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**Some Random
Remarks
about
Electronic Music**

OTTO LUENING

Electronic music has gone along a zig-zag path. This article may follow suit. But first a definition of electronic music will serve as a starting point. Electronic Music is music which uses electronically generated sound or sound modified by electronic means, with or without voices or musical instruments, live or over speakers. My effort here is to highlight events from the past that have a bearing on the present or point to the future. Essential to a fuller understanding of the broad developments within the field are the readings given at the end of the article.*1, 2, 3

Recently I have had numerous conversations about much new music with many composers, some of them young. In order to communicate with them I found that in addition to the standard contemporary music vocabulary as approved and used by our

best music journals I had to be able to follow and even use a new one. The New has become an end in itself. But can we really be sure that our latest novelty has not been beaten by a month, a week, or a minute as we practice our Olympic Gamesmanship? Have I any assurance that I am ahead of the man in Iceland? Nowadays possibilities are limitless. Is the starting point limitless, too, or are we looking for totally planned spontaneity? I understand that this is the age for squaring the circle and circling the squares.

Electronic music is part of the avant-garde mystique. Yet, as we enter the race for the newest we remember that it takes a long time to produce works in this medium. One wonders whether newness organized and an end in itself is conservatism under a new label. Perhaps a glance into the past will help to clarify things. At worst, in the end we can take a stand by accepting all or by avoiding whatever it is that connects us to it. Do we want an all-purpose music, with or without sound and/or silence, or are such conscious positions unimportant after all?

Preoccupation with acoustics is not new. I Ching and Chinese acoustical studies both stem from approximately 2800 B.C., and King Fang tried a fifty-three-tone scale within an octave over fifteen centuries before the West got around to it. The work of the Sanskrit grammarian Panini of the third or fourth century B.C. has survived. In addition to making purely linguistic studies he found the relationship between language sounds and physical positions of the mouth. Ptolemy and Pythagoras are so well advertised that they need only brief mention. As we move forward in time a number of interesting experiments come to mind.

Don Nicola Vicentino's (c. 1550 A.D.) "Archicembalo" was a harpsichordlike instrument with thirty-one steps within an octave. With it he hoped to revive the ancient Greek modes. Although there was at least one organist who played the instrument with great skill and Vicentino's ideas were received with favor in some quarters, he could not prevail against the taste of his time. His influence, however, was felt.

Athanasius Kircher, another inventor, moved in still other directions. In 1660 he constructed a composing machine with the fine name "Arca Musarithmica." Scale, rhythm, and tempo relations were represented by numbers and number relations, indeed arithmetic, from which the machine got its name.

A hundred years after Kircher had built his composing machine the drive toward machine music had produced not only instruments like the mechanical organs, trumpets, musical clocks, and glass harmonicas that interested Mozart, Kirnberger, Haydn, and Handel but also those practical and playing instruments, the perfected organ and pianoforte. The "Electric Harpsichord", invented by J. B. Delaborde in Paris (1761), Hipp's "Electromechanical Piano" in Neuchatel (1867), Elisha Gray's "Electroharmonic Piano" demonstrated in Chicago in 1876, the same year that Koenig's "Tonametric" apparatus (which divided four octaves into six hundred seventy equal parts) was demonstrated in Philadelphia, and Julian Carrillo's theories of microtones and preoccupation with a ninety-six-tone scale (Mexico, 1895) bring us to the threshold of the twentieth century.

Edison's patent for the phonograph (1878), the Emile Berliner telephone transmitter and disc record (1877), the development of various acoustical principles by Alexander Melville Bell (1867), Helmholtz's *Sensations of Tone* (1885), and the work of W.C. Sabin, P.M. Morse, Lord Rayleigh, Dayton Miller, Harvey Fletcher, and other scientists gave focus to experiments of the past and influence us to this day.

On March 10, 1906, an editorial in the professional electro-technical journal, *Electrical World*, published in New York, described a demonstration that took place in Mount Holyoke, Massachusetts, on that date. A machine, the "Dynamophone," produced music made by a group of dynamos run by alternating current. The editorial was signed L. Stokowski. Other reporters wrote that the machine, also called "Telharmonium," was the largest musical instrument in the world. It weighed two hundred tons. The electrically generated music was transmitted over telephone wire systems, but these proved to be too fragile to carry such an array of signals. Upon the complaint of the regular telephone subscribers this "extraordinary electrical invention for the production of scientifically perfect music" stopped functioning.

The experiments of Thaddeus Cahill, who invented this instrument, were presented first in 1900. They came to the attention of Ferruccio Busoni when he read the July, 1906, article in McClure's Magazine, "New Music for an Old World," by R. S. Baker. At that time Busoni was writing his *Sketch of a New Esthetic of Music* which was published in 1907. In this remarkable collection of "notes", as he called the booklet, he questioned much of the prevailing music practice and pointed

out some new possibilities. He wrote that art forms last longer if they stay close to the essence of each individual species. He suggested that music is almost incorporeal (he called it "sonorous air"), almost like Nature herself. He opposed formalism, systems, and routine, but asserted that each musical motive contains within itself its "life germ", the embryo of its fully developed form, each one different from all the others. He proclaimed that the creative artist did not follow laws already made; he made laws. Busoni decried a too rigid adherence to existing notation and said that the terms consonance and dissonance were too confining. He suggested an expansion of the major-minor-chromatic scale and assembled one hundred thirteen other scale formations within the octave C-C. (Ernst Bacon expanded this number by using algebraic permutations. Using intervals no larger than a major third he found one thousand four hundred ninety possibilities. See "Our Musical Idiom", *The Monist*, 1917, about this and other interesting matters.) Busoni predicted a revolution in the field of harmony. He was convinced that instrumental music had come to a dead end and that new instruments were needed, and he suggested a scale of thirty-six divisions within the octave as an interesting possibility for new music.

In Cahill's instrument Busoni saw a way out of the impasse which instrumental music had reached. However, he warned that a lengthy and careful series of experiments and further ear-training was necessary to make the unfamiliar material plastic and useful for coming generations. Two years after Busoni made these statements the Italian Marinetti published in *Le Figaro* in Paris his "Futurist Manifesto" which called for a world-wide artists' revolt against the ossified values of the past. The movement spread rapidly to Germany, Russia, and Switzerland.

"The Art of Noises", compiled in 1913 by Luigi Russolo, a painter, is still of interest. He suggested fixing the pitch of noise sounds and classified them as follows:

Group 1	Group 2	Group 3
Booms	Whistles	Whispers
Thunder claps	Hisses	Murmurs
Explosions	Snorts	Mutterings
Crashes		Bustling noises
Splashes		Gurgles
Roars		

Group 4	Group 5	Group 6
Screams	Noises obtained by	Voices of animals,
Screeches	percussion or	men
Rustlings	metals, wood,	Shouts
Buzzes	stone, and	Shrieks
Cracklings	terracotta	Groans
Sounds by friction		Howls
		Laughs
		Wheezes
		Sobs

In his diary about "Concrete Music"*4 Pierre Schaeffer names Russolo as the precursor of the noise montage as it developed at the Centre d'Etude of the Radiodiffusion-Télévision Française by mid-century. Russolo implemented his catalogue of noises by building a whole collection of noise-making instruments. Futurism became Dadaism when Tristan Tzara coined the term in 1916 in Zurich. His recipe for making a poem still has a bearing on some of today's artistic manifestations: ". . . cut out the single words of a newspaper article, shake well in a bag, take them out one by one and copy them down in the order in which you picked them."

Between Busoni's booklet and the advent of Dadaism Schoenberg wrote his *Harmonielehre* (1911). In this important book triadic harmony evolved systematically and logically to a system of chords built on perfect fourths. The work ends with a prophetic statement about timbre melodies. And in 1913 the Paris premiere of Stravinsky's *Rite of Spring* took place. Orchestral rhythm and timbre were given a new dimension and the work had a profound effect on composers, indeed, on the art world in general.

When I met Busoni in Zürich in 1917, his views about composition had changed since 1907. Ontour he had seen the German-American theorist Bernhard Ziehn in Chicago. Ziehn had published in 1887 a remarkable harmony text which developed a system of symmetrical inversion based on the old *Contrarium Reversum*. When Busoni met him in 1910, he was engaged in developing a system of canonical techniques.

In his Zürich years Busoni assumed that composers who showed him scores would have mastered technical problems more or less by themselves. He expected experimentation and analysis; novelty for its own sake interested him no longer. He talked of form, not formula, and spoke, as he had written in the past, of taste, style, economy, temperament (human, not

musical!), intelligence, and equipoise.

Edgard Varèse, friend and protégé of Busoni, and precursor of much that has happened, suggested in the early 1920's that greater cooperation between engineers and composers would be both desirable and necessary if the art were to reach new heights. Curiously enough, Carlos Chavez in his *Toward a New Music* (W.W. Norton, 1937) also expressed the hope that a collaboration between engineers and musicians would take place. Some of the results of this kind of cooperation have been and still are far reaching.

Joerg Mager built an electronic "Spharophon" in Germany which was presented at the Donaueschingen Festival in 1926. Supported by the city of Darmstadt he later developed a "Partiturophon" and a "Kaleidophon." All these useful electronic instruments had been tried in theatrical productions, and although all were destroyed in World War II, Mager's example animated others to explore the field. It was Friedrich Trautwein who introduced his "Trautonium" a few years later. It became a practical instrument that was used by a number of composers including Hindemith, Richard Strauss, and Werner Egk. Hindemith, in his *Craft of Musical Composition*, acknowledges his debt to Trautwein and his instrument for providing the foundation for many of the theses that he expresses in his book. The Hindemith-Trautwein research team was discontinued because of the war and was never active again, but improvements of the "Trautonium" by Oscar Sala resulted in the "Mixtur-Trautonium", a very brilliant instrument which Sala plays and for which he composes with skill. The German composers Henze, Orff, Erbse, and others have also composed for this instrument.

Leon Theremin introduced to Russia in 1923 the instrument bearing his name. A number of composers have used it in their compositions, among them Paschtschenko, Schillinger, Slonimski, Varèse, Grainger, Martinu, and Fuleihan. The Theremin-Cowell Rhythmicon, for which Cowell composed several pieces in 1932, could perform the most complicated kinds of polyrhythmic formations with clarity. Henry Cowell's tone-clusters, introduced to the wider public in the early 1920's, became the starting point for further extensions of piano resonance, for other preparations of the piano useful as sound sources for experimental music.

Just before and during the 1920's various kinds of research were brought into focus. For example, in the field of theory

Ernst Kurth published his *Grundlagen des Linearen Kontrapunkts* (1917) and other works that dealt with musical form in Busoni's sense of the term, and in 1926 Josef Mathias Hauer presented his theory of tropes. In France, Maurice Martenot demonstrated his Ondes Martenot in the Paris Opera on April 20, 1928. Nineteen years later he was Professor at the Paris Conservatoire, instructing classes in Ondes playing. A long list of composers have used the Ondes Martenot. They include Honegger, Milhaud, Messiaen, Jolivet, Koechlin, and Varèse. The inventor built a special model of the instrument in 1938 following specifications of Rabindranath Tagore and Alain Daniélou for the purpose of reproducing the microtonal refinements of Hindu music. Another invention of far reaching importance must be mentioned here. Lee DeForest, with inspired vision, thought first of the Audion (1906), now called the Triode. This and his three hundred other patents had a deciding influence on modern communications.

At the 1926 Chamber Music Festival in Donaueschingen in Germany it was suggested that recordings might be used as creative tools for musical composition. Two years later a research program was established at the Hochschule für Musik in Berlin to examine this and related problems. By 1930 Paul Hindemith and Ernst Toch had produced short montages based on phonographic speed-up and slow-down, sound transposition and mixing, as well as polyrhythmic experiments. Toch produced his *Fuge aus der Geographie*, a work based on four-part vocal choral writing. Hindemith used instruments and solo voice as his sound sources. Robert Beyer, in the article "Das Problem der Kommender Musik", (*Die Musik*, Volume 19, 1928) had expressed new ideas on space or room music but without having gained significant reactions from professionals and the public.

From the 1930's until after World War II much attention was given to producing electric instruments that could imitate existing instruments. At the same time the tape recorder was perfected and seemed destined to be used for creative purposes. Research and development took place, in part, at great institutions like the Bell Telephone Laboratories, the Brookhaven National Laboratories, the University of California, and the Institutes of Physics in Berlin and Moscow.

Pierre Schaeffer, an engineer in Paris, had presented a "Concert of Noises" over the French Radio in 1948. He had arranged sounds from natural and instrumental sources into a series of montages, somewhat like the experiments by Hindemith and

Toch in Berlin but with much greater freedom in sound and noise selection. The sounds were treated, manipulated, and presented from phonograph records. By 1952 Schaeffer was director of the research center of Radio-Diffusion Française and had associated himself with the engineer Poulin and, among others, the composers Jolivet, Messiaen, Pierre Henry, and Boulez. This group presented two concerts of *Musique Concrète* in the hall of the Conservatoire in May, 1952. A year later Schaeffer's *Orpheus* was first performed at the Don-aueschingen Festival. The resulting scandal focused international attention on the new music. Since then the Paris radio has organized study groups, produced much music over the air and in concert, and built a concert hall to perform the music. Schaeffer has taken out many patents, notably those for the Phonogène and Morphophone, both used in the Paris center.

Vladimir Ussachevsky, born in China of Russian parents and educated in the United States, first experimented with tape in 1951, independent of the Paris group. His experiments were presented at Columbia University in May, 1952. At the Bennington Composers Conference in the fall of 1952 some short compositions by Ussachevsky and the present writer were performed. On October 28, 1952, in a concert at the Museum of Modern Art in New York, Leopold Stokowski introduced a work by Ussachevsky and three by this writer. Both composers used tape techniques, with flute and piano as sound sources. Thus, the pieces were called tape music. (For a description of the techniques see Vladimir Ussachevsky, "The Processes of Experimental Music", *Journal of the Audio Engineering Society*, July, 1958.)

The first public performance of a work for tape recorder and symphony orchestra was *Rhapsodic Variations* by the present writer and Vladimir Ussachevsky, a work commissioned by the Louisville Orchestra and programmed there March 20, 1954. It was during these years that the Columbia Studio was first established and the earlier works by Ussachevsky and Luening were produced with Peter Mauzey as consulting engineer. In 1959 with the help of a Rockefeller grant the Columbia-Princeton Electronic Music Center was established under the direction of Milton Babbitt and Roger Sessions from Princeton and Vladimir Ussachevsky and the present writer from Columbia. The Center has been active in advising other institutions about establishing studios. There are now seven in the United States and more are planned.

In 1955 the Radio Corporation of America demonstrated the

Olson-Belar "Electronic Music Synthesizer" for the American Institute of Electrical Engineers in New York. The concept of almost limitless possibilities of tonal synthesis was impressive. In 1958 Babbitt, Ussachevsky, and this author did research with the Synthesizer at RCA. A second model, Mark II, was lent to the Columbia-Princeton Center in 1959. My work, Dynamophonic Suite, based on material from the Synthesizer manipulated on tape, was presented at the American Academy in Rome in 1958. Babbitt, who has been concerned with electronic music since the late 1930's, presented the first extended work for this medium, entitled Composition for Synthesizer, on May 9, 1961, at Columbia University. The output of the Synthesizer provided the sole material for the piece and it was not subjected to any further modifications.

On the same program my composition entitled Gargoyles, for violin and synthesized sound, was performed. The violin is played live; the sounds from the Synthesizer have been manipulated on tape. Appearing also on this program was Ussachevsky's Creation, a work which combines a live chorus and solo voice with electronic sounds. The voices sing a tri-lingual text.

In Germany in 1948 H.W. Dudley from the Bell Telephone Laboratories demonstrated the "Vocoder", a composite device consisting of an analyzer and an artificial talker. This instrument and the Mathematical Theory of Communication (1949) by Claude Shannon and Warren Weaver made a strong impression on Dr. Werner Meyer-Eppler at the Phonetic Institute of Bonn University. Meyer-Eppler presented the "Vocoder" at the Northwest German Music Academy in Detmold where he gave a lecture, Developmental Possibilities of Sound, in 1949.

In 1950 Beyer, who had been present at Meyer-Eppler's lecture in Detmold, gave two lectures and Meyer-Eppler gave one lecture on "The World of Sound of Electronic Music". Varèse and Herbert Eimert attended. The next year Meyer-Eppler produced models of synthetic sounds at Bonn University and presented them at Darmstadt. On October 18 these experiments were broadcast over the Cologne Radio station and the staff recommended. . . "to follow the process suggested by Dr. Meyer-Eppler to compose directly onto magnetic tape". These events led to the creation of the "Electronic Studio" at the Northwest German Radio in Cologne. In 1952 Bruno Maderna composed his *Musica su due Dimensioni* for live instruments and electronic sounds. The preparation of the tape was made with the help of Meyer-Eppler. Pierre Boulez and Karlheinz

Stockhausen heard the work in Darmstadt.

May 26, 1953, saw the first performance of works from the Cologne studio, works by Eimert and Beyer. Then in 1954 the studio gave a concert of purely electronic works by Goeyvaerts, Pousseur, Gredinger, Eimert, and Stockhausen. The compositions used a strict serial technique. The Cologne studio has had a study group for some time and last year appointed Stockhausen Artistic Director.

Luciano Berio and Bruno Maderna first heard electronic music in 1956 at the Museum of Modern Art concert in New York. Two years later they founded the "Studio de Phonologie Musicale de Milan" (RAI). Berio's *Mutazioni* and Maderna's *Sequenzi a Strutture* were performed that year, and since that time the studio has been opened to a number of composers from various countries.

The present state of electronic studio facilities has fairly complete documentation from 1948 through 1962 in the publication *Répertoire International des Musiques Expérimentales**4 which lists twenty-one studios in 1962. Since then another dozen have come to my attention including those at Brandeis, Yale, Wayne State, Pennsylvania, Michigan, San Francisco Conservatory of Music, and Bennington College.

r e f e r e n c e s

- 1 H. Partch, *Genesis of a Music* (University of Wisconsin Press, 1949).
- 2 F. K. Prieberg, *Musik des Technischen Zeitalters* (Atlantis Musikbücherei, 1956).
- 3 F. K. Prieberg, *Musica ex Machina* (Ullstein Verlag, 1960).
- 4 *Répertoire International des Musiques Expérimentales* (Service de la Radio-Télévision Française, 1962).