BIOGRAPHICAL MEMOIR

OF

DAYTON CLARENCE MILLER
1866–1941

BY

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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
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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 equip-
ment 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 ex-
periments 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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BIBLIOGRAPHY

KEY TO ABBREVIATIONS

Am. Architect—American Architect
Astron. J.—Astronomical Journal
ican Ethnology, Smithsonian Institution
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. Am. Chem. Soc.—Journal, American Chemical Society
J. Franklin Inst.—Journal, Franklin Institute
Canada
Mod. Sci.—Modern Science
Papers of Am. Musicological Soc.—Papers of the American Musicological
Society
Phil. Mag.—Philosophical Magazine
Phys. Rev.—Physical Review
and Sciences
Proc. A. A. A. S.—Proceedings, American Association for the Advance-
ment of Science
Proc. B. A. A. S.—Proceedings, British Association for the Advancement
of Science
Proc. Music Teachers Natl. Assn.—Proceedings, Music Teachers Na-
tional Association
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
The letter (A) signifies an abstract; the letter (T) that the title only appears in the periodical indicated.


"Observations of Comet 1889 V and an investigation of its orbit with an ephemeris," dissertation for doctorate (Privately published, Princeton, 1890); Sidereal Messenger 20, 35 (1890), report of elements only.

"Astronomical spectroscopy, with special reference to the most recent photographic developments," Civil Engineers' Club of Cleveland, Apr. 12, 1892; J. Assn. Eng. Soc. 11, 379-382 (1892).


"Note on the electric conductivity of certain specimens of glass with reference to their fitness for use in static machines," Proc. A. A. A. S., Detroit 46, 103 (A) (1897); Science 6, 219 (T) (1897).

"Study of standard meter scales rules on nickel, silver and glass," Proc. A.A.A.S., Boston 47, 137 (T) (1898); Science 8, 531 (A) (1898).

"Exhibit of an automatic mercurial air-pump designed by Professor E. W. Morley," Proc. A.A.A.S., Boston 47, 137 (T) (1898); Science 8, 532 (A) (1898).


Laboratory physics, a student's manual (Ginn, 1903).


"Biographical notes of Edward W. Morley," for presentation of portrait to Cleveland Chemical Soc. (1906), manuscript.


The flute and flute-playing, tr. from the German work of Boehm, with annotations (Ed. 1, 1908; ed. 2, rev., 1922).


"I. Development of three types of the 'phonodeik' for photographically recording and for projecting sound waves," demonstrated before the A.A.A.S. and Am. Phys. Soc. (Baltimore, Boston, Washington, Cleveland) and the B.A.A.S. (Dundee), and briefly described in Phys. Rev. 28, 151 (A) (1909); Science 29, 471 (A) (1909); Phys. Rev. 30, 263 (T) (1910); Science 31, 590 (T) (1910); Proc. B.A.A.S., Winnipeg (1909), 414; Proc. B.A.A.S., Dundee (1912), 419; Engineering (London) 54, 550 (1912); Fifth International Con-
gress of Mathematicians, Cambridge, Eng. (1912); Science of musical sounds, chap. III.


"Address, with experiments, upon sound waves: their meaning, registration and analysis," Central Assn. Sci. and Math. Teachers, Cleveland, 1910.


"Photometric tests of illuminating gas," report to Mayor Newton D. Baker, Cleveland, 1912, manuscript.


"IV. Quantitative analysis of vowel sounds involving the analysis of about 100 records of 11 standard words from 8 different voices, leading to definite classification," A.A.A.S. and Am. Phys. Soc., Atlanta, 1914; Science of musical sounds, chaps. VII and VIII.


Several confidential reports for the Submarine Defense Assn., as a member of the Committee on Location and Detection (1918); several confidential reports for the Natl. Research Coun. on scientific instruments for war uses (1918).


"II. Pressures and velocities, internal and external, due to the discharge of large guns." Natl. Acad. Sci., Washington, Apr. 30, 1919; Science 49, 430 (T) (1919).


Reports to the Aeolian Co. on special researches: (1) “Complete photographic study of the vibration of the sound-board of a piano, for every tone in the scale (86 notes)”; (2) "Photographs of every tone in the scale for each of two pianos, for comparisons of tone-quality"; (3) “Photographic investigations of various talking machines as regards effects on tone-quality of various diaphragms, tone-arms, horns, forms of case, etc.”

Reports to the Westinghouse Electric and Manufacturing Co. on special researches: (1) “Study of the acoustic characteristics of horns for radio loud-speaking telephones”; (2) “Study of the acoustic characteristics of various types of transmitting microphones, as used in radio communication."
Report to the Brunswick-Balke-Collender Co., "Photographic investigation of the acoustic properties of horns for talking machines, made of various materials and of various sizes and shapes."


“List of works on the flute in the library of Dayton C. Miller” (Privately published, 1922).


"Physical characteristics of music and speech," Soc. Motion Picture Engineers, Lake Placid, Sept. 26, 1928; Trans. 12, 647-659 (1928).


"Professor Michelson at Case," Case Alumnus (May, 1931), 6-8, 17. Laboratory physics (enlarged ed., Ginn, 1932).


"Sound will be controlled," Am. Architect 141, 70, 71, 116 (1932).


"Sounds from large guns," Case Alumnus (Feb., 1934), 18-19, 46.


"Carrying the academic torch," Case Alumnus (Apr., 1935), 22-23.

"The spirit and service of science," Commencement Address, Case School of Applied Science, Cleveland, June 1, 1936; Science 84, 297-304 (1936).

*Sound waves: their shape and speed* (Macmillan, 1937).


"To Eckstein Case," 53rd Commencement Luncheon, Case School of Applied Science, June 7, 1937; Case Alumnus 16, No. 8 (May-June, 1937), 23-24, 95-96.


"Spirit of science in the world of today," Commencement Address, Baldwin-Wallace College, Berea, Ohio, June 12, 1939; Baldwin-Wallace Coll. News Letter 5, No. 7 (July, 1939).