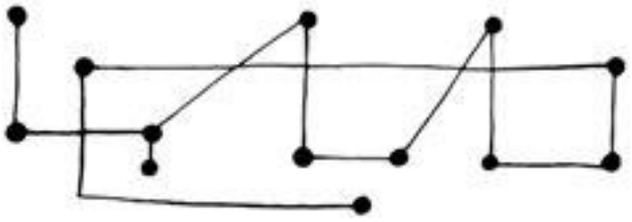



## FORUM: ELECTRONIC MUSIC AND COMPUTER RESEARCH

# ELECTRONIC MUSIC, 1948-1953

LOWELL CROSS

### *Introduction*

THE EMERGENCE of electronic music as a major development in music history has occurred within the brief period of the last twenty years. A testament to the enthusiasm with which composers have embraced electronic media during the period 1948–1967 is the recently published *Répertoire International des Musiques Électroacoustiques/ International Electronic Music Catalog.* Writing in September 1967, its compiler, Hugh Davies, states that the catalog accounts for nearly 5,000 compositions and that 2,500 more are likely to exist.[1] This world-wide acceptance of electronics for compositional purposes not only serves as an index to the milieu and working habits of the composer in mid-twentieth century, but also is indicative of the acute confrontation that has arisen between man's sensory awareness and his technology.

The years 1948–1953 are crucial to the chronology of new music, for it was during this period that the foundations were laid for electronic music in its present form. To be sure, various mergings of electronics and music had been undertaken, both in theory and in fact, throughout the first half of the century. Figures as diverse as Busoni, Schoenberg, Varèse, Schillinger, Stokowski, Chávez, and Cage had all postulated before World War II that new compositional procedures were forthcoming from science. A viable collaboration had already begun between musicians and engineers in the construction of electronic instruments for performance. The "Theremin," the "Trautonium," the "Ondes Martenot," and numerous keyboard instruments which appeared between the world wars were certainly capable of producing a kind of electronic music. But the orientation of composers, striving to work directly with sound, was the basis for the electronic music which has evolved since World War II. It is a music whose sound materials are realized directly by the composer, or with his approval, through electronic circuitry, amplifiers, and loudspeakers, and which in most cases has relied upon storage de-

[1] Hugh Davies, *Répertoire International des Musiques Électroacoustiques/International Electronic Music Catalog. Electronic Music Review,* 2–3 (April–July 1967), pp. iv, ix. Published April 1968; cited hereafter as *Répertoire International.*

vices—film soundtracks, disc or tape recordings, and more recently, electronic computers and related memory and logic machinery—for the collecting, composing, and performing of such materials.

The various techniques of gathering these basic compositional elements serve to define the establishing branches of electronic music. The school of "musique concrète" (Schaeffer, Henry), begun in Paris in 1948, has depended since the outset upon the recording of natural aural phenomena via microphones, then subjecting this stored information to manipulation and transformation. The "elektronische Musik" of the group working in Köln (Beyer, Eimert, Meyer-Eppler, Stockhausen) since 1951 has proceeded also from manipulation and transformation of stored material, but here the preference has been for electronically generated sound (sine and other periodic waveforms, "white" noise, and sounds from the "Monochord" and the "Melochord"), organized according to compositional principles derived from the works of Schoenberg and Webern. The schools of "music for magnetic tape" (Cage, Brown, Feldman, Wolff, Tudor, the Barrons) and "tape music" (Ussachevsky, Luening) that began to flourish independently in New York in 1951 have drawn upon both natural and electronic sound materials, organized according to their individual aesthetic demands. However, the earliest "tape music" by Ussachevsky and Luening was composed exclusively from sounds produced by conventional musical instruments.

Musique concrète, elektronische Musik, and tape music are now usually grouped together under the collective term "electronic music." In spite of their wide divergence, these various approaches may be considered together with justification. All share the common property of having greatly expanded the creative means available to composers. The new opportunities so offered are compelling ones: 1) musical events may be temporally organized (especially by magnetic tape editing) with great precision into structural schemes that were previously impossible; 2) if desired, the role of the human performer is totally eliminated, thus affording the composer a direct confrontation with his audience; and 3) a vast and entirely new sound realm, demanding new modes of listening and musical perception, is at last made accessible.

## *Chronology of Inventors and Precursors*

The appearance of musique concrète in 1948, and the more "electronic" developments that followed soon after, would hardly have been possible without the setting of the stage by a visionary group of scientific and musical pioneers. The importance of their work,

much of which has passed into undeserved disregard, becomes evident with the discovery that means for direct electronic composition were actively being sought throughout the first half of the century. The fact that such means were actually employed to compose works of "proto"-electronic music (see below the work of Ruttmann, Hindemith, Toch, the *Bauhaus* group, Honegger, Cage, and McLaren) greatly diminishes the novelty of post-World War II electronic music and demands that we review some of the developments that have made it all possible.[2]

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| 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 *Electrical World,* "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 *McClure's Magazine.* |
| 1907, Berlin | Ferruccio Busoni (1866–1924) reads Baker's article and enthusiastically foresees the promise of Cahill's work in his *Entwurf einer neuen Aesthetik der Tonkunst.* |
| 1910–1913, Italy | Francesco Balilla Pratella (1880–1955) and Luigi Russolo (1885–1947) publish their |

[2] 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.

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| | Futurist manifestoes for music in Milan and Florence. |
| 1911, Vienna | Arnold Schoenberg (1874–1951) completes his *Harmonielehre,* 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 *New York Morning Telegraph*). |
| 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 *Christian Science Monitor*). |
| 1922–1927, Paris | Darius Milhaud (b. 1892) experiments with vocal transformation by phonograph speed change. |
| 1924, Berlin | Jörg Mager (1880–1939) publishes *Eine neue Epoche der Musik durch Radio* 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 *Pini di Roma.* |
| 1924–1925, Budapest | Dr. Endre Magyari constructs electronic devices for Radio Budapest's identification signal. |
| 1926/1927, Paris/New York | First performances of *Ballet mécanique,* 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 |

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| | 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 *Die Musik.* |
| 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 *Genie Civil.* |
| 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 *First Airphonic Suite for RCA Theremin with Orchestra,* performed with Sokoloff conducting the Cleveland Orchestra and Leon Termen (Theremin) as soloist. |
| 1929–1930, Berlin | Paul Hindemith (1895–1963) and Ernst Toch (1887–1964) experiment with phonograph techniques at the Rundfunkversuchsstelle, |

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| | Staatliche Hochschule für Musik. Their compositions included *Studie für instrumentale Klänge, Studie für vokale Klänge* (Hindemith), and *Fuge aus der Geographie,* phonograph version (Toch). |
| | Hindemith and Kretzmer (?) compose Trautonium music. |
| 1930, Berlin | Trautwein publishes his *Elektrische Musik.* |
| 1930–1932, Dessau | László Moholy-Nagy (1895–1946), Oskar Fischinger, Trautwein, Paul Arma (b. 1905), and other *Bauhaus* 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 *Parsifal.* |
| 1931, New York | Schillinger reviews and forecasts electronic applications for music in his article, "Electricity, a musical liberator," appearing in *Modern Music.* |
| 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 Pfleumer 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. |

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| 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." |

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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 "Melochord," later installed in the NWDR Electronic Music Studio in Köln. |
| 1950, Trossingen | The Hohner firm exhibits the "Elektronium." |

## *Musique Concrète*

From the foregoing evidence, it becomes apparent that the first works of musique concrète which Pierre Schaeffer (b. Nancy, France, 1910) produced in May and June 1948 were not as strikingly innovative as they have often been considered. Nevertheless, Schaeffer's contributions cannot be minimized. He has been quite influential in establishing many of the techniques of transforming and manipulating sound for compositional purposes; he has actively promoted scientific research into the acoustical phenomena of musical events; and perhaps most importantly, he founded the first enduring "school" of electronic music.

It is significant that Schaeffer received his training not in music, but in radio broadcasting. He was awarded diplomas by L'École Polytechnique and L'École des Télécommunications de la Radiodiffusion-Télévision Française. He has spent most of his working life with the RTF in Paris. On August 24, 1944, Schaeffer was responsible for the joyous broadcast announcing the liberation of Paris. He read from Victor Hugo ("Assez de honte! Redevenez la grande France!"), played "La Marseillaise" (to which thousands of ecstatic Parisians responded by throwing open their windows and singing

along with their radios), and appealed to all parish priests to ring their church bells in celebration.[3] Since 1935, he has occasionally made contributions to French literature, including a biography of Clotaire Nicole, dramatic productions for stage and radio, the essay "Amérique, nous t'ignorons," and a novel, *Les Enfants de coeur.*

Pierre Schaeffer began to formulate his ideas for musique concrète during the first half of 1948. He has recounted the sentiments and the sense of discovery which he experienced during those and the following months in the form of diaries, "Introduction à la musique concrète,"[4] and *À la recherche d'une musique concrète.*[5] The first is the earliest written source of any consequence that exists for musique concrète, but unfortunately it suffers from inconsistencies of chronology. It serves only to supplement *À la recherche d'une musique concrète,* a document of primary importance. This latter work is divided into four sections, "Premier Journal de la musique concrète, 1948–1949," "Deuxième Journal de la musique concrète, 1950–1951," "L'expérience concrète en musique, 1952," and "Esquisse d'un solfège concret." In the first section Schaeffer conveys, in a style appropriate to radio journalism, the doubts, uncertainties, illuminations, and feelings of exultation he underwent during his metamorphosis from broadcaster to creator. He sets forth his reasons for naming his work "musique concrète," makes passing references to his predecessors (the Futurists, John Cage), and offers personal reflections on his first compositions and their theoretical implications. The second part continues in the same style, revealing Schaeffer's increasing association with Pierre Henry (composer) and Jacques Poullin (engineer). References are made to their collective involvement with important new equipment received during 1950 and 1951: continuously variable speed turntables, a device for controlling sound in space, and single- and multi-channel tape recorders. For the third section, Schaeffer abandons his chronological account to concentrate on matters of a theoretical nature.[6] Of particular importance is his concern for the musical event in isolation, "l'objet musical." Further examples of Schaeffer's theoretical speculations are found in the last section, written in collaboration with the physicist and acoustician, Abraham André Moles. The solfège that Schaef-

[3] Larry Collins and Dominique Lapierre, *Is Paris Burning?* (New York: Simon and Schuster, 1965), pp. 256–257.

[4] *Polyphonie,* 6 (1950), pp. 30–52. Schaeffer's article is dated December 1949.

[5] Paris: Éditions du Seuil, 1952.

[6] With musique concrète and elektronische Musik, the usually separate functions of theory and practice arose simultaneously and inseparably.

fer and Moles are seeking to establish is concerned with the characterization and classification of sound events and "objets musicaux." [7]

The innovation that distinguished Pierre Schaeffer's work from earlier experiments was his isolation of the sound event ("l'objet musical") by means of the recording process. The "compositional" techniques he employed to combine, repeat, transform, and organize his sound objects were a natural outgrowth of his long experience with the equipment of radio broadcasting. With this background, it was natural for him to view the significance of his work from a musical standpoint rather than as an application of technology. The early passages of *À la recherche d'une musique concrète* reveal Schaeffer's interest in a "symphony of noises" and a "piano of noises." [8] The implication is that extra-musical sounds could be treated musically by determining for them a familial or a scalar ordering, yet allowing them to retain the essence of their noise-like properties. This brings us to Schaeffer's definition of musique concrète.

> Ce parti pris de composition avec des matériaux prélevés sur le donné sonore expérimental, je le nomme, par construction, *Musique Concrète,* pour bien marquer la dépendance où nous nous trouvons, non plus à l'égard d'abstractions sonores préconçues, mais bien des fragments sonores existant concrètement, et considérés comme des objets sonores définis et entiers, même et surtout lorsqu'ils échappent aux définitions élémentaires du solfège.[9]

During the time he was arriving at this definition, Schaeffer had already begun to put his ideas into effect. At Easter in 1948 he notes that he "had experimented for two months [but] had composed nothing," and seeking to correct this situation, he developed the "exciting, sensational" idea of a "concert of locomotives." [10] The result was the first piece of musique concrète, *Étude aux chemins de fer.* The sounds for this three-minute study are simply those associated with trains: whistles, escaping steam, the wheels clicking along the rails. Schaeffer had carried out his intentions by using the means at his disposal. The RTF equipment and catalog of sound-effects recordings permitted him to isolate his materials and bring them together into a "composition." As is very often the case with electronically produced

[7] See Schaeffer's recent comprehensive investigation, *Traité des objets musicaux* (Paris: Éditions du Seuil, 1966).

[8] In 1948, Schaeffer was unaware of John Cage's "prepared piano," and considered the work of the Futurists to be fundamentally different from his. *À la recherche d'une musique concrète,* pp. 26–27, 31, footnotes.

[9] *Ibid.,* p. 22. A condensed definition appears in the *Polyphonie* article, p. 39.

[10] *À la recherche d'une musique concréte,* p. 18.

works, the piece suffers in comparison with the accompanying verbal expressions offered by the composer. If one wished to assign a musical form to this first example of musique concrète, the rondo would be the most apt choice. The recurring element is the sprightly whistle of a steam locomotive, interspersed among a variety of other railroad sounds. With the possible exception of the "coda" (a melodic variation of the whistle), no transpositions or other special treatments of the sounds are evident. Repetitions of the isolated sounds were obtained by recording them onto disc loops ("boucles"). When played back, the effect of a loop is precisely that of a phonograph stylus repeating the same groove over and over. The sequential organization of *Étude aux chemins de fer* was accomplished by "cueing" the isolated sound events and repetitions on individual turntables and drawing upon them at will. The completed version came into being on a phonograph disc, realized in the re-recording process.[11]

It is interesting to consider that such a modest little piece, composed by reconstructing in time the sounds of trains, could have a position in music history. The significance of *Étude aux chemins de fer* results from the following attributes: 1) the act of composition was accomplished by a technological process, 2) the work could be replayed innumerable times in precisely the same manner, 3) the replaying was not dependent upon a human "performer," and 4) the basic elements were "concrete," thereby offering the listener a mode of audition quite different from that of perceiving "abstract" music. But as we have already noted, the outstanding feature of Schaeffer's work was his establishment of a trend, one which was capable of development and increasing sophistication.

On October 5, 1948, the Radiodiffusion-Télévision Française presented a program of Schaeffer's first five works of musique concrète under the collective title "Concert de bruits":

*Étude aux chemins de fer*
*Étude aux tourniquets*
*Étude au piano I* (*Étude violette*)
*Étude au piano II* (*Étude noire*)
*Étude aux casseroles* (*Étude pathétique*).[12]

During periods of experimentation, Pierre Schaeffer made a primitive advance in his pursuit of a scale of values for "les objets musicaux." He discovered for himself, like many of his precursors years

[11] The much easier technique of tape editing was not available to Schaeffer until three years later.

[12] Pierre Schaeffer, "La Musique concrète," *La Vie musicale,* 1 (July–August 1951), 8. Davies, *Répertoire International,* p. 69.

before, the sonic transformations that result from playing recordings at slower and faster speeds (33⅓ rather than 78 rpm, etc.). Schaeffer employed this procedure in composing his second study. His sound sources were percussion instruments (xylophone, bells) and toy whistling tops ("whirligigs" or "tourniquets"). The title *Étude aux tourniquets* is also suggestive of the rotating turntables as they relentlessly repeat the closed disc loops.

Schaeffer received the help of the composer Pierre Boulez (b. Montbrison, France, 1925) in realizing the two piano studies. Boulez was asked to record a series of piano chords reminiscent of past musical styles (classical, romantic, impressionistic, atonal, etc.). These became the raw materials for subsequent manipulations. Even though he chose sounds associated with "abstract" music, Schaeffer insisted on maintaining his "concrete" approach, offering as justification the contrast he brought about between the continuity and fragmentation of the recorded piano sounds. He also confessed a satisfaction in having avoided any recourse to a "prepared" piano. He considered the first étude to be "harsh, abrupt" ("heurtée"); he described the second as "plus melodique." [13]

The fifth study is a more complex sound-montage. Schaeffer's "objets musicaux" were spinning covers from saucepans ("casseroles"), canal boats, sung and spoken sounds, harmonicas, and a piano. The wider spectrum of sound heard in *Étude aux casseroles* brings to it a quality of comparative ingenuousness, despite its inflexible tactus of 78 pulsations per minute. Pierre Schaeffer composed one other work of musique concrète in 1948, *Diapason concertino.* Like *Étude violette* and *Étude noir,* this longer piece (9′30″) is a study in piano sounds, recorded for Schaeffer by Jean-Jacques Grunenwald.

The year 1949 marked the beginning of Schaeffer's collaboration with Pierre Henry (b. Paris, 1927). Schaeffer had worked alone as a composer throughout 1948. His associations with the sound engineer, Jacques Poullin, and the musicians Boulez and Grunenwald, had been undertaken only during the process of collecting and recording "les objets musicaux." The young Henry, who had studied with Olivier Messiaen (b. Avignon, 1908) at the Paris Conservatoire, appealed to Schaeffer to the extent that the older man welcomed him as a co-composer. The association that began in 1949 lasted until 1958, when Henry became the principal composer at the new rival "Studio Apsome." With Henry's arrival at the RTF studios, the works composed there became longer and more ambitious. Schaeffer's *Suite pour 14 instruments,* composed in 1949, is a five-movement work lasting

[13] *À la recherche d'une musique concrète,* p. 27.

twenty-three minutes.[14] The first joint composition by Schaeffer and Henry, *Symphonie pour un homme seul* (1949–1950, 22′), has undergone a number of revisions and applications; the definitive version was released only in 1966.[15] Pierre Henry rapidly developed into a prolific composer of musique concrète on his own account. By the end of 1953, he had produced more works (at least 37 alone, 7 jointly with Schaeffer) than all of the other RTF composers taken together. Examples of his works are *Concerto des ambiguïtés* (1950, 34′), fifteen short pieces with the collective title *Le Microphone bien tempéré* (1950–1951, 55′15″), *Vocalises* (1952, 2′55″), *Antiphonie* (1952, 3′), and *Le Voile d'Orphée* (1953, 15′15″).

In 1951, the RTF established the first studio expressly designed for electronic composition. The new equipment installed there included tape recorders and devices developed by Poullin for composition and performance, including "le pupitre de relief spatial" (or "potentiomètre d'espace") the "morphophone," and two "phonogènes." The first mentioned was an electroacoustical device for creating the illusion of sound moving in space. The "morphophone" employed a ten-channel magnetic tape loop system with adjustable filters for producing variable artificial reverberation. The two "phonogènes" were special machines for playing tape loops at variable speeds. One was constructed to perform over a continuously variable range, while the other was designed to be controlled by a twelve-position keyboard and a two-position transposing switch, thus providing 24 discrete pitch transformations of the recorded information.[16] With the installation of these sophisticated devices in the new studio, Schaeffer was much better equipped to adjust his "objets musicaux" to the scalar orderings that he had been attempting to establish. But as Henry and other trained composers began to work there, Schaeffer's output fell off sharply. He continued to compose jointly with Henry,[17] but the works for which he alone was responsible totaled only three more through 1953: *L'Oiseau RAI* (1950, 3′07″), musique concrète for a film, *Maskerage* (1952, 9′15″), and a piece for radio, *Les Paroles dégelées* (1952, 3′). One cause for Schaeffer's decreased output may

[14] Performance times for the various forms of electronic music require different bases of comparison from those for standard works. A twenty-three-minute composition of musique concrète conveys a feeling of extended duration.

[15] Davies, *Répertoire International*, pp. 69, 79.

[16] "Historique des recherches de musique concrète," *La Revue musicale*, 244 (1959), p. 58. Hugh Le Caine, "Electronic music," *Proceedings of the Institute of Radio Engineers*, XLIV, 4 (April 1956), 474–475.

[17] Their most ambitious collaboration of this period is the "opera" *Orphée 53* (1951–1953, 1¼ hr.) for tape, violin, harpsichord, and two singers.

have been his initial disenchantment with tape recorders.[18] Perhaps he felt unwilling to abandon the turntables and disc loops that had helped him to attain a position of prominence in music.

The RTF musique concrète studio attracted a number of important composers between 1951 and 1954. A complete catalog of works produced there during this period by composers other than Schaeffer and Henry is given below:

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| André Hodeir (b. Paris, 1921) | *Jazz et Jazz* (piano and tape, 1951–1952, 3′) |
| Pierre Boulez | *Étude I sur un son* (1952, 3′)<br>*Étude II sur sept sons* (1952, 3′) |
| Olivier Messiaen | *Timbres-Durées* (1952, 15′) |
| Monique Rollin (b. France, 1927) | *Étude vocale I* (1952, 1′40″)<br>*Étude vocale II* (1952, 1′40″) |
| Marius Constant (b. Rumania, 1925) | *Le joueur de flûte* (1952, 1 hr.) |
| Karlheinz Stockhausen (b. Mödrath, Germany, 1928) | *Étude* (1952, 3′) |
| Michel Philippot (b. France, 1925) | *Étude I* (1952, 5′18″) |
| Jean Barraqué (b. Paris, 1928) | *Étude* (1953, 4′) |
| Darius Milhaud | *La Rivière endormie* (*Étude Poétique,* Op. 333, for mezzo soprano, two narrators, orchestra, and tape, 1954, 7′30″) |
| Edgar Varèse | *Déserts* (winds, percussion, tape, 1954, 10′. Only a portion of the tape realization was done at the RTF studio.).[19] |

## *Elektronische Musik*

The origins of electronic music in Germany are not confined to the work of a single figure, as was the case with Pierre Schaeffer's musique concrète. Elektronische Musik came into being as the result of a rather loose collaboration among three men: Werner Meyer-Eppler (b. Antwerp, 1913; d. Bonn, 1960), Robert Beyer (b. Germany, 1901), and Herbert Eimert (b. Bad Kreuznach, 1897). Dr. Meyer-Eppler was a physicist and mathematician. At the time of his death, he was Director of the Institut für Phonetik und Kommunikationsforschung at the University of Bonn. He was one of the leading figures in the

[18] The "magnétophones" began to be put into use in April 1951. See Schaeffer's dubious reactions to their idiosyncrasies in *À la recherche d'une musique concrète,* pp. 96ff.

[19] Davies, *Répertoire International,* pp. 70–71.

field of information theory, and much of his later work was concerned with applying the generalized theories of communication to problems in music and electroacoustics. Meyer-Eppler became involved with the relevance of electronics to music at an earlier stage than his two colleagues. In 1949, he published an important text on electronic sound generation, *Elektrische Klangerzeugung*.[20] The subtitle of this concise, yet technically comprehensive work is "Elektronische Musik und synthetische Sprache." It offers a rigorous introduction to the fundamentals of electroacoustics and surveys in detail the work of numerous experimenters from Cahill through Trautwein and Bode. Another important feature of *Elektrische Klangerzeugung* is its bibliography. Meyer-Eppler lists over 250 writings, technical and historical, which relate significantly to the prehistory of electronic music.

Detailed information on the work of Robert Beyer, whether concerned with his involvement with electronic music or not, is quite elusive. He published articles on new music during the 1920's, including the important study "Das Problem der 'kommenden Musik.'"[21] From 1951 to 1953, he and Eimert collaborated in Köln to produce four of the very first pieces of elektronische Musik. Beyer wrote articles on electronic music between 1952 and 1955 for the periodicals *Zeitschrift für Musik* and *Melos*.[22] These writings come under such salient headings as "Zur Geschichte der elektronischen Musik" and "Zur Situation der elektronischen Musik," but their very generalized approach prevents them from being the important sources of information that their titles imply. Beyer appears to have made no further contributions to electronic music after 1955.

Herbert Eimert was to become the Director of the Studio für Elektronische Musik, Nordwestdeutscher Rundfunk, Köln. He began his formal musical training at the Kölner Konservatorium in 1919 and soon developed into an admirer of the twelve-tone theories of Schoenberg and Josef Matthias Hauer (1883–1959). By 1924, Eimert's *Atonale Musiklehre* had been published by Breitkopf und Härtel. That same publisher offered in the following year his string quartet, which is said to be the first German (as distinct from Austrian) twelve-tone work to appear in print.[23] Eimert then undertook musicological studies at the University of Köln for the next six years. He was

[20] Meyer-Eppler had published as early as 1943 on such topics as "Tonfilmspalt und Filmfrequenzgang," *Kinotechnik*, XXV (1943), 1–7, 16–18.

[21] *Die Musik*, XX, 12 (September 1928), 861ff.

[22] Cited in the bibliography.

[23] Helmut Kirchmeyer, "Versuch über Herbert Eimert," Baden-Baden, Wergo Schallplattenverlag, undated (notes to the phonograph recording, Wergo WER 60006).

awarded a doctorate in 1931, following the completion of his dissertation, "Musikalische Formstrukturen im 17. und 18. Jahrhundert. Versuch einer Formbeschreibung." During the 1920's, Eimert contributed musicological and theoretical articles to *Melos, Zeitschrift für Musikwissenschaft,* and *Zeitschrift für Aesthetik.* A second book entitled *Lehrbuch der Zwölftontechnik* (Wiesbaden, 1950) has been published also in Italian (Milan, 1954) and Spanish (Buenos Aires, 1957).

Meyer-Eppler and Beyer began a collaboration of sorts in 1950 at Darmstadt, where they gave lectures on "Die Klangwelt der elektronischen Musik."[24] Varèse also lectured there that year, but it is doubtful that any mutual influences or lines of communication were established. At approximately the same time, Harald Bode delivered one of his "Melochords" to Meyer-Eppler in Bonn.[25] Meyer-Eppler used the "Melochord" to produce a number of "Klangmodelle" which were subsequently programmed by NWDR, Köln, on October 18, 1951. The radio broadcast carried the same title as the Darmstadt lectures, "Die Klangwelt der elektronischen Musik."[26] Meyer-Eppler's "Klangmodelle" and other related examples (including one by Varèse) were the points of departure for a discussion among Eimert, Meyer-Eppler, and Beyer. Eimert's introductory remarks, together with certain supplementary notes which he added at a later date, are given below. It is worth noting that he found Meyer-Eppler's "Melochord" examples to be the most significant.

Nachtprogramm M. W. 18. Okt. 1951, 23,00 Uhr
„Die Klangwelt der elektronischen Musik"
Gespräch: Eimert, Meyer-Eppler, Beyer
Band, ca. 6–8 Sek.

Einleitung: Eimert
Erschrecken Sie bitte nicht, meine Verehrten; die paar Takte, die Sie eben gehört haben, wollen nur das Signal geben für unser Nachtprogramm: Die Klangwelt der elektronischen Musik. Diese paar Takte elektronischer Musik – entschuldigen Sie, daß ich mich hier schon unterbreche: Sind es überhaupt Takte? Ich meine Zählzeiten, wie sie in jeder Notenschrift festgelegt sind? Nein, es sind keine Takte, und was die Notenschrift angeht, so dürfte es vorläufig schwer fallen, Klanggebilde solcher Art schriftlich zu

[24] Beyer published an article with this same title a year and a half later: *Zeitschrift für Musik,* CXIII (February 1952), 74ff.

[25] Harald Bode, in telephone conversation with Lowell Cross. North Tonawanda, New York–Toronto, Ontario, March 29, 1968.

[26] A further use of this title is for a chapter heading by Karl H. Wörner in *Neue Musik in der Entscheidung* (Mainz: Schott, 1954), pp. 296ff.

fixieren. Das ist natürlich gleich ein gewaltiges Problem: Musik, die man – vorerst wenigstens – nicht aufschreiben kann! Wir werden von solchen Klängen gewissermaßen überfallen und stehen ein bißchen hilflos davor, weil wir sie nicht im Notenbild kontrollieren können; weil uns die rationale Bestätigung der Notenschrift fehlt. In solchen Fällen, wo wir ein Tor aufstoßen und nicht wissen, wohin der Weg führt, empfiehlt es sich immer, Rat und Trost bei der Geschichte zu suchen. Dieser notenlose Zustand der elektronischen Musik erinnert in etwa an das frühmittelalterliche Stadium der Musik, als es noch keine Notenlinien gab und man sich mit einem Ungefähr von allen möglichen Hilfszeichen behelfen mußte. Aber das nur nebenbei, denn wir wollen uns ja hier nicht mit Fragen befassen, über die sich erst einmal die Fachleute den Kopf zerbrechen müssen, vielmehr möchten wir dem Hörer einige konkrete Eindrücke von dieser neuen Klangwelt vermitteln. Dazu bedarf es nun einiger Hinweise und Überlegungen, damit es keine Mißverständnisse gibt. In diesem Punkt möchte ich ein wenig vorbauen. Es gibt nichts Neues in der Musik, was sich im ersten Augenblick, sozusagen auf Anhieb, dem breiten Verständnis darbieten würde. Als Schönberg und Strawinsky vor 40 Jahren die erste neue Musik unseres Jahrhunderts machten, da wurden sie von fast allen Hörern ausgelacht, von Hörern, die gewiß sehr stolz auf ihre musikalische Bildung und auf ihre Urteilsfähigkeit gewesen sind. Und warum haben diese Hörer gelacht oder ihr Mißfallen ausgedrückt? Weil sie einfach ihre überkommenen Vorstellungen von Brahms, Reger, Strauß oder Pfitzner bei Strawinsky und Schönberg nicht bestätigt fanden. Das ist ja die am meisten verbreitete – und ich möchte sagen: die am meisten törichte Art des Urteilens über Musik: daß der Hörer das Neue verurteilt, einfach weil es nicht in seine mitgebrachten Klischeevorstellungen hineinpaßt. Gegen solche Mißverständnisse und Vorurteile möchte ich auch von vorneherein die elektronische Musik in Schutz nehmen, dies um so mehr, als wir ihnen in einigen Versuchen nur das Anfangsstadium dieser unerhört neuen Musik zeigen können. Es geht also nicht darum, mehr oder weniger geistreiche Meinungen darüber zum besten zu geben, wichtig allein ist. . . .

*Die erste Manuskriptseite des Musikalischen Nachtprogramms, das am Vormittag des 18. Oktober 1951 der Gründungsversammlung vorgeführt und am Abend in einer einstündigen Sendung auf Mittelwelle über die Sender Hamburg und Köln des Nordwestdeutschen Rundfunks ausgestrahlt wurde. Zum erstenmal erfuhr eine breite Hörerschaft etwas über die neue Möglichkeit, elektronische Klänge nicht nur zu erzeugen, sondern*

*auch auf dem Tonband festzuhalten und damit der Bearbeitung zugänglich zu machen. Teilweise waren die Klänge schon für diese Sendung bearbeitet worden, so in den übereinander kopierten Einzeltönen eines von Oskar Sala gespielten Trautoniums. Die wichtigsten Klangmodelle stammten von dem damaligen Bonner Universitätsdozenten Werner Meyer-Eppler, der im Institut für Phonetik und Kommunikationsforschung der Bonner Universität ein einstimmiges elektrisches Spielinstrument (Melochord) zur Verfügung hatte. Ferner wurden ein Klangbeispiel von Edgar Varèse und sprachsynthetische Klänge eines amerikanischen „Voders" (Voice Operation Demonstrator) vorgeführt.*[27]

October 18, 1951, was an important day for elektronische Musik, since on that same day Eimert, Meyer-Eppler, Beyer, and others met and decided to establish an electronic music studio. It was agreed that the studio should be in Köln, for the new facilities of the recently completed Kölner Funkhaus could become available, and the location offered close proximity to Professor Trautwein in Düsseldorf and Dr. Meyer-Eppler in Bonn. The protocol of the meeting follows:

Köln, den 18. 10. 1951

Verteiler:

| | |
|---|---|
| Herrn Intendant Hartmann | Herrn Prof. Dr. Nestel |
| Herrn Dr. Eimert | Herrn Obering. Schulz |
| Herrn Semmelroth | Herrn Dr. Meyer-Eppler |

Bericht über eine Besprechung anläßlich der Vorführung des Nachtprogrammbandes über elektronische Musik am 18. 10. 1951

Anwesend waren: Vom Institut für Phonetik und Kommunikationsforschung der Universität Bonn: Herr Dr. Meyer-Eppler.
Vom NWDR Hamburg und Köln: die Herren Intendant Hartmann, Prof. Dr. Nestel, Obering. Schulz, Dr. Eimert, Semmelroth, Beyer, Dr. Müller, Werner, Enkel, Exner.

Durch das von Herrn Dr. Meyer-Eppler vorgeschlagene Verfahren der kompositorischen Musikgestaltung unmittelbar auf Magnettonband eröffnen sich auch für den Rundfunk neue Perspektiven. So wird es beispielsweise möglich, das Problem der „rundfunkeigenen Musik" in Angriff zu nehmen und auch für das Hörspiel

[27] Herbert Eimert in "Notizen zum *Epitaph* und den *Sechs Studien*," Baden-Baden, Wergo Schallplattenverlag, undated (notes to the phonograph recording, Wergo WER 60014), p. 5.

akustische Effekte von bisher noch nicht gehörter Gestalt bereitzustellen. Die für die Herstellung derartiger authentischer Musik und Klangformen notwendigen technischen Hilfsmittel sind—bis auf das erforderliche elektronische Musikinstrument—in jedem Rundfunkstudio vorhanden. Es wäre nur notwendig, diese Einrichtungen geeigneten, vom Rundfunk beauftragten Komponisten zugänglich zu machen. Die betreffenden Betriebsräume werden hierdurch ihrem eigentlichen Zweck nicht entfremdet. Es ist nur erforderlich, sie im Bedarfsfall dem betreffenden Komponisten zur Verfügung zu stellen. Zusätzliche Kosten entstehen außer durch die Anschaffung des elektronischen Instrumentes nicht.

Es wird empfohlen, das Problem in Köln in Angriff zu nehmen, weil die wissenschaftlichen und technischen Voraussetzungen hier durch die leichte Greifbarkeit der Herren Prof. Trautwein (Düsseldorf) und Dr. Meyer-Eppler (Bonn) besonders günstig sind und außerdem geeignete Räume im neuen Funkhaus zur Verfügung sein sollen.

Wenn die angeschnittenen Fragen in diesem Jahr nicht in Deutschland zu einer Realisierung führen, werden sie uns im nächsten Jahr von den USA vorgelegt werden.

*Protokoll vom 18. 10. 1951 über den Beschluß der Gründung des Studios für elektronische Musik im Westdeutschen (damals noch Nordwestdeutschen) Rundfunk Köln.*[28]

The Köln studio became fully operational by 1953. Since the composers working there chose to draw upon sound materials that were exclusively electronic in origin, this limitation of means demanded that their equipment offer a wide range of possibilities for sound generation and modification. A description of the installation was published in 1954 by Fritz Enkel (1908–1959), the first technical director of the studio, in a special collection of twelve articles concerned with elektronische Musik.[29] The commitment to magnetic tape composition required the presence of a number of recording and reproducing devices. In addition to standard single- and four-channel

[28] *Ibid.*, pp. 4–5.

[29] Fritz Enkel, "Die technischen Einrichtungen des 'Studios für elektronische Musik,'" *Technische Hausmitteilungen des Nordwestdeutschen Rundfunks,* VI, 1–2 (1954), 8–15. Translated by D. A. Sinclair as "The technical facilities of the electronic music studio (of the Cologne Broadcasting Station)." Ottawa, National Research Council of Canada, Technical Translation TT-603, 1956. All twelve NWDR articles have been translated as TT-601 to TT-612.

recorders, as well as implements for tape cutting and splicing, various loop players and machines with continuously variable speeds were employed. Tape recorders were also used for the production of "regenerative" reverberation effects. Raw electronic sound was produced by the "Monochord" (a modified Trautonium), the "Melochord," variable frequency generators for sine, sawtooth, and other periodic waveforms, and a "white noise" generator.[30] Modifications of these materials were accomplished by modulators of the "ring" and "quadripole" type, for variations of timbre, spectrum, and transposition; variable high-pass, low-pass, and band-pass filters for further timbre modifications and the "coloring" of noise; and specially designed circuits for shaping the attack, decay, and dynamics of individual sounds.

There is no doubt that Herbert Eimert's long-standing association with the compositional techniques of Schoenberg and Webern determined the aesthetic posture of the Köln studio's formative years. In his writings from this early period, Eimert proposed that the course which he and his colleagues had chosen was historically inevitable, that the far-reaching principles implicit in Schoenberg's and Webern's works had now been realized, and that the composers of elektronische Musik were operating with procedures which had brought forth an absolute interrelation of sound and structure.

> But let us see the situation another way with electronic music as the focal point of a progressive development, connected with the most recent instrumental school of pointillism. Next comes the only recently discovered music of Anton Webern [1883–1945], a point of departure for the present day composers, then Schoenberg's twelve-note music and finally the so-called "modern classics." In this arrangement we have at least a certain inevitability of human progress; what was seen as postlude now seems like our prelude.[31]
>
> . . .
>
> Schoenberg did not pursue the idea [of "Klangfarbenmelodie" beyond the *Five Pieces for Orchestra,* Op. 16], while Webern merged it with his concept of the proportional series in which both the harmonic and the melodic employ the same interval proportions so that the consonances no longer depend on arbitrary or statistical factors but, excluding all illogical elements, on harmonic ratios, i.e., on acoustical structures which conform to the law of the per-

[30] White noise, similar in sound to a waterfall or escaping steam, is so named because of its analogy to white light. Noise of this type contains components from the full audio spectrum; when the spectrum is narrowed, the noise becomes "colored."

[31] Herbert Eimert, "Die sieben Stücke"/"What is electronic music?" *Die Reihe,* 1/1 (1955/1958), 8/1.

mutations of series. This is one of those turning points of electronic music, which is no longer merely copying Webern's inspired concept, but which "elevates" in both senses of the word. Many of Webern's constructions seem like premature electronic fragments. His permutations of sounds lead directly to the question of shaping sounds by the grouping of sinusoidal tones, which has become a current concern of electronic music. Timbre as a by-product of structural contours! [32]

. . .

Only in electronic music has the real sense of [Webern's] developments been realised.[33]

. . .

"The Opportune Moment of History" . . . What we are referring to here are the musical boundaries which have been reached in the intensified twelve-tone technique, which at the same time constitute the limits of playability. It is not that limits are being imposed on virtuosity, but rather that the unplayability of this latest instrumental music is due to a rationalization of musical elements which is no longer reducible to manual performance. This definitely constitutes a genuine point of departure for electronic music. At the same time the true nature of the electronic musical media is revealed here by the very fact that these media have become available for composition at the precise moment of history when they are needed.

. . . the basic unit of electronic music is not some microscopic interval, but belongs to quite a different dimension. It appears not as a division, but as something abstracted from the musical sound. It is produced by the generator as a pure tone (without overtones) having the form of a sinusoidal oscillation. This sinusoidal tone, which is well known in acoustics, is something totally new in music. Also new is the possibility of composing by structural arrangement of sinusoidal tones combined into sounds. For the first time it is then possible for the sound structure to become an integral part of the opus structure.[34]

The compositions produced in the NWDR studios from 1951 to 1953 are listed below. While these pieces are important as the first works of

[32] Herbert Eimert, "Zur musikalischen Situation," *Technische Hausmitteilungen des NWDR,* VI, 1–2 (1954), 42–46 ("The place of electronic music in the musical situation," National Research Council of Canada Technical Translation TT-610, pp. 6–7).

[33] Herbert Eimert, "What is electronic music?" *Die Reihe,* 1 (1958), p. 8.

[34] Herbert Eimert, "The place of electronic music in the musical situation," pp. 5–6, 13.

a new school of electronic composition, they do not appear to have assumed the momentous historical position assigned to them in Eimert's writings.

| | |
|---|---|
| Heinz Schütz (b. Germany, 1926) | *Morgenröte* (c. 1951, 2′30″), *Der Griff nach den Sternen* (1953, 2′10″), *Gegen den Dezembersturm* (1953, 4′), all composed at NWDR, but apart from the Studio für Elektronische Musik. |
| Beyer and Eimert | *Klang im unbegrenzten Raum* (3 movements, 1951–1952, 10′20″), *Klangstudie I* (1952, 3′50″), *Klangstudie II* (1952–1953, 4′30″), *Ostinate Figuren und Rhythmen* (1953, 3′45″) |
| Eimert | *Struktur 8* (1953, 4′), *Glockenspiel* (1953, 1′) |
| Stockhausen | *Studie I* (1953, 9′18″) |
| Karel Goeyvaerts (b. Belgium, 1923) | *Compositie nr. 5 met zuivere tonen* (1953, 2′30″). Goeyvaert's earlier *Compositie nr. 4 met dode tonen* (1952, 9′16″) remains an unrealized score of electronic music. |
| Hermann Heiss (1897–1966) | *Elektronische Studie* (1953, 0′40″).[35] |

The most significant composition of this group is *Studie I* by Karlheinz Stockhausen. From 1951 to 1953, Stockhausen was in Paris, where he studied composition with Messiaen and Milhaud. During this time, he was introduced by Karel Goeyvaerts to the properties of sine waves, which he employed in the short étude he composed at the RTF musique concrète studio.

> Goeyvaerts wrote to me in Paris at that time that he had been making inquiries in Brussels and had heard something about generators of sine-waves; I should begin some time to produce sounds with the help of such sinus-tone generators. I made the first attempts at a synthetic sound-composition with sinus-oscillators in the Club d'Essai, Paris.
>
> I began working at Cologne Radio Station in 1953. Among the sound-sources in the Cologne studio at this time were electronic music-instruments—a melochord and a trautonium—which served in some experiments as sound-sources, but which were soon discarded when the idea of sound-synthesis asserted itself.[36]

[35] Davies, *Répertoire International,* pp. 49, 51, 240.

[36] Karlheinz Stockhausen, "Electronic and instrumental music," *Die Reihe,* 5 (1961), p. 60.

*Studie I* (= *Komposition 1953 Nr. 2*) was composed according to strict serial principles. The variables of intensity, duration, and pitch (including "tone groups," "sound groups," and "sequence groups"), were subjected to a precisely controlled serial ordering. During the process of composing *Studie I,* Stockhausen became one of the first composers to arrive at a system of notation for electronic music.[37] The piece has been the subject of a detailed analysis which appeared in the special NWDR collection of articles.[38]

## *Music for Tape*

A number of European writers, including Eimert, Meyer-Eppler, and Moles, have arbitrarily incorporated the work of the separate New York groups into a single school. Perhaps one reason for this confusion was a report on American tape composition delivered by Vladimir Ussachevsky (b. Hailar, Manchuria, 1911) at the Paris experimental music congress in June 1953. Ussachevsky discussed his collaboration with Otto Luening (b. Milwaukee, 1900) at Columbia University, as well as the work of John Cage (b. Los Angeles, 1912), Earle Brown (b. Lunenburg, Mass., 1926), Morton Feldman (b. New York, 1926), Christian Wolff (b. Nice, France, 1934), and David Tudor (b. Philadelphia, 1926) at the New York recording studio of Louis and Bebe Barron (b. 1923 and 1928). Subsequent European reports on the activities of these New York composers also included references to Edgar Varèse (b. Paris, 1883; d. New York, 1965); therefore, it was incorrectly concluded that these composers together constituted a single American school of "music for tape."

The Cage "music for magnetic tape" and Ussachevsky-Luening "tape music" groups began their independent investigations at almost the same time. "In 1951 [Cage] organized a group of musicians and engineers for the making of music directly on magnetic tape, producing in that way works by Christian Wolff, Morton Feldman, Earle Brown, and himself."[39] This collaboration of musicians received technical assistance from the recording engineers, Louis and Bebe Barron, who had begun to experiment with the musical possi-

[37] See Herbert Eimert, Fritz Enkel, and Karlheinz Stockhausen, "Fragen der Notation elektronischer Musik," *Technische Hausmitteilungen des NWDR,* VI, 1–2 (1954), 52–54 ("Problems of electronic music notation," National Research Council of Canada Technical Translation TT-612).

[38] Karlheinz Stockhausen, "Komposition 1953 Nr. 2," *Technische Hausmitteilungen des NWDR,* VI, 1–2 (1954), 46–51 ("Electronic musical composition no. 2, 1953," National Research Council of Canada Technical Translation TT-611).

[39] John Cage, with Robert Dunn, *John Cage* [catalog of works] (New York: Henmar Press, 1962), p. 53.

bilities of magnetic tape as early as 1948.[40] The first piece to be completed in this project was Cage's *Imaginary Landscape No. 5* (1951–January 1952, 4′), "a recording on tape, using as material any 42 phonograph records." The score, composed by "chance operations derived from the *I-Ching* [the Chinese *Book of Changes*]," [41] is a set of instructions for splicing together the recorded information.

> This . . . work, so far as I can ascertain, was the first piece of music for magnetic tape made in this country.
>
> The chief technical contribution of my work with tape is in the method of splicing, that is, of cutting the material in a way that affects the attack and decay of sounds recorded. By this method I have attempted to mitigate the purely mechanical effect of electronic vibration in order to heighten the unique element of individual sounds, releasing their delicacy, strength and special characteristics, and also to introduce at times complete transformation of the original materials to create new ones.[42]

The second, and last, tape piece that Cage composed as a member of this project was *Williams Mix* (1952, 4′). The score materials are very similar to those of the preceding study: the means of composition were the *I-Ching* chance operations, which again produced a system for splicing tapes and making loops. The realization of this work requires approximately 600 recordings from six categories: city sounds; country sounds; electronic sounds; manually-produced sounds, including the literature of music; wind-produced sounds, including songs; and small sounds requiring amplification to be heard with the others.[43]

The other members of the collaboration, excluding David Tudor, composed one work each: Wolff, *For Magnetic Tape* (1952–1953, 21′); Brown, *Octet I* (for eight loudspeakers, 1953, 3′25″); Feldman, *Intersection* (1953, 3′).[44] The Brown and Feldman pieces were completed at the "Rangertone" Studios of R. H. Ranger, Inc., Newark, New Jersey. The "Project of Music for Magnetic Tape" was short-lived, lasting only from 1951 to 1953, but its demise did not signify the end

[40] Davies, *Répertoire International,* p. 204. The Barrons have produced numerous electronic soundtracks for films, theater, and the commercial broadcast media since 1951. Their tape compositions from the 1951–1953 period are *Heavenly Menagerie* (1951, 7′20″), *The Bells of Atlantis* (film music, 1952, 10′), and *For an Electronic Nervous System* (1953, 4′).

[41] Cage, *John Cage,* p. 37.

[42] John Cage, "The 25-year retrospective concert of the music of John Cage," New York, George Avakian, 1959 (notes to the phonograph recordings, Avakian JCS-1).

[43] *Ibid.* The work is named for Cage's architect friend, Paul Williams, who provided the group with financial assistance.

[44] Davies, *Répertoire International,* pp. 198, 204.

of the electronic involvement of all members of the group. Earle Brown continued his work in Paris, and John Cage has been active at many electronic music centers (including the RAI Studio di Fonologia in Milan, Brandeis University, the University of Illinois, and private studios in New York). In the early 1960's, Cage and David Tudor established the continuing trend of "live," as opposed to taped, electronic music.

Vladimir Ussachevsky has been one of the few composers of electronic music to offer concise documentation of the circumstances and early experiments relating to his entry into this field. In an article published in *Revue Belge de Musicologie,* Ussachevsky reported how his experimentation began in the latter part of 1951.

> As everywhere, it was the tape recorder and the discovery of various ways to manipulate sound on magnetic tape that provided an incentive to produce compositions with sounds either synthesized or transformed, and originating from the total world of sound rather than deriving exclusively from musical instruments. At Columbia University, where the now-called "tape-music" originated, the entire interest in this new way to compose began when a professional Ampex tape recorder was purchased to record the concerts given at the University. This tape recorder was in my charge, and one day I suddenly realized that it could be treated as an instrument of sound transformation. A sympathetic engineer, Peter Mauzey, gave me some technical advice. Several months later, on May 9, 1952, I presented a few examples of my discovery in a public concert in New York together with other compositions I had written for conventional instruments. That summer, my colleague at the University, Professor Otto Luening, joined me in making experiments, and on October 28, 1952, Leopold Stokowski placed four of our compositions for tape recorder on a program of contemporary music given in the Museum of Modern Art in New York City. Through the hospitality of Pierre Schaeffer, these same compositions, plus those of John Cage and his school, and a short, purely electronic work of Louis and Bebe Barron (who own the private studio mentioned earlier) were given in Paris at the first International Congress of Experimental Music, which I attended as an American delegate. Since that time, "tape music" has become recognized more or less as a distinct branch of this new compositional medium, and the studio at Columbia University became slowly enlarged.[45]

[45] Vladimir Ussachevsky, "Columbia-Princeton Electronic Music Center," *Revue Belge de Musicologie,* XIII, 1–4 (1959), 129.

Ussachevsky's first experiments were five studies he referred to as "Transposition," "Reverberation," "Experiment," "Composition," and "Underwater Waltz" (1951–1952, total duration approximately nine minutes). "Transposition" is simply a study in the sonic transformations achieved through octave transpositions made during the recording process. The original sound was the lowest note on the piano (A, 27.5 cycles per second). By taking advantage of the two tape speeds of his recorders, Ussachevsky produced a descending series of A's from a high hiss-like sound to a very low resonating timbre below the piano range. "Reverberation" is exactly the same material with the added "regenerative" reverberation available from any tape recorder with independent recording and playback functions.[46] The remaining studies are arrangements of these materials into small musical structures. One reviewer at Ussachevsky's concert of May 9, 1952, described the reactions to this "reverberant" quality as follows:

> . . . Ussachevsky's electronic repetitions are controlled, and vary from three or four to an indefinite number in the space of a quarter note at about *tempo allegro*. The repetitions overlap. One would not expect such a series of mechanical repetitions to be related to human experience, yet to nearly everyone the effect seems to suggest some half-forgotten, elusive experience. Several people have testified independently that the sounds correspond to what is heard at one level of consciousness during the process of going under an anesthetic; others recall having heard such automatic sounds in dreams.[47]

"Head reverb" is today one of the most exhausted clichés of electronic music.

Otto Luening's first tape music treated flute sounds in much the same manner that Ussachevsky employed sounds from a piano. Luening's *Fantasy in Space* (1952, 2′50″) is typical of his early use of the medium. The piece was realized through the recording of Luening's unaccompanied flute playing, to which the tape machine added layers of regenerative reverberation. *Fantasy in Space* is characterized by peculiarly banal melodic material, yet it was the composer's avowed intention to produce a work that would communicate with

[46] "Head reverb," as it is usually called, is accomplished by immediately re-recording the taped information as it is reproduced at the playback head. The result is a constant repetition of information. The rate of recurrence depends upon tape speed and the distance between the recording and playback heads.

[47] Henry Cowell, "Current chronicle: New York," *The Musical Quarterly*, XXXVIII, 4 (October 1952), 600.

listeners "conditioned to impressionistic, virtuoso and tonal music."[48] The other works that Ussachevsky and Luening produced through 1953 are: Ussachevsky, *Sonic Contours* (1952, 7′18″); Luening, *Invention in 12 Notes* (1952, 3′40″); Luening, *Low Speed* (1952, 3′40″); Luening and Ussachevsky, *Incantation* (1953, 2′33″).[49]

The first tape music of Ussachevsky and Luening was composed with a greater respect for older musical traditions than any other works discussed in this survey. Ussachevsky, who was trained at the Eastman School of Music by Howard Hanson and Bernard Rogers, readily admits to having composed "pseudo-romantic Russian [music] —very melodic, very harmonic and modestly dissonant"[50] until his encounter with electronic media in 1951. Luening studied in Europe with Ferruccio Busoni, Busoni's disciple Philipp Jarnach (b. 1892), and Volkmar Andreae (1879–1962). Until he began to work with tape, his reputation was based upon flute playing, opera conducting, and a compositional style of conventional means.[51] The most striking examples of the musical conservatism of these composers are found in their works for tape and ordinary musical instruments. The orchestral writing in one of their joint compositions, *Rhapsodic Variations for Tape Recorder and Orchestra* (1953–1954, 17′), with its traditional handling of tonality, form, and orchestration, presents quite an unusual contrast to the sounds produced by the tape recorder.[52] Yet despite the somewhat anomalous results of their conventional approach to new media, the Ussachevsky-Luening collaboration must be judged a successful one. Their work culminated in the establishing of the elaborately equipped Columbia-Princeton Electronic Music Center. The Center was given a $175,000 grant by the Rockefeller Foundation in 1958, and in the following year the Mark II RCA Synthesizer became an integral part of its installation.

Edgar Varèse had been searching for decades for electronic equipment to fulfill his compositional needs. Finally, as a result of the generosity of his friends and admirers, he received an anonymous gift of a professional Ampex tape recorder and accessory electronic equipment. The presentation was made to Varèse on March 22,

[48] Quoted in Eugene Bruck, "Sounds of new music," New York, Folkways Records and Service Corp., 1957 (notes to the phonograph recording, Folkways FX 6160).
[49] Davies, *Répertoire International*, pp. 205–206.
[50] Quoted in Joan Peyser, "Seven times the computer said no," *The New York Times*, CXVII (March 3, 1968), section 2, D 19.
[51] See Jack Beeson, "Otto Luening," *Bulletin of American Composers Alliance*, III, 3 (Autumn 1953), 2–8.
[52] The tentative employment of sine-wave glissandi in the tape recorder's part is one of the first uses of purely electronic sound by Ussachevsky and Luening.

1953, nine months before his seventieth birthday.[53] He immediately set to work collecting the materials for the electronic sections of *Déserts*. Varèse's activities did not go ignored this time, for his travels with his recorder became the subject of popular articles,[54] and Pierre Schaeffer invited him to work on *Déserts* at the RTF studio in Paris. A few years later, Varèse produced one of the finest works in the tape medium, *Poème électronique*, at the Philips Laboratories, Eindhoven, Holland. The composition was played over four hundred loudspeakers in the Philips Pavilion of the 1958 Brussels World's Fair. In 1961, Ussachevsky invited Varèse to the Columbia-Princeton Electronic Music Center, where he completed his realization of the *Déserts* materials.

## *Other Developments*

Those composers and engineers who established the first principal centers for electronic music in Paris, Köln, and New York between 1948 and 1953 were by no means alone in their pursuits. Significant work was being undertaken by over twenty-five additional individuals in at least fourteen localities. The following supplementary information has been compiled largely from Hugh Davies' *Répertoire*.

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| 1948–1953, Berlin | Oskar Sala (b. Germany, 1910) produces electronic pieces with his "Mixturtrautonium," including *Faust I* (1948, 20′) in collaboration with Hans-Martin Majewski (b. Germany, 1911). Sala's work with the "Mixturtrautonium" continues to the present. |
| 1949, New York | Eric Siday (b. England, 1905) begins his production of electronic music for the advertising and broadcast media. His highly successful applications have become even more widespread in recent years. |
| c. 1949, New York | Abraham H. Frisch (b. USA, 1900) initiates his series of numerous rhythmic studies, using for sound sources magnetized stencils placed directly on tape. |
| 1950, Brussels | Raymond Chevreuille (b. Brussels, 1901) composes a "radio cantata," *D'un Diable de Briquet* |

[53] Chou Wen-Chung, "Varèse: a sketch of the man and his music," *The Musical Quarterly*, LII, 2 (April 1966), 166.

[54] See Frederic Grunfeld, "Adventures in sound: the well-tempered ionizer," *High Fidelity*, IV, 7 (September, 1954), 39ff.

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| | (for narrator, soprano, chorus, and orchestra with disc and tape recordings, 40′). |
| | Marina Scriabine (b. Russia, 1911) composes *Étude* (2′30″) at the private studio of Hervé Thys. |
| 1950–1952, Paris | Gil J. Wolman (b. France, 1929) and Jean Louis Brau (b. France, 1930) realize electronic poetry at various film and recording studios. |
| 1950–1954, Buenos Aires | Mauricio Kagel (b. Buenos Aires, 1931) composes music for discs and tape: 8 *Estudios* (1950–1953, 4′–17′) and *Música para la torre* (in conjunction with sculpture, 1953–1954, 108′ minimum). |
| 1950, Paris | André Almuro (b. France, 1927) realizes his "oratorio," *L'Enfant poète* (25′). |
| | Guy Bernard (b. France, 1907) manipulates taped instrumental sounds for *Guernica* (film music, 10′). |
| 1950, Rome | Gino Marinuzzi (b. New York, 1920) begins experimentation and establishes an electronic studio. |
| 1950–1955, Ottawa | Louis Applebaum (b. Toronto, 1918) produces a series of short studies on tape with material from the "Composertron." This device, designed by Osmond Kendall (b. England, 1909) was a synthesizer using "drawn sound" techniques. |
| 1951, Paris | Marcel van Thienen (b. France, 1922) produces a 20-minute tape background for a reading of *La Ralentie* of Henri Michaux. |
| 1951, Tokyo | A group of composers establishes "Jikken Kobo" (Experimental Laboratory), using equipment furnished by the Sony Corporation. Works included *Toraware no onna* (*Imprisoned Woman*, tape poem, 1951, 23′) and *Piece B* (tape poem, 1951, 10′) by Kuniharu Akiyama (b. Japan, 1929 —both his works are lost); and *L'Espugue* (with slide projections, 1953, 10′) and *Another World* (with slide projections, 1953, 15′) by Joji Yuasa (b. Japan, 1929). |
| 1951–1952, Geneva | Achille Christen (b. Switzerland, 1914) composes electronic music for films. |
| 1951–1952, München | Josef Anton Riedl (b. Germany, 1929) composes two tape works, *Studie für konkrete Klänge Nr. 1* (1951, 3′30″) and *Studie für konkrete Klänge Nr. 2* (1952, 4′). |

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| 1951–1952, Paris | Compositions realized at the RTF studios, but independent of Schaeffer's musique concrète group: André Almuro and Maurice Jarre (b. France, 1924), *Hérédité* (music for a radio play, 1951, 30′); Áltagōr (real name, André Vernier, b. France, 1915), *Métapoésie* (poetry with recorded sounds, 1952). |
| 1952, Bonn | With Meyer-Eppler's assistance, Bruno Maderna (b. Venice, 1920) composes *Musica su due Dimensioni I* (for flute, percussion, and tape, 1952, 7′30″, now withdrawn). |
| 1952, Hilversum | Henk Badings (b. Bandoeng, Java, 1907) produces electronic music for a radio play, *De gravin Catalene* (20′) at the studios of Nederlandsche Radio Unie (NRU). |
| 1952, New York | John Herbert McDowell (b. USA, 1926) composes a tape piece, *Production* (8′). |
| 1953, Los Angeles | Paul Beaver (b. USA, 1925) uses electronic sound in a film, *The Magnetic Monster.* |
| 1953, Milan | Luciano Berio (b. Oneglia, Italy, 1925) realizes a demonstration tape piece, *Mimusique n. 1* (4′, now withdrawn), at the studios of Radio Audizioni Italiane (RAI). |
| 1953, München | Hans Werner Henze (b. Gütersloh, Germany, 1926) includes electronic music in his radio opera, *Das Ende einer Welt.* |
| 1953, Tokyo | Toshiro Mayuzumi (b. Yokohama, 1929) composes a tape collage, *XYZ* (3 movements, 13′20″), probably at the studios of Nippon Hoso Kyokai (NHK). |

Electronic music proliferated rapidly after 1953. Important studios were soon established in Milan, Tokyo, London, Geneva, Gravesano, Utrecht, Brussels, Berlin, Darmstadt, Warsaw, and at the Universities of Illinois and Toronto.[55] In 1956, the first score of an electronic piece was published by Universal Edition—Stockhausen's *Studie II* (Köln, 1954). By the early 1960's, two additional branches had been added to electronic music, "computer music" and "live electronic music." Both appear to have developed as reactions to the limitations and slow pace of tape realization, with its necessary requirements of splicing, mixing, and re-recording. Computers have

[55] In Europe and Japan, electronic music has received most of its financial support from radio and television broadcasting centers. In North America, major electronic music studios are usually located at universities.

already been converted into formidable musical instruments. They have been successfully employed both as sound sources and as means for the organization and analysis of musical structures.

A number of composers who produced electronic music in its early years eventually concluded that the medium was incompatible with their artistic demands. Pierre Boulez, Morton Feldman, and Hans Werner Henze are all renowned composers of the postwar generation who turned away from electronic composition after giving it serious consideration. The attitude of Boulez, who has repudiated all of his electronic works, may be considered typical of this reaction. "The machine has enormous capabilities, but its skill is very small when compared to that of an interpreter. . . . We are interested much more by the possibilities given by the fantasy and inspiration of the human interpreter than by precise mechanical realization." [56]

Attempts to find direct musical antecedents for the various techniques of electronic composition do not lead to satisfactory conclusions. We have seen that Herbert Eimert considered his work to be a logical step beyond the musical procedures of Anton Webern. However, a comparison of their works reveals numerous discrepancies in this attitude. Pierre Schaeffer, Edgar Varèse, and John Cage have been taken to task for failing to acknowledge their debts to Luigi Russolo.[57] Otto Luening studied with Busoni in 1917, but Luening has reported that his teacher spoke then of form and style in a traditional sense and no longer showed an interest in novel musical techniques.[58]

The actual circumstances that permitted electronic music to come into being are not contingent upon these tenuous threads to the past. Electronic music is a product of our technological age. Its development has depended as much on the engineering skills of Werner Meyer-Eppler, Jacques Poullin, Louis Barron, Peter Mauzey, and many others, as on the musical ideas of contemporary composers. Electronic devices have today assumed a natural place among the working materials of serious composers. The sounds produced from them are no longer to be regarded as either a panacea for the ills of musical composition or as the outlandish playthings of eccentric experimenters, but rather as useful resources for the music of our time.

[56] Quoted in Roger Maren, "Electronic music: untouched by human hands," *The Reporter,* XVI (April 18, 1957), 42.

[57] See Maurice Lemaître, "Introduction," in Luigi Russolo, *L'Art des bruits: Manifeste futuriste 1913* (Paris: Richard-Masse, 1954), p. 12.

[58] Otto Luening, "Some random remarks about electronic music," *Journal of Music Theory,* VIII, 1 (1964), 93–94.

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