

1877–1896, USA	Thomas Edison (1847–1931) and Emile Berliner (1851–1929) independently develop and patent the cylindrical and disc phonograph systems.
1895, USA	Dr. Thaddeus Cahill (1867–1934) applies for patent for “sounding staves,” granted as U.S. Patent 520,667 in 1897.
1898, Copenhagen	Valdemar Poulsen (d. 1942) patents his “Telegraphone,” the first magnetic recording machine.
1900, USA	W. Duddell describes the first (?) audio oscillator (negative resistance oscillator) in his article, “On rapid variations in the current through the direct-current arc.”
1906, New York	Cahill’s “Telharmonium” (or “Dynamophone,” Holyoke, Mass.) is described in two short unsigned articles in <i>Electrical World</i> , “The art of Telharmony” and “The generating and distributing of music by means of alternators.”
1906, USA	Lee DeForest (1873–1961) develops the triode “audion,” the first vacuum tube. Ray Stannard Baker discusses Cahill’s work in “New music for an old world,” an article appearing in <i>McClure’s Magazine</i> .
1907, Berlin	Ferruccio Busoni (1866–1924) reads Baker’s article and enthusiastically foresees the promise of Cahill’s work in his <i>Entwurf einer neuen Aesthetik der Tonkunst</i> .
1910–1913, Italy	Francesco Balilla Pratella (1880–1955) and Luigi Russolo (1885–1947) publish their

<sup>2</sup> The information for this section has been compiled from a wide range of material, including standard reference dictionaries and encyclopedias. The sources relevant to this chronology are indicated with an asterisk in the bibliography.

	Futurist manifestoes for music in Milan and Florence.
1911, Vienna	Arnold Schoenberg (1874–1951) completes his <i>Harmonielehre</i> , which he concludes with the proposal of timbre-melody (“Klangfarben-melodie”).
1914, Milan	Russolo’s first “art of noises” concert, April 21, is performed on his “Intonarumori.” The “Intonarumori” were acoustical noise-instruments, whose sounds (howls, roars, shuffles, gurgles, etc.) were hand-activated and projected by horns and megaphones. Similar concerts took place in Paris during the week June 17–24, 1921.
1916, New York	Edgar Varèse (1883–1965) calls for new musical instruments and an enrichment of our “musical alphabet” (quoted in the <i>New York Morning Telegraph</i> ).
1919–1920, USSR (Leningrad and Moscow)	Leon Termen (name Gallicized as “Theremin,” b. 1896), builds and demonstrates his “Etherophone” or “Thereminovox” (U.S. Patent, 1928).
1922, New York	Varèse insists that “the composer and the electrician will have to labor together” (quoted in <i>Christian Science Monitor</i> ).
1922–1927, Paris	Darius Milhaud (b. 1892) experiments with vocal transformation by phonograph speed change.
1924, Berlin	Jörg Mager (1880–1939) publishes <i>Eine neue Epoche der Musik durch Radio</i> and exhibits the “Sphärophon,” the first of his electronic performance instruments (others: “Elektrophon,” “Kaleidophon,” and “Partiturophon”).
1924, Rome	Ottorino Respighi (1879–1936) calls for a phonograph recording of nightingales in his <i>Pini di Roma</i> .
1924–1925, Budapest	Dr. Endre Magyari constructs electronic devices for Radio Budapest’s identification signal.
1926/1927, Paris/New York	First performances of <i>Ballet mécanique</i> , for which the composer George Antheil (1900–1959) required car horns, airplane propellers, saws, and anvils.
1927, New York	Varèse begins his discussions with Harvey

	Fletcher of Bell Telephone Laboratories concerning the development of an electronic instrument for composition. Varèse applied for Guggenheim fellowships until 1936 so that he, René Bertrand, Fletcher, and others could collaborate, but was denied each time. The sound studios in Hollywood also refused him assistance.
1928, Berlin	Friedrich Trautwein (1888–1956) completes the "Trautonium," an electronic performance instrument.  Robert Beyer (b. 1901) develops new attitudes on the spatial aspects of music in his article, "Das Problem der 'kommenden Musik,'" appearing in <i>Die Musik</i> .
1928, Germany	Walther Ruttmann (1887–1941) composes a soundtrack montage for film (sound only, no visuals).
1928, Paris	Maurice Martenot (b. 1898) demonstrates the "Ondes Martenot."  René Bertrand exhibits the "Dynaphone."  A. Givelet writes on "Les instruments de musique à oscillations électriques," in September 22 issue of <i>Genie Civil</i> .
1929, Evanston, Ill.	Laurens Hammond (b. 1895) establishes his company for the manufacture of electronic musical instruments, which have included the "Hammond Organ," the "Novachord," the "Solovox," and reverberation devices (U.S. Patents 1,956,350; 2,230,826, etc.).
1929, Frankfurt am Main	Bruno Hellberger and Peter Lertes collaborate on the "Hellertion."
1929, Paris	Givelet and E. E. Coupleux demonstrate a music "synthesizer" utilizing four electronic oscillators controlled by punched paper rolls (U.S. Patent 1,957,392).
1929, New York	Joseph Schillinger (1895–1943) composes his <i>First Airphonic Suite for RCA Theremin with Orchestra</i> , performed with Sokoloff conducting the Cleveland Orchestra and Leon Theremin (Theremin) as soloist.
1929–1930, Berlin	Paul Hindemith (1895–1963) and Ernst Toch (1887–1964) experiment with phonograph techniques at the Rundfunkversuchsstelle,



	Staatliche Hochschule für Musik. Their compositions included <i>Studie für instrumentale Klänge</i> , <i>Studie für vokale Klänge</i> (Hindemith), and <i>Fuge aus der Geographie</i> , phonograph version (Toch).
	Hindemith and Kretzmer (?) compose Trautonium music.
1930, Berlin	Trautwein publishes his <i>Elektrische Musik</i> .
1930–1932, Dessau	László Moholy-Nagy (1895–1946), Oskar Fischinger, Trautwein, Paul Arma (b. 1905), and other <i>Bauhaus</i> artists work with “drawn sound” and other sound-on-film techniques.
1931, Germany	Winifred Wagner commissions Mager to produce electronically synthesized bell sounds for the Bayreuth production of <i>Parsifal</i> .
1931, New York	Schillinger reviews and forecasts electronic applications for music in his article, “Electricity, a musical liberator,” appearing in <i>Modern Music</i> .
1932, New York	Leopold Stokowski (b. 1882) addresses the Acoustical Society of America, calling for a collaboration among physicists, musicians, and psychologists, and predicting a time when the composer “can create directly into TONE, not on paper.”
1933–1937, Paris	Maurice Jaubert (1900–1940), Arthur Hoérée (b. 1897), and Arthur Honegger (1892–1955) manipulate soundtracks for their motion-picture music.
1934, Paris	The Russian mystic and composer Nicolas Oboukhov (1892–1954) supervises the construction of his “Croix sonore,” an electronic instrument in the form of a cross.
1935, Germany	The manufacturing firm Allgemeine Elektrizitäts Gesellschaft (AEG) builds and demonstrates the first “Magnetophon” (tape recorder), using magnetic tape developed by Fritz Pfeumer and manufactured by I. G. Farben AG.
1935, Leningrad	Yevgeny Sholpo (d. 1951) constructs “Variophones” (4 models), which used graphic coding of films and were forerunners of the ANS (photo-electric sound synthesizer) of the Moscow experimental studio.

c. 1936, New York

Varèse experiments with phonographs that could be operated backwards and at variable speeds.

1937, Mexico/New York

Carlos Chávez (b. 1899) calls for a collaboration among engineers and composers in his *Toward a New Music*.

1937, New York

J. Murray Barbour (b. 1897) lectures before the American Musicological Society on "Music and electricity."

1937, Seattle

John Cage (b. 1912) foresees "the synthetic production of music . . . through the aid of electrical instruments which will make available for musical purposes any and all sounds that can be heard."

1938, Berlin

Harald Bode (b. 1909) builds the electronic "Melodium."

1939, New York

Norman McLaren (b. 1914) completes his first films with "drawn sound." His work continues to the present at the National Film Board of Canada, Ottawa and Montréal.

1939, Seattle

Cage realizes his *Imaginary Landscape No. 1* at the radio studio of the Cornish School. The work, to be performed as a recording or as a broadcast, calls for muted piano, cymbal, and 2 variable speed turntables playing Victor test recordings of fixed and variable frequencies. Cage's article "Goal: new music, new dance" is published in *Dance Observer*.

1940, Ottawa

Hugh Le Caine (b. 1914) initiates his development of electronic musical instruments at the National Research Council of Canada.

c. 1940, Princeton, N.J.

Milton Babbitt (b. 1916) experiments with film soundtracks.

1941, Paris

Georges Jenny constructs the "Ondioline."

1942, Chicago

Cage composes *March (Imaginary Landscape No. 2)* for percussion quintet and amplified coil of wire, and *Imaginary Landscape No. 3*, for percussion, tin cans, muted gong, audio frequency oscillators, variable speed turntables, frequency recordings, buzzer, amplified coil of wire, and marimbula amplified by a contact microphone. Cage calls for "experimental radio music" in an article in *Modern Music*, "For more new sounds."

## FORUM: ELECTRONIC AND COMPUTER RESEARCH

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| 1944, New York     | Percy Grainger (1882-1961) and Burnett Cross patent a device for "Free Music" employing 8 audio oscillators and synchronizing equipment.                   |
| 1944-1950, Paris   | Paul Boisselet (b. 1917) experiments with disc and tape procedures.  |
| 1945, USA          | J. M. Hanert describes an electronic music synthesizer using punched cards to encode the electrical analogs of musical parameters (U.S. Patent 2,541,051). |
| 1945-1948, Ottawa  | Le Caine develops the "Electronic Sackbut," an instrument performed in the three space coordinates.  |
| 1947-1955, London  | Tristram Cary (b. 1925) experiments with disc manipulations.   |
| 1948, Berlin       | Oskar Sala (b. 1910) supervises the construction of the "Mixturtrautonium," an extended version of Trautwein's instrument.                                 |
| 1949, near München | Bode builds the "Melochoord," later installed in the NWDR Electronic Music Studio in Köln.   |
| 1950, Trossingen   | The Hohner firm exhibits the "Elektronium."  |