL HISTORY

Lyman James Briggs was born on May 7, 1874, on a farm in Assyria, Michigan, 12 miles north of Battle Creek. His childhood and early education are best told from a handwritten autobiography I (P.B.M.) persuaded him to write in 1952, when he was seventy-eight years old:

Grandfather Briggs gave the land on which to build the district school and the Methodist Church. Through Grandfather, my forbears go back to Clement Briggs, who came to the Plymouth colony on the *Fortune* in 1621, the first ship to follow the *Mayflower*.

My father, Chauncey Lewis Briggs, was the eldest of eight children. He went to the Briggs school built by my grandfather and later taught there, the same school that my younger brother Clifton and I were later to attend.

My boyhood life on the farm was a happy outdoor life full of interesting things. I was early made to realize that the privilege of membership in my family entailed certain duties and responsibilities. Derelictions led to smarting consequences. Happily there were few, for I seemed to have sensed early the basic soundness of responsibility. It was the duty of my brother and myself to feed the chickens and the pigs; to gather the eggs; to keep the kitchen wood box filled; to drive the cows to pasture; to go to the post office for mail; and to market eggs at the country crossroads store in exchange for groceries my mother specified. These things were to be done first without prompting. Then we could play.

In winter nearly every boy had a “schooner” for sliding down hill. It consisted of a stout oaken barrel stave to which was nailed a short upright, topped by a short crossboard for a seat. We became very expert in riding these schooners, going down a long hill like the wind, without once touching our feet. At one time my popularity in school was unchallenged, for I was the sole owner of the staves from a defunct vinegar barrel.

Lyman's father, who had served in the Union Army's Corps of Engineers during the Civil War, persuaded him to attend Michigan Agricultural College (now Michigan State University) in East Lansing, which he entered by examination in 1889 at the age of fifteen. Although he majored in agriculture, his interests centered on mechanical engineering and later physics. In his own words:

> Since this was a Land Grant college, courses were given both in agriculture and the mechanic arts. I elected the former, because I thought it would please my father. But by the end of the college year my interest had swung so strongly to the physical sciences that I wished I had elected mechanical engineering. It was too late to do so, however, and I still maintain my membership in the class of '93, to which I had become deeply attached. In later years I was glad I did not make the change, for I learned something of geology, physiology, biology, entomology, and botany, which otherwise I would not have acquired. In addition, I took all the courses in chemistry and mathematics that were available. But my absorbing interest was in physics. From the moment I saw the great glass cases in the physical laboratory filled with marvelous apparatus I knew I wanted to be a physicist.

After graduating second in his class in 1893 he went to the University of Michigan, where he received a masters degree in physics in 1895.

## PROFESSIONAL HISTORY

In the autumn of 1895, Lyman Briggs entered Johns Hopkins University for further graduate study in the Ph.D. program in physics. While still an undergraduate, he had fallen in love with Katharine Cook, daughter of A. J. Cook, professor of entomology at Michigan Agricultural College. His desire to marry Katharine led him to secure a research position with the Department of Agriculture in Washington, D.C., in 1896; they were married the same year. While working in Washington, he traveled to Baltimore three times a week to pursue his research with the great Henry Rowland.

He spent appreciable time studying the newly discovered Roentgen rays, but he chose an agricultural topic for his thesis research and received his doctorate in 1903 with a dissertation entitled “On the absorption of water vapor and of certain salts in aqueous solution by quartz.” That same year he was elected to the Cosmos Club at the age of twenty-nine.

In his first professional position as a physicist, in charge of the Physics Laboratory Division, later the Bureau of Soils, in the U.S. Department of Agriculture, he was one of the new breed of interdisciplinary scientists who made use of a much more varied background in order to understand the biology and ecology of plant life in terms of the physics involved. His research work at the Department of Agriculture concentrated on characterization of water retention by soil (1907, 1910). He was one of the founders of the science of soil physics and devised a soil classification technique based on centrifuging, which is still a standard method. He organized a biophysical laboratory in 1906, which later became the Bureau of Plant Industry. With H. L. Shantz (1911, 1912), he studied the effect of environmental factors on water uptake by plants, and became one of our early ecologists. Briggs thus pioneered the application of scientific methods and instrumentation to agricultural research.

Wars were to play a major role in defining Briggs’s career. Mobilization pressures from World War I resulted in an Executive Order detailing him from the Department of Agriculture to the Department of Commerce’s Bureau of Standards in 1917. He was set to work on two topics: a stable zenith instrument for the Navy and the design and construction of a wind tunnel for aeronautical research. In a short time, he was successful on both scores, apparently having had no difficulty with this sudden change of field of research.

With John F. Hayford, he developed a gyroscopic instrument for maintaining an artificial horizon below deck as an aid in directing gunfire from battleships. The stable zenith instrument was used to synchronize the training of big guns, to point them in the direction of the target with the proper elevation. It was necessary to establish an artificial horizon, independent of pitch and roll of the ship, and then, by observation of the motion of the ship, the crew had to be informed when to fire. A model was developed, and installed in one of the battleships. Eventually, it was installed in the control rooms of all the main ships of the line. The confidential Hayford-Briggs report, turned over to the Navy, unfortunately was never published.

In 1920 Briggs resigned from the Department of Agriculture and permanently joined the Bureau of Standards. He became chief of the Engineering Physics Division (later the Mechanics and Sound Division). He appointed Hugh L. Dryden to head the Aerodynamics Physics Section, and together they did some of the best early research in aerodynamics in the nation. Their special study of the characteristics of airfoils in airstreams moving at speeds approaching the speed of sound (1925) found application in determining the blade form of aircraft propellers. Briggs was a member of the National Advisory Committee for Aeronautics from 1933 to 1945.

Retaining his interest in navigation, he invented, with Paul R. Heyl, the earth inductor compass (1922). The Heyl-Briggs earth inductor compass worked by spinning an electric coil in the magnetic field of the Earth, thereby determining the bearing of an airplane in relation to the Earth's magnetic field. For this invention, they received the Magellan Medal of the American Philosophical Society in 1922. A compass of this type was used by Admiral Byrd in his flight to the North Pole, and by Charles Lindbergh on his flight across the Atlantic in 1927.

Briggs's character and his mode of operation in these early happy years at the Bureau are well described in *Measures for Progress*[1] from which we cite:

> Dr. Briggs was of slight, slender build and of warm, affectionate, and unfailingly kind demeanor and manner. [The first Bureau director], Dr. [Samuel W.] Stratton, when harassed by demands upon his time and attention or in a stormy mood, often sought out Briggs's company in his laboratory in West building, for as he once said, "You always have something nice to report to me and I appreciate it. These other fellows give me a lot of trouble." The "something nice" was usually a new and ingenious piece of apparatus or testing device, for, like Stratton, Dr. Briggs was strongly mechanical and an inveterate tinkerer. When he came from the Department of Agriculture, he brought with him his mechanic, Mr. Cottrell, and for years the two designed and constructed many special devices that Briggs used in his measurement studies. His laboratory was a wonderful clutter of apparatus in various stages of assembly, a tangle of piping and tubing and ticking instruments, but it was comfortable and a tranquil spirit filled it.
>
> His serenity of temper was Dr. Briggs outstanding characteristic, and he was to have a need of it under the frustrations of the depression years and the pressures and harassments of security in World War II.

In 1926 Bureau Director George Burgess appointed Briggs as the Bureau's assistant director for research and testing. On Burgess's death in 1932, Briggs was nominated to the position of director of the Bureau by President Herbert C. Hoover, but none of the president's nominations during the last session were acted upon by the Senate. He was renominated by President Franklin D. Roosevelt after the election. When Roosevelt was pressed to name "a good Democrat" to the office, he is said to have replied, "I haven't the slightest idea whether Briggs is a Republican or a Democrat; all I know is that he is the best qualified man for the job."[1] Prior to his confirmation, however, the pressures of the Depression had caused a budget reduction of 50% at

NBS, so it was hard to imagine a less auspicious beginning for a new director. A major managerial and diplomatic effort on Briggs's part resulted in retention of about two-thirds of the career employees. He put many of his staff on part-time employment. Others continued their work at the Bureau as employees of the American Standards Association. He emphasized programs with direct economic relevance, including research in building materials and low-cost housing. He tried to convince the administration of the role of basic scientific research in furthering economic growth. The Bureau's important Mathematical Tables Project had its origin in the Depression when Briggs persuaded the Works Progress Administration to provide funds for unemployed mathematicians in the New York City area. Appropriations began to rise by the mid-1930s, due to Briggs's persuasive power with Congress and with the administration, and quite a few of the employees dismissed earlier were rehired.

As director of the Bureau, in 1934 Briggs succeeded in restoration of its original name, which had been lost in 1903: the *National* Bureau of Standards (NBS).

When war began to threaten Europe in 1939, Briggs sent Secretary of Commerce Daniel C. Roper a list of services NBS could provide in case of an armed conflict. At that time, the Danish physicist Niels Bohr alerted American scientists to the discovery of fission of uranium by Otto Hahn and Fritz Strassmann in Berlin, as confirmed by Lise Meitner and Otto Robert Frisch, then refugees in Scandinavia. The fissionable uranium isotope could possibly be used to make a bomb. American scientists persuaded Albert Einstein to write a letter to President Roosevelt about this possibility. After receiving Einstein's letter of advocacy in October 1939, Roosevelt asked Briggs to head and organize a top-secret project, the Uranium Committee, to investigate the possibility of using the energy generated by atomic fission of uranium. At that time, it was not even known which uranium isotopes could be split by slow neutrons, and the possibility of a chain reaction remained to be demonstrated. The first meeting of the Uranium Committee, chaired by Briggs, took place at NBS on October 21, 1939, with Eugene P. Wigner, Leo Szilard, and Edward Teller amongst the attendees. In 1940 the Uranium Committee became the S-1 Committee, chaired by Briggs, of the newly founded National Defense Research Committee. The S-1 Committee met regularly at NBS, and its work greatly expanded. Initial work on separating, purifying, and characterizing uranium isotopes was done at NBS, where about sixty civil servants were engaged in the project. In 1941 Briggs recommended an all-out effort to President Roosevelt, thus giving impetus to the Manhattan Project.

Meanwhile, other major defense assignments were accepted by Briggs, so that by 1942, 90% of the work at NBS was classified. It included the non-rotating proximity fuze; guided missile development; establishment of a Radio Propagation Laboratory; critical materials research on optical glass, for which Germany had been the sole supplier, and on quartz and synthetic rubber; and measurement and calibration services. To Briggs fell the unenviable task of modifying the Bureau's culture from open access and communication to secrecy.

In 1948 Briggs received the Medal of Merit from the President of the United States for his distinguished work in connection with World War II. On request of Secretary of Commerce Henry A. Wallace in 1945, he wrote a 180-page account on NBS war research (1949).

Briggs was elected to the National Academy of Sciences in 1942. The election biography lists his membership and/or presidency of over a dozen scientific associations, his recipiency of the Magellan Medal, and his scientific papers in soil science, aerodynamics, stratospheric research, and standards of measurement.

Upon his retirement in 1945, at the age of seventy-two, Briggs was appointed director emeritus of NBS after forty-nine years of service in the federal government. NBS employees through their Employees Welfare Association erected a bronze sundial in his honor. At his explicit request, however, the names of the first *three* directors of NBS were cast onto the rim of the instrument: Samuel Wesley Stratton, George Kimball Burgess, and Lyman James Briggs.[3] The sundial presently graces the courtyard of the National Institute of Standards and Technology.

## LATER YEARS

Lyman and Katharine Briggs had two children, a daughter Isabel, my (P.B.M.) mother, and a son Albert who died in infancy. I spent a month every summer with my grandparents in Washington, and have fond memories, as a child, of Sunday afternoons at the Bureau of Standards looking at exhibits and exploring the underground steam tunnels that connected the various buildings at the Bureau. In games of billiards with my grandfather I was introduced to the laws of physics and the beauty of classical music, two of his favorite hobbies and sources of relaxation. In 1942 I lived with my grandparents while attending George Washington University. My grandfather and I would canoe down the Potomac River to open-air concerts at the Watergate near the Lincoln Memorial.

My grandfather loved to tell stories and often used an appropriate anecdote to make a point. To help defuse a strained or angry situation, he would tell the story of an elderly gentleman, traveling across the country by train, who became incensed at breakfast when the dining-car steward told him there were no figs on board. “But your menu says clearly “fresh figs for breakfast,” the gentleman insisted, “and I want fresh figs!” The steward was unable to persuade him to make another choice; as they were disputing, the train slowed for a station stop. The steward excused himself and disappeared; amazingly, he returned in a short time with a dish of fresh figs that he had managed to buy while the train was stopped in the station. He presented the dish with a flourish, only to be told, “Take them away, I prefer to be angry!”

After his retirement, Briggs happily returned to research and the pursuit of his diverse interests. At NBS, he established a laboratory for studying fluids under negative pressure. The choice of this topic was directly related to his early interest in water uptake by plants. He used a centrifuge, which had been his instrument of choice in his studies on water content of soils in the early 1900s, to study the stability of columns of liquids in fine capillaries subjected to tension. He measured the negative pressure (or tension) at which the column would break. At room temperature, the maximum attainable tension in water was over 250 bar, and in mercury close to 500 bar (1950-53). The 1950 paper on limiting negative pressure in water is a classic and is still cited regularly in the literature on metastable water.

Another remarkable piece of research was triggered by his lifelong passion for baseball. During the war, he had set up measurement methods for the performance of baseballs with government-mandated reduced rubber content and had demonstrated that the complaints voiced about the cork-filled surrogates were valid (1945). The question he now addressed was: is it possible to pitch the ball so that it curves away from the plane of the pitch? By using his 1917 wind tunnel, and with collaboration of two pitchers from the Washington Senators baseball club, he carefully studied the effect of spin and speed on the trajectory and established the relationship between amount of curvature and the spin of the ball. To measure the spin, he attached a light-weight tape to the ball and counted the number of completed turns in the twisted tape (1959).[1] The newspaper accounts of this work made it the most widely known of all his achievements.

The National Geographic Society had always been one of his interests. In 1934, while he chaired the society's Committee on Research and Exploration, he provided the instrumentation for two stratospheric balloon flights. The first flight was aborted, but the second broke a world record for altitude (1936) that was maintained until 1951. After retirement he became even more active in the society, and led the expedition to study the solar eclipse in Brazil in 1947. A prolific author, Briggs frequently wrote articles for the *National Geographic Magazine*, including a memorable story on carbon dating published in 1958, when he was eighty-four years old. At the Cosmos Club and in Washington science circles, he is fondly remembered for the exceptional range of his interests and for his many contributions to scientific research.

The significance of Briggs's life is best summarized by quoting a statement by his successor as director of the Bureau, Edward U. Condon:[2] "Briggs should always be remembered as one of the great figures in Washington during the first half of the century, when the federal government was slowly and stumblingly groping towards a realization of the important role [that] science must play in the full future development of human society."

KARMA BEAL, ARCHIVIST at the National Institute of Standards and Technology, formerly the National Bureau of Standards, made available to us material from NIST archives, including newspaper clippings

and biographical material assembled at NIST for special occasions, such as Briggs's retirement, his eightieth birthday, and the centenary of his birth.[2] A history of the National Bureau of Standards by Rexmond C. Cochrane[1] contains much biographical material on Briggs and his tenure at NBS, while NIST archives contain the original notes about the interview with Briggs conducted by Cochrane in 1961. The special issue of *Scientific Monthly* (May 1954) contains a biography by Wallace R. Brode (NBS) with a list of selected publications by Briggs. His former collaborators in soil science, atomic energy, aerodynamics, gravity, and geographic exploration wrote articles highlighting Briggs's contributions to these fields.[3] We made ample use of the biography written by Allen V. Astin on the occasion of the centennial celebration of Briggs's birth.[4] Karma Beal meticulously read the manuscript for accuracy of facts. Judson French made many suggestions for improvement of the manuscript.

## NOTES

1. R. C. Cochrane. *Measures for Progress, a History of the National Bureau of Standards.* Washington, D.C.: U.S. Government Printing Office, 1966, 1974.

2. Narrative drawn from a centennial exhibit commemorating the 100th anniversary of the birth of Lyman J. Briggs. NIST archives, 1974.

3. *Sci. Mon.* May 7, 1954. Articles by W. R. Brode: "Lyman J. Briggs: Recognition of his eightieth birthday," pp. 269-74; V. Bush: "Lyman J. Briggs and atomic energy," pp. 275-77; E. C. Crittenden: "Some problems in national and international standards," pp. 278-82; N. E. Dorsey: "Spontaneous freezing of water," pp. 283-88; H. L. Dryden: "Supersonic travel within the last two hundred years," pp. 289-95; G. Grosvenor: "Earth, sea and sky: Twenty years of exploration by the National Geographic Society," pp. 296-302; P. R. Heyl: "Gravitation, still a mystery," pp. 303-306; L. A. Richards: "The measurement of soil water in relation to plant requirements," pp. 307-13.

4. A. V. Astin. Lyman James Briggs, 1874-1963. *Cosmos Club Bull.* March 1977. A manuscript of this title is in the NIST archives, but it differs in detail from the published version.

## SELECTED HONORS AND DISTINCTIONS

| | |
|---|---|
| 1916 | President, Philosophical Society of Washington |
| 1917 | President, Washington Academy of Sciences |
| 1932 | Chairman, Federal Specifications Board |
| 1933-1939 | Chairman, Federal Fire Council |
| 1933-1945 | Director, National Bureau of Standards |
| 1933-1964 | Life Trustee, National Geographic Society |
| 1934, 1935 | Chairman, Special Advisory Committee for Stratospheric Balloon Flights |
| 1935 | Chairman, National Conference on Weights and Measures |
| 1938 | President, American Physical Society |
| 1939 | Chairman, Uranium Committee S-1 of the National Defense Research Committee |
| 1937 | Chairman, Research Committee of the National Geographic Society |
| 1942 | Vice-chairman, National Advisory Committee for Aeronautics |
| 1945-1963 | Director Emeritus, National Bureau of Standards |

Briggs was awarded honorary doctorates by the following institutions:

| | |
|---|---|
| 1932 | Science, Michigan State College |
| 1935 | Engineering, South Dakota School of Mines |
| 1936 | Law, University of Michigan. |
| 1937 | Science, George Washington University |
| 1939 | Science, Georgetown University |
| | Science, Columbia University |

Briggs received the following honors:

| | |
|---|---|
| 1922 | Magellan Medal, American Philosophical Society |
| 1942 | Elected Member, National Academy of Sciences |
| 1948 | Medal of Merit by President Truman |
| 1954, 1962 | Franklin R. Burr Award, National Geographic Society |

Briggs at various times served as president of:

American Physical Society
Washington Academy of Sciences

Philosophical Society of Washington
Cosmos Club, Washington, D.C.
Federal Club, Washington, D.C.

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1907

With J. W. McLane. The moisture equivalents of soils. *U. S. D. A. Bur. Soils Bull.* 45.

1910

With J. W. McLane. Moisture equivalent determinations and their application. *Proc. Am. Soc. Agron.* 2:138-47.

1911

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1912

With H. L. Shantz. The wilting coefficient for different plants and its indirect determination. *U. S. D. A. Bur. Plant Ind. Bull.* 230.

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1922

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### AERODYNAMICS

1925

With G. F. Hull and H. L. Dryden. Aerodynamics of airfoils at high speeds. *Natl. Adv. Comm. Aeron. Rep.* 207.

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1936

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1949

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1945

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1959

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1950

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1953

The limiting negative pressure of mercury in Pyrex glass. *J. Appl. Phys.* 24:488-90.