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OF

DAYTON CLARENCE MILLER

1866–1941

BY

HARVEY FLETCHER

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Dayton C. Miller

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When Dayton C. Miller entered upon the scientific scene around 1890 the opinion of at least one prominent scientific figure was that further progress in physics would be limited to the "fourth decimal place." Miller's decision to take up acoustics as his chief activity was not only remarkable in view of this opinion but even more remarkable in that the work of Rayleigh had been so thorough and comprehensive that it seemed indeed that nothing further was to be done in the field of acoustics. That he was able to achieve so much is striking tribute to the perspicacity and industry which so distinguished him.

Dr. Miller was prominently connected with the beginning of the renaissance in the science of acoustics which has been going on with increasing momentum during the last quarter of a century. Notable contributions were made particularly to the parts called musical acoustics and architectural acoustics. Also the general field of physics was not neglected.

Dayton C. Miller was born in Strongville, Ohio, on March 13, 1866, the son of Charles Webster Dewey and Vienna (Pomeroy) Miller. He had the good fortune of having his early boyhood training on a farm where his early interest and ingenuity in making things had a chance for expression. When Dayton was eight years old the Miller family moved to Berea, Ohio, where the father operated a hardware store at the back of which was a tin shop. These facilities provided Dayton with mechanical tools which he learned to use in his early boyhood and soon he became very proficient in building complicated mechanical things. Among these are three astronomical telescopes, the last one being a 5-inch refractor which is now at the Case School of Applied Science.

Miller's father prospered at Berea, becoming identified with banking and later with the electric traction business. Dayton's natural love of music was fostered very much since his mother

played the organ and his father sang in the church choir. At thirteen we find him with his first flute, one made of silver. This was a forerunner of a great collection of flutes, about which we will hear later. His dual interest in music and science was early shown by the contribution made at the commencement exercises at Baldwin University, where he graduated in 1886. At that time he gave a lecture on the sun and played a solo on his silver flute. After graduation he spent fifteen months as assistant cashier in his uncle's bank at Berea. The life of a banker seemed to be a dull one to him so he left this position and went to Princeton for postgraduate work in astronomy, studying under Professor Young. After completing one year of graduate work he returned again to his Alma Mater for a year's teaching. The pull of research however was too strong so the next year saw him again at Princeton, where he finished his work for the doctorate, receiving the degree of Doctor of Science from that institution in the spring of 1890, having finished all the work for the doctorate within two years.

Miller's excellent record won for him the appointment to the newly founded Thaw Fellowship in Astronomy at Princeton. However, the difficulty of having certain glass prisms molded and properly ground made it necessary to postpone active work in the capacity of Fellow for a year after the appointment. This forced delay may seem like a trivial incident in his life but as so frequently happens it was this delay that changed the whole course of his career. Instead of developing in astronomy at Princeton, Dr. Miller accepted a teaching position at the newly formed Case School of Applied Science in Cleveland, back in his native state. No doubt he thought that the job assigned to him, which was the teaching of elementary mathematics, was temporary and that at the end of the year he would return to Princeton. However, he proved to be such an excellent teacher that he was induced to stay at Case School and indeed he spent the rest of his professional life there (51 years).

After three years in the department of mathematics Dr. Miller was asked to take charge of the work in physics while they were looking for a man to replace Dr. Reid as professor of

physics. And thus through these circumstances he was started on a career in physics. It is needless to say that no one was found to replace him in the physics department and at the end of his first year he was promoted to the rank of Assistant Professor. His confidence of success in this field at this time was shown by his getting married to Edith Easton of Princeton, New Jersey.

His experimental skill was first shown by the remarkable X-ray photographs which he took only a few months after Roentgen announced his discovery. For this purpose Dr. Miller used some of the Crookes and Geissler tubes which he had purchased at the World's Fair in Chicago three years earlier. Dr. Crile of the famous clinic in Cleveland bearing his name heard of these photographs and promptly brought one of his patients with a broken arm to be photographed by the new X-ray technique. This was probably the first X-ray photograph of surgical importance that was made. Later, with the help of Dr. Miller's technique, bullets were located and the shape of impacted teeth indicated.

The famous Michelson-Morley experiment which was designed to measure the velocity of the earth through ether and which laid the experimental foundation for the theory of relativity was performed in 1887 at Case School. This was just three years before Miller entered the school as a young teacher. The Millers and the Morleys became warm friends as they lived neighbors in the same apartment building. In 1900 they went to Paris to attend the International Science Congress, at which time they met the famous Lord Kelvin. He urged them to repeat the ether-drift experiment, so immediately on their return a series of measurements was started which lasted for several years. A small positive effect was obtained which Miller always insisted was real. The development of the theory of relativity revived and increased the importance of the question, and Miller's conscientiousness made him decide that a repetition of the experiment with improvements was called for. This he did, carrying out much of the work at the observatory on Mount Wilson. Such was his industry that he personally made more than 100,000

readings and obtained a small but definite positive result which in his mind vitiated the postulate of the theory of relativity.

The Rockefeller Laboratory of Physics at Case School which was built in 1904 was planned by Professor Miller. The equipment used in this building for his famous demonstration-lecture courses was purchased by him during a special trip to Europe in 1905. He developed remarkable skill in his teaching technique and in his many public lectures for utilizing such demonstration apparatus to make the facts of science live.

Dr. Miller's love for music was deep, particularly for the opera and for the symphony. It is said that he heard Parsifal performed 23 times. The Millers made frequent trips to Bayreuth, Germany, for the Wagnerian Festival. He was an expert performer on the flute, pipe organ and piano, and he composed thirty-one pieces for these instruments. This love of music naturally orientated his scientific investigations into the field of acoustics. Miller wanted to know how the physical characteristics of musical tones were related to the various musical qualities of the tone. He also wanted to know what were the physical factors which made an auditorium good or bad for musical performances. On both of these questions he became an expert.

To investigate the first question he invented the Phonodeik which records the pressure of sound as a function of time. Not only did Miller use this instrument as a research tool in his laboratory but, because of the great popular interest that it aroused, he gave public lectures all over America and Europe using the Phonodeik to throw on a screen the speech wave patterns produced by various spoken words and other sounds. One very important conclusion which was drawn from his experiments made with the Phonodeik on vowel sounds was that the character of a vowel sound depends only upon frequency regions which are independent of the pitch at which the vowel is sounded.

Professor Miller was very active in a large number of scientific societies. In 1907 he was Vice President of Section B of the American Association for the Advancement of Science; in 1914

he was elected to the American Academy of Arts and Sciences; in 1919 to the American Philosophical Society; and he became a member of the National Academy of Sciences in 1921. He was Secretary of the American Physical Society for four years from 1918 to 1922. After this successful term as Secretary he became Vice President in 1923-1924 and President in 1925-1926; and then remained a member of the council for fifteen years. From 1927 to 1930 he was Chairman of the Division of Physical Sciences of the National Research Council. From 1931 to 1933 he was President of the Acoustical Society of America. He maintained an active interest in all of these societies during the rest of his life.

As mentioned earlier, at the age of thirteen Miller purchased his first flute which was one made of silver. From that time to the end of his life he made it a hobby to be interested in flutes of all kinds and made a remarkable collection of them. This collection now numbers 1426 instruments. It also includes a very comprehensive collection of books about the flute and many works of art relating to it. Before his death he made arrangements with the Library of Congress in Washington for placing this collection of flutes on permanent exhibition. In his will he donated this collection to the Library of Congress. The collection was shipped to Washington and it was planned to have the entire exhibit on display by January 1, 1943, but due to the war the exhibit remains in the packing cases and has been transported to a secret place for safe-keeping until after the war.

In addition to the gold flute and the Chinese flutes of jade and carved ivory some of the more interesting specimens in the collection are a glass flute that belonged to President James Madison, a glass flute owned by the Emperor Franz Joseph of Austria, another brought to America by Jerome Bonaparte and a brass flute that was specially constructed for the premiere of the opera Aida at Cairo. Dr. Miller was a consultant for many manufacturers of musical instruments and his researches led to a multitude of improvements.

His industry and conscientiousness made him active in various ways which he considered to the advantage of the community.

As a consequence it is perhaps not surprising that he received the award of the Cleveland Chamber of Commerce in 1928 as the man who had done most for Cleveland in the then current year. That a scientist should receive such an award is perhaps the best of all indications of Miller's personal qualities. His numerous friends and his scientific achievements round out a personality which will be long remembered by scientists.

In this biographical memoir I have borrowed freely from the splendid article written by Dr. Robert S. Shankland entitled "Dayton Clarence Miller: Physics Across Fifty Years," and have borrowed completely the following bibliography which he compiled.

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KEY TO ABBREVIATIONS

Am. Architect—American Architect
Astron. J.—Astronomical Journal
Astrophys. J.—Astrophysical Journal
Bull. Bur. Am. Ethnology, Smithsonian Inst.—Bulletin, Bureau of American Ethnology, Smithsonian Institution
Bull. Natl. Research Coun.—Bulletin, National Research Council
Bull. Polish Med. and Dental Assn. Am.—Bulletin, Polish Medical and Dental Association of America
Central Assn. Sci. & Math. Teachers—Central Association of Science and Mathematics Teachers
Cleveland Med. Gazette—Cleveland Medical Gazette
Elec. World—Electrical World
J. Acous. Soc. Am.—Journal, Acoustical Society of America
J. Am. Chem. Soc.—Journal, American Chemical Society
J. Assn. Eng. Soc.—Journal, Association of Engineering Societies
J. Franklin Inst.—Journal, Franklin Institute
J. Opt. Soc. Am.—Journal, Optical Society of America
J. Roy. Astron. Soc. Canada—Journal, Royal Astronomical Society of Canada
Mod. Sci.—Modern Science
Papers of Am. Musicological Soc.—Papers of the American Musicological Society
Phil. Mag.—Philosophical Magazine
Phys. Rev.—Physical Review
Proc. Am. Acad. Arts and Sci.—Proceedings, American Academy of Arts and Sciences
Proc. A. A. A. S.—Proceedings, American Association for the Advancement of Science
Proc. B. A. A. S.—Proceedings, British Association for the Advancement of Science
Proc. Music Teachers Natl. Assn.—Proceedings, Music Teachers National Association
Proc. Natl. Acad. Sci.—Proceedings, National Academy of Sciences
Proc. Natl. Dental Assn.—Proceedings, National Dental Association
Proc. Royal Soc. Canada—Proceedings, Royal Society of Canada
Proc. S. P. E. E.—Proceedings, Society for the Promotion of Engineering Education
Rev. Mod. Phys.—Review of Modern Physics
Sch. Sci. and Math.—School of Science and Mathematics
Sci. Am.—Scientific American
Sci. Am. Supp.—Scientific American Supplement

Sci. Mo.—Scientific Monthly
Trans. Am. Med. Assn.—Transactions, American Medical Association
Trans. Am. Otological Soc.—Transactions, American Otological Society
Trans. Ky. Acad. Sci.—Transactions, Kentucky Academy of Sciences
Western Reserve Univ. Bull.—Western Reserve University Bulletin

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