NATIONAL ACADEMY OF SCIENCES

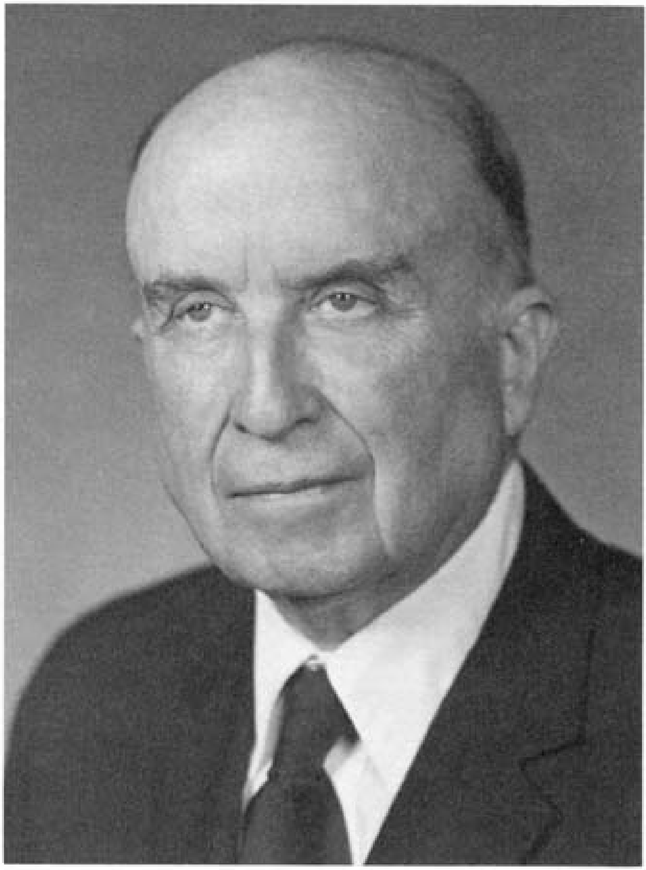
HARRY F. OLSON

1901—1982

A Biographical Memoir by

CYRIL M. HARRIS

Biographical Memoir



Harry F. Olson

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December 28, 1901–April 1, 1982

BY CYRIL M. HARRIS

HARRY F. OLSON, pioneer in acoustics and electronic sound recording, died on April 1, 1982, at Princeton Medical Center at the age of eighty-one. He had been a member of the National Academy of Sciences since 1959.

During his career of nearly forty years with RCA, Dr. Olson developed several types of microphones for broadcasting and recording, high-fidelity loudspeakers, phonograph pickups and recording equipment, underwater sound equipment, and sound motion picture and public address systems; he contributed substantially to the development of the RCA magnetic tape recorder for television and the RCA music synthesizer.

Harry F. Olson was born in Mt. Pleasant, Iowa, on December 18, 1901, the first of two children. Both his father, a farmer, and mother, a talented amateur artist, were born in Sweden and had come to this country to seek new opportunity.

Their son exhibited an interest in science and technology at an early age, which they encouraged by supplying him with a modest shop and laboratory. While still in grade school and with very little data on design, Harry built and flew model airplanes—an art then in its infancy. In high school he graduated to building a steam engine and a wood-fired boiler, which he used to drive a direct current generator constructed from parts of an automobile generator he had rewound for 110 volts. He also designed and built an amateur radio station, became proficient with the code, and obtained an operator's license.

In 1924, majoring in electrical engineering, Harry graduated near the top of his class from the University of Iowa's College of Engineering. G. W. Stewart, then head of the physics department, chose him to receive a graduate scholarship, and in 1925, he earned the M.A. degree with a thesis on acoustic wave filters in solids. As part-time research assistant to J. A. Eldridge, he worked on polarization of light by electron impact; while with A. Ellett he conducted research on atom beams.

One experiment, verifying the Maxwell velocity distribution of atoms, used a small boiler partially filled with cadmium and equipped with a narrow aperture to supply a fine beam of atoms. The atom beam was sent through a series of Fizeau wheels driven by the squirrel-cage rotor of an induction motor, all operating in a vacuum. The three-phase stator windings of the induction motor were located outside the vacuum chamber. The atom beam passed through the slots in the wheels and the atoms were collected on a glass plate cooled by liquid air. They then measured the density of the collected atoms. From the dimensions, geometry, rotational velocity, and density, the researchers determined the velocity distribution. They then reflected a narrow beam of cadmium atoms from a rock salt crystal and found that the reflection was specular. For his doctoral thesis, Olson carried out research on the polarization of resonance radiation in mercury and received the Ph.D. degree in 1928.

From his association with Stewart, the inventor of the acoustic wave filter, and with Dean Carl E. Seashore, who specialized in the psychology of music, Harry Olson developed an interest in music, acoustics, and sound reproduction. In 1928, he joined RCA as a member of the Research Department. Except for the two-year period from 1930 to 1932, when he was associated with the Engineering Department of the Photophone Division of RCA in New York City, Dr. Olson was associated with the RCA research organization continuously until his retirement. In 1934 he was placed in charge of acoustical research for the RCA Manufacturing Company. In 1942 his Acoustical Research Laboratory was moved from Camden, New Jersey, to the newly constructed RCA Laboratories in Princeton, New Jersey, where he had a well-equipped acoustical facility, constructed under his supervision. This included a free-field (anechoic) room that was the world's largest at that time, a reverberation chamber, and an ideal listening room. He continued as director of acoustical research until 1967, when he was appointed staff vice-president.

Dr. Olson's work on the development of microphones for the motion picture and broadcast industries resulted in microphones that found widespread commercial use. Especially noteworthy were his bidirectional velocity microphones and his unidirectional cardioid microphones. He continued to develop new types of microphones, including higher-order gradient microphones, ultra-directional microphones, noise-cancelling microphones, and various types of miniature microphones which were used both in industry and in the military. He also developed loudspeakers that made significant improvements in linearity and uniformity in frequency response of loudspeakers that were commercially available at the time.

During World War II, Dr. Olson and the group he led worked on various military projects with an emphasis on underwater sound and antisubmarine warfare. This work included significant improvements in sonar transducers, the development of an acoustic proximity fuse for depth charges, and voice communication transducers for use in noisy environments. During the academic years from 1940 to 1942, he also lectured in acoustical engineering at Columbia University.

Following World War II, Dr. Olson continued his research in sound reproduction. One of his experiments, now considered a classic, determined the preferred bandwidth for the reproduction of music. Previous experimenters had found that listeners seemed to prefer a high-frequency cutoff of 5000 Hz for reproduced music. Dr. Olson carried out an experiment in which a small orchestra sat behind a visually opaque but acoustically transparent screen. The screen incorporated a concealed low-pass acoustical filter having an upper frequency cutoff of 5000 Hz. This filter could be opened or closed, allowing either the full range of frequencies to pass or the range only below 5000 Hz. The listeners were asked to select their preference between two conditions: full bandwidth or restricted bandwidth. There was overwhelming preference in favor of the full bandwidth. Next, the orchestra was replaced with a sound-reproduction system where the loudspeakers were located in the position of the orchestra, behind the screen. When the sound system was free of distortion, the listeners preferred the full bandwidth. But when he introduced small amounts of nonlinear distortion, the restricted bandwidth was preferred, thus demonstrating clearly the importance of high quality in audio systems.

Early in 1950, RCA asked Dr. Olson to develop a team in his laboratory to make significant improvements in magnetic tape recording that could lead to the magnetic tape recording of television signals. To accomplish this would require a breakthrough in the quality of both the magnetic tape and the recording heads. The 3M Company was selected as the collaborator for providing the special tape needed for this new process. In May 1956, after several years of development, the system was completed and was moved from his laboratory in Princeton to the NBC Studios in New York City, where it provided the world's first broadcast of tape-recorded color television signals. Dr. Olson then started a project in tape-coating technology in his laboratory. When finally developed, this equipment was transferred, as a unit, to RCA's newly created Magnetic Products Division in Indianapolis, where it was used in the commercial production of magnetic tapes.

Dr. Olson's interest in musical acoustics led to the development, with Herbert Belar, of the RCA Electronic Music Synthesizer. Music synthesizers have become commonplace since the advent of transistors and integrated circuits. But in the era of vacuum tubes and relays, of which the RCA device was constructed, the production of an arbitrarily selected audio signal by means of a synthesizer was a considerable achievement. At first, Olson and Belar's synthesizer was used at the RCA Laboratories at Princeton to compose musical selections that were issued as records. It was later moved to the Electronic Music Center at Columbia University, where it is still in use.

For his achievements, Dr. Olson received many honors and awards, including the Modern Pioneer Award of the National Association of Manufacturers (1940), the John H. Potts Medal of the Audio Engineering Society (1952), the Samuel L. Warner Medal of the Society of Motion Picture and Television Engineers (1955), the John Scott Medal of the City of Philadelphia (1956), the Achievement Award of the IRE Professional Group on Audio (1956), the John Ericsson Medal of the American Society of Swedish Engineers (1963), the Emile Berliner Award of the Audio Engineering Society (1965), and the Institute of Electrical and Electronic Engineers' Mervin J. Kelly Medal (1967), Consumer Electronics Award (1969), and Lamme Medal (1970).

He was awarded the first Silver Medal in engineering acoustics of the Acoustical Society of America in 1974 and in 1981 was given the Gold Medal of the Society with the following citation: ". . . for his innovative and lasting contributions in acoustic transduction, sound reproduction, electronic music and speech synthesis, and his service to the Society." He served on the Executive Council of the Society from 1937 to 1940, as vice-president from 1942 to 1944, president-elect from 1951 to 1952, and president from 1953 to 1954. He was, in addition, associate editor of the *Journal of the Acoustical Society of America* for thirty years.

He was a member of the American Society of Motion Picture and Television Engineers, Fellow of the American Physical Society, Fellow of the Institute of Electrical and Electronic Engineers, and Fellow of the Acoustical Society of America. Dr. Olson was an honorary member, a founder, and past-president of the Audio Engineering Society. He was also a member of Tau Beta Pi and Sigma Xi and received an honorary D.Sc. degree from Iowa Wesleyan College.

Dr. Olson was the author of numerous acoustical studies and contributed to more than 130 articles and professional papers. His books, *Elements of Acoustical Engineering* (1940, 1947), *Dynamical Analogies* (1942, 1958), *Musical Engineering* (1952), *Acoustical Engineering* (1957), and *Music, Physics and Engineering* (1966), are widely used by students and engineers throughout the world. *Acoustical Engineering* and *Dynamical Analogies,* particularly, are considered standard reference texts in the field and have been translated into Russian and Japanese. Dr. Olson held more than one hundred U.S. patents awarded on devices and systems in the field of acoustics, a partial list of which follows. The titles given here are descriptive and are not the actual titles recorded on the patents.

Many of his patents are considered to be fundamental—as, for example, patents on the velocity microphone, the cardioid microphone, functional sound absorbers, the electronic music synthesizer, the air-suspension loudspeaker, and the electronic sound absorber.

Harry Olson retired in 1967 but continued as a consultant to RCA Laboratories for several years thereafter. He is survived by his wife, the former Lorene Johnson of Morris, Illinois, whom he married in 1935. In their early years, Lorene helped him to prepare the manuscripts for his many books and articles. Like his mother, she was an amateur artist, and her prominently displayed oil paintings enlivened his office walls throughout his career.

HONORS AND DISTINCTIONS

DEGREES AND HONORARY DEGREES

1924 B.E., University of Iowa
1925 M.S., University of Iowa
1928 Ph.D., University of Iowa
1932 E.E. (Professional), University of Iowa
1959 D.Sc. (Honorary), Iowa Wesleyan

MEMBERSHIPS

Tau Beta Pi
Sigma Xi
Acoustical Society of America, Past-President
Audio Engineering Society, Past-President
Society of Motion Picture and Television Engineers
Institute of Electrical and Electronic Engineers
American Society of Swedish Engineers
American Physical Society
National Academy of Sciences

HONORS AND AWARDS

1940 Modern Pioneer Award of the National Association of Manufacturers
1952 John Potts Gold Medal of the Audio Engineering Society
1955 Samuel L. Warner Gold Medal of the Society of Motion Picture and Television Engineers
1956 The John Scott Medal of the City of Philadelphia
1956 The Achievement Award of the Institute of Radio Engineers
1963 John Ericsson Gold Medal of the American Society of Swedish Engineers
1965 The Emile Berliner Award
1967 Mervin J. Kelly Medal of the Institute of Electrical and Electronic Engineers
1969 Consumer Electronics Award of the Institute of Electrical and Electronic Engineers
1970 Lamme Gold Medal of the Institute of Electrical and Electronics Engineers
1974 The First Silver Medal of the Acoustical Society of America

PATENTS

1932	Velocity Microphone	1,885,001
1932	Unidirectional Cardioid Microphone	1,892,645
1935	Double Voice Coil Loudspeaker	2,007,748
1940	Multiple Flare Horn	2,203,875
1941	Line Microphone "Shotgun Microphone"	2,228,886
1942	Multiple Loudspeakers	2,269,284
1949	Air Suspension Loudspeaker	2,490,466
1950	Synthetic Reverberation	2,493,638
1950	Functional Sound Absorbers	2,502,016
1951	Single Element Cardioid Microphone	2,539,671
1953	Noise Discriminator, Threshold Type	2,645,684
1958	Electronic Music Synthesizer	2,855,816
1961	Speech Analyzer	2,971,058
1961	Electronic Sound Absorber	2,983,790
1961	Music Composing Machine	3,007,362
1963	Stereophonic Loudspeaker	3,104,729
1964	Stereophonic Disk System	3,118,977

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1929

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1932

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1933

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On the collection of sound in reverberant rooms with special reference to the application of the ribbon microphone. Proc. Inst. Radio Eng., 21(5):655.

1934

With Frank Massa. *Applied Acoustics.* Philadelphia: P. Blakiston's Son & Co.

A new cone loudspeaker for high fidelity sound reproduction. Proc. Inst. Radio Eng., 22(1):33.

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1936

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1937

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1938

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A horn consisting of manifold exponential sections. J. Soc. Motion Pict. Eng., 30(5):511.

1939

The unidirectional microphone. RCA Broadcast News, 30:3.

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