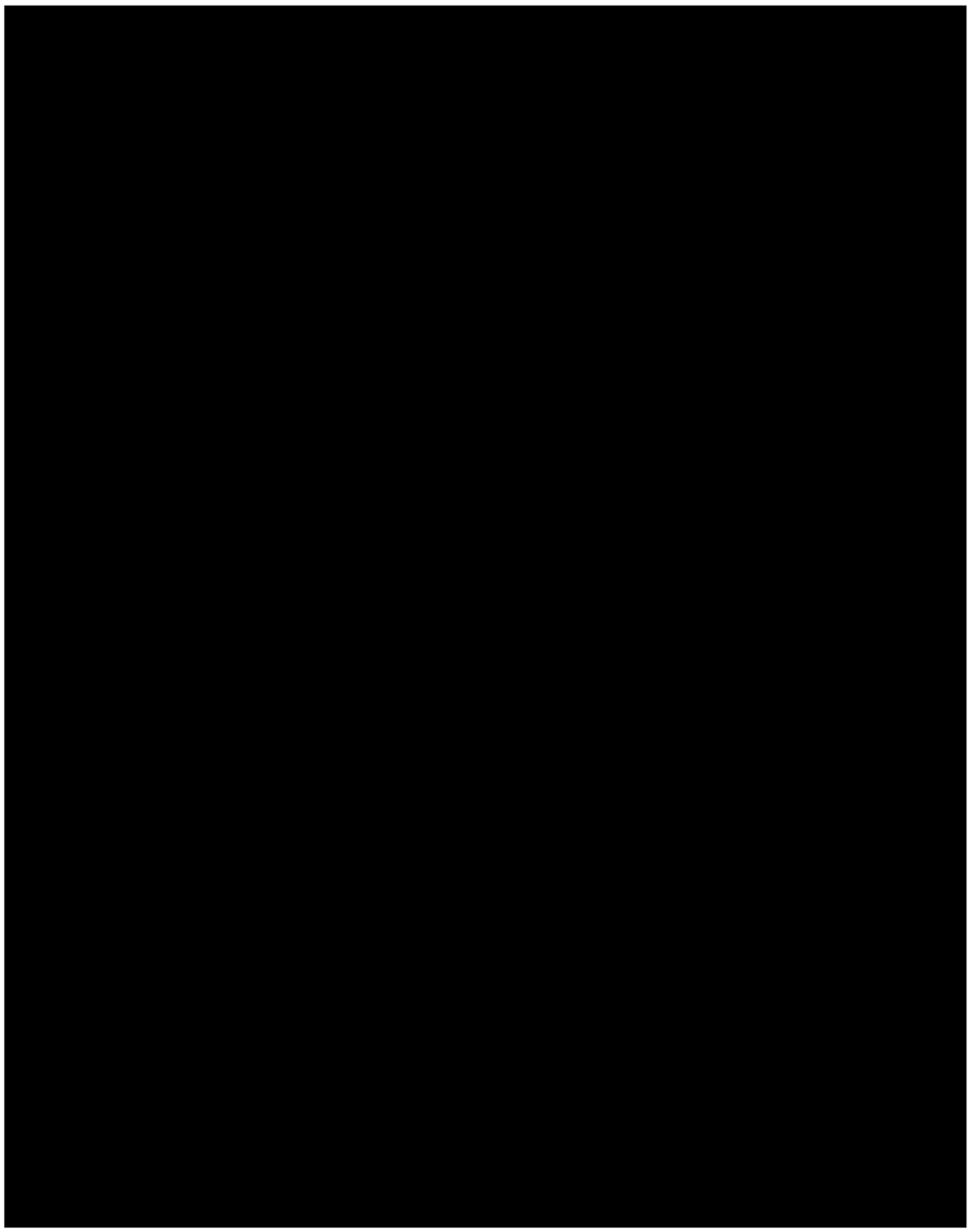


A HISTORY OF ELECTRONIC MUSIC PIONEERS

David Dunn

"When intellectual formulations are treated simply by relegating them to the past and permitting the simple passage of time to substitute for development, the suspicion is justified that such formulations have not really been mastered, but rather they are being suppressed."

—Theodor W. Adorno

"It is the historical necessity, if there is a historical necessity in history, that a new decade of electronic television should follow to the past decade of electronic music."

—Nam June Paik (1965)

INTRODUCTION:

Historical facts reinforce the obvious realization that the major cultural impetus which spawned video image experimentation was the American Sixties. As a response to that cultural climate, it was more a perceptual movement than an artistic one in the sense that its practitioners desired an electronic equivalent to the sensory and physiological tremendums which came to life during the Vietnam War. Principal among these was the psychedelic experience with its radical experiential assault on the nature of perception and visual phenomena. Armed with a new visual ontology, whatever art image-making tradition informed them it was less a cinematic one than an overt counter-cultural reaction to television as a mainstream institution and purveyor of images that were deemed politically false. The violence of technology that television personified, both metaphorically and literally through the war images it disseminated, represented a source for renewal in the electronic reconstruction of archaic perception.

It is specifically a concern for the expansion of human perception through a technological strategem that links those tumultuous years of aesthetic and technical experimentation with the 20th century history of modernist exploration of electronic potentials, primarily exemplified by the lineage of artistic research initiated by electronic sound and music experimentation beginning as far back as 1906 with the invention of the Telharmonium. This essay traces some of that early history and its implications for our current historical predicament. The other essential argument put forth here is that a more recent period of video experimentation, beginning in the 1960's, is only one of the later chapters in a history of failed utopianism that dominates the artistic exploration and use of technology throughout the 20th century.

The following pages present an historical context for the specific focus of this exhibition on early pioneers of electronic art. Prior to the 1960's, the focus is, of necessity, predominantly upon electronic sound tool making and electroacoustic aesthetics as antecedant to the more relevant discussion of the emergence of electronic image generation/processing tools and aesthetics. Our intention is to frame this image-making tradition within the realization that many of its concerns were first articulated within an audio technology domain and that they repeat, within the higher frequency spectrum of visual information, similar issues encountered within the electronic music/sound art traditions. In fact, it can be argued that many of the innovators within this period of electronic image-making evolved directly from participation in the

Photo: Salvatore Martirano's SAL–MAR CONSTRUCTION, 1969–72, set up for concert at State University of New York (SUNY), Stonybrook, Long Island. Courtesy of Salvatore Martirano

electronic music experimentation of that time period.

Since the exhibition itself attempts to depict these individuals and their art through the perspective of the actual means of production, as exemplified by the generative tools, it must be pointed out that the physical objects on display are not to be regarded as aesthetic objects per se but rather as instruments which facilitate the articulation of both aesthetic products and ideological viewpoints. *It is predominantly the **process** which is on exhibit.* In this regard we have attempted to present the ideas and artwork which emerged from these processes as intrinsic parts of ideological systems which must also be framed within an historical context. We have therefore provided access to the video/audio art and other cultural artifacts directly from this text (i.e., barcodes) as it unfolds in chronological sequence. Likewise, this essay discusses this history with an emphasis on issues which reinforce a systemic process view of a complex set of dialectics (e.g. modernist versus representationist aesthetics, and artistic versus industrial/technocratic ideologies).

EARLY PIONEERS:

One of the persistent realities of history is that the facts which we inherit as descriptions of historical events are not neutral. They are invested with the biases of individual and/or group participants, those who have survived or, more significantly, those who have acquired sufficient power to control how that history is written. In attempting to compile this chronology, it has been my intention to present a story whose major signposts include those who have made substantive contributions but remain uncelebrated, in addition to those figures who have merely become famous for being famous. The reader should bear in mind that this is a brief chronology that must of necessity neglect other events and individuals whose work was just as valid. It is also an important feature of this history that the artistic use of technology has too often been criticized as an indication of a de-humanizing trend by a culture which actually embraces such technology in most other facets of its deepest fabric. It appears to abhor that which mirrors its fundamental workings and yet offers an alternative to its own violence. In view of this suspicion I have chosen to write this chronology from a position that regards the artistic acquisition of technology as one of the few arenas where a creative critique of the so-called technological era has been possible.

One of the earliest documented musical instruments based upon electronic principles was the CLAVECIN ÉLECTRIQUE designed by the jesuit priest Jean-Baptiste Delaborde in France, 1759. The device used a keyboard control based upon simple electrostatic principles.

All barcodes in this article pertain to the MUSIC stations.

The spirit of invention which immediately preceeded the turn of this century was synchronous with a cultural enthusiasm about the new technologies that was unprecedented. Individuals such as Bell, Edison, and Tesla became culture heroes who ushered in an ideology of industrial progress founded upon the power of harnessed electricity. Amongst this assemblage of inventor industrialists was DR. THADDEUS CAHILL, inventor of the electric typewriter, designer and builder of the first musical synthesizer and, by default, originator of industrial muzak. While a few attempts to build electronic musical instruments were made in the late 19th century by Elisha Gray, Ernst Lorenz, and William Duddell, they were fairly tentative or simply the curious byproducts of other research into electrical phenomena. One exception was the musical instrument called the CHORALCELO built in the United States by Melvin L. Severy and George B. Sinclair between 1888 and 1908. Cahill's invention, the TELHARMONIUM, however, remains the most ambitious attempt to construct a viable electronic musical instrument ever conceived.

Working against incredible technical difficulties, Cahill succeeded in 1900 to construct the first prototype of the TELHARMONIUM and by 1906, a fairly complete realization of his vision. This electro-mechanical device consisted of 145 rheotome/alternators capable of producing five octaves of variable harmonic content in imitation of orchestral tone colors. Its prinicipal of operation consisted of what we now refer to as additive synthesis and was controlled from two touch-sensitive keyboards capable of timbral, amplitude and other articulatory selections. Since Cahill's machine was invented before electronic amplification was available he had to build alternators that produced more than 10,000 watts. As a result the instrument was quite immense, weighing approximately 200 tons. When it was shipped from Holyoke, Massachusetts to New York City, over thirty railroad flatcars were enlisted in the effort.

While Cahill's initial intention was simply to realize a truly sophisticated electronic instrument that could perform traditional repetoire, he quickly pursued its industrial application in a plan to provide direct music to homes and offices as the strategy to fund its construction. He founded the New York Electric Music Company with this intent and began to supply realtime performances of popular classics to subscribers over telephone lines. Ultimately the business failed due to insurmountable technical and legal difficulties, ceasing operations in 1911.

The Telharmonium and its inventor represents one of the most spectacular examples of one side of a recurrent dialectic which we will see demonstrated repeatedly throughout the 20th century history of the artistic use of electronic technology. Cahill personifies the industrial ideology of invention which seeks to imitate more efficiently the status quo. Such an ideology desires to

summarize existent knowledge through a new technology and thereby provide a marketable representation of current reality. In contrast to this view, the modernist ideology evolved to assert an anti-representationist use of technology which sought to expand human perception through the acquisition of new technical means. It desired to seek the unknown as new phenomenological and experiential understandings which shattered models of the so-called "real".

The modernist agenda is brilliantly summarized by the following quote by Hugo Ball:

"It is true that for us art is not an end in itself, we have lost too many of our illusions for that. Art is for us an occasion for social criticism, and for real understanding of the age we live in...Dada was not a school of artists, but an alarm signal against declining values, routine and speculations, a desperate appeal, on behalf of all forms of art, for a creative basis on which to build a new and universal consciousness of art."

Many composers at the beginning of this century dreamed of new electronic technologies that could expand the palette of sound and tunings of which music and musical instruments then consisted. Their interest was not to use the emerging electronic potential to imitate existant forms, but rather to go beyond what was already known. In the same year that Cahill finalized the Telharmonium and moved it to New York City, the composer FERRUCCIO BUSONI wrote his *Entwurf einer neuen Ästhetik der Tonkunst* (Sketch of a New Aesthetic of Music) wherein he proposed the necessity for an expansion of the chromatic scale and new (possibly electrical) instruments to realize it. Many composers embraced this idea and began to conceptualize what such a music should consist of. In the following year, the Australian composer PERCY GRAINGER was already convinced that his concept of *FREE MUSIC* could only be realized through use of electro-mechanical devices. By 1908 the Futurist Manifesto was published and the modernist ideology began its artists' revolt against existant social and cultural values. In 1913 Luigi Russolo wrote *The Art of Noise*, declaring that the "evolution of music is paralled by the multiplication of the machine". By the end of that year, RUSSOLO AND UGO PIATTI had constructed an orchestra of electro-mechanical noise instruments (intonarumori) capable of realizing their vision of a sound art which shattered the musical status quo. Russolo desired to create a sound based art form out of the noise of modern life. His noise intoning devices presented their array of "howlers, boomers, cracklers, scrapers, exploders, buzzers, gurglers, and whistles" to bewildered audiences in Italy, LONDON, and finally Paris in 1921, where he gained the attention of Varèse and Stravinsky. Soon

after this concert the instruments were apparently only used commercially for generating sound effects and were abandoned by Russolo in 1930.

Throughout the second decade of the 20th century there was an unprecedented amount of experimental music activity much of which involved discourse about the necessity for new instrumental resources capable of realizing the emerging theories which rejected traditional compositional processes. Composers such as Ives, Satie, Cowell, VARÈSE, and Schoenberg were advancing the structural and instrumental resources for music. It was into this intellectual climate, and into the cultural changes brought on by the Russian Revolution, that LEON THEREMIN (Lev Sergeyevich Termen) introduced the Aetherophone (later known as the Theremin), a new electronic instrument based on radio-frequency oscillations controlled by hands moving in space over two antennae. The extraordinary flexibility of the instrument not only allowed for the performance of traditional repetoire but also a wide range of new effects. The theatricality of its playing technique and the uniqueness of its sound made the Theremin the most radical musical instrument innovation of the early 20th century.

The success of the Theremin brought its inventor a modest celebrity status. In the following years he introduced the instrument to Vladimir Lenin, invented one of the earliest television devices, and moved to New York City. There he gave concerts with Leopold Stokowski, entertained Albert Einstein and married a black dancer named Lavinia Williams. In 1932 he collaborated with the electronic image pioneer MARY ELLEN BUTE to display mathematical formulas on a CRT synchronized to music. He also continued to invent new instruments such as the Rhythmicon, a complex cross-rhythm instrument produced in collaboration with HENRY COWELL. Upon his return to the Soviet Union in 1938, Theremin was placed under house arrest and directed to work for the state on communications and surveillance technologies until his retirement in the late 1960's.

In many ways, Leon Theremin represents an archetypal example of the artist/engineer whose brilliant initial career is coopted by industry or government. In his case the irony is particularly poignant in that he invented his instruments in the full flowering of the Bolshevik enthusiasm for progressive culture under Lenin and subsequently fell prey to Stalin's ideology of fear and repression. Theremin was prevented until 1991 (at 95 years of age) from stepping foot outside the USSR because he possessed classified information about radar and surveillance technologies that had been obsolete for years. This suppression of innovation through institutional ambivalence, censorship or co-optation is also one of the recurrent patterns of the artistic use of technology throughout the 20th century. What often begins with the desire to expand human perception ends with commoditization or direct

repression.

By the end of the 1920's a large assortment of new electronic musical instruments had been developed. In Germany JÖRG MAGER had been experimenting with the design of new electronic instruments. The most successful was the SPHÄROPHON, a radio frequency oscillator based keyboard instrument capable of producing quarter-tone divisions of the octave. Mager's instruments used loudspeakers with unique driver systems and shapes to achieve a variety of sounds. Maurice Martenot introduced his Ondes Martenot in France where the instrument rapidly gained acceptance with a wide assortment of established composers. New works were written for the instrument by Milhaud, Honegger, Jolivet, VARÈSE and eventually MESSIAEN who wrote *Fête des Belles Eaux* for an ensemble of six Ondes Martenots in 1937 and later as a solo instrument in his *3 PETITES LITURGIES* of 1944. The Ondes Martenot was based upon similar technology as the Theremin and Sphärophon but introduced a much more sophisticated and flexible control strategy.

Other new instruments introduced around this time were the Dynaphone of Rene Bertrand, the Hellertion of Bruno Helberger and Peter Lertes, and an organlike "synthesis" instrument devised by J. Givelet and E. Coupleaux which used a punched paper roll control system for audio oscillators constructed with over 700 vacuum tubes. One of the longest lived of this generation of electronic instruments was the TRAUTONIUM of Dr. Friedrich Trautwein. This keyboard instrument was based upon distinctly different technology than the principles previously mentioned. It was one of the first instruments to use a neon-tube oscillator and its unique sound could be selectively filtered during performance. Its resonance filters could emphasize specific overtone regions. The instrument was developed in conjunction with the Hochschule für Music in Berlin where a research program for compositional manipulation of phonograph recordings had been founded two years earlier in 1928. The composer PAUL HINDEMITH participated in both of these endeavors, composing a *Concertino for Trautonium and String Orchestra* and a sound montage based upon phonograph record manipulations of voice and instruments. Other composers who wrote for the Trautonium included Richard Strauss and Werner Egk. The greatest virtuoso of this instrument was the composer OSKAR SALA who performed on it, and made technical improvements, into the 1950's. Also about this time, the composer Robert Beyer published a curious paper about "space" or "room music" entitled *Das Problem der Kommender Musik* that gained little attention from his colleagues (Beyer's subsequent role in the history of electronic music will be discussed later).

The German experiments in phonograph manipulation constitute one of the first attempts at organizing sound electronically

that was not based upon an instrumental model. While this initial attempt at the stipulation of sound events through a kind of sculptural moulding of recorded materials was short lived, it set in motion one of the principle approaches to electronic composition to become dominant in decades to come: the electronic music studio. Other attempts at a non-instrumental approach to sound organization began in 1930 within both the USSR and Germany. With the invention of optical sound tracks for film a number of theorists become inspired to experiment with synthetic sound generated through standard animation film techniques. In the USSR two centers for this research were established: A.M. Avzaamov, N.Y. Zhelinsky, and N.V. VOINOV experimented at the Scientific Experimental Film Institute in Leningrad while E.A SCHOLPO and G.M. Rimski-Korsakov performed similar research at the Leningrad Conservatory. In the same year, Bauhaus artists performed experiments with hand-drawn waveforms converted into sound through photoelectric cells. Two other German artists, RUDOLPH PFENNINGER and OSCAR FISCHINGER worked separately at about this time exploring synthetic sound generation through techniques that were similar to Voinov and Avzaanov.

A dramatic increase in new electronic instruments soon appeared in subsequent years. All of them seem to have had fascinating if not outrightly absurd names: the Sonorous Cross; the ELECTROCHORD; the Ondioline; the CLAVIOLINE; the Kaleidophon; the Electronium Pi; the Multimonica; the Pianophon; the Tuttivox; the Mellertion; the Emicon; the Melodium; the Oscillion; the Magnetton; the Photophone; the Orgatron; the Photona; and the PARTITUROPHON. While most of these instruments were intended to produce new sonic resources, some were intended to replicate familiar instrumental sounds of the pipe organ variety. It is precisely this desire to replicate the familiar which spawned the other major tradition of electronic instrument design: the large families of electric organs and pianos that began to appear in the early 1930's. LAURENS HAMMOND built his first electronic organ in 1929 using the same tone-wheel process as Cahill's Telharmonium. Electronic organs built in the following years by Hammond included the NOVACHORD and the Solovox. While Hammond's organ's were rejected by pipe organ enthusiasts because its additive synthesis technique sounded too "electronic," he was the first to achieve both stable intonation through synchronized electromechanical sound generators and mass production of an electronic musical instrument, setting a precedent for popular acceptance. Hammond also patented a spring reverberation technique that is still widely used.

The Warbo Formant Organ (1937) was one of the first truly polyphonic electronic instruments that could be considered a predecessor of current electronic organs. Its designer the German

engineer HARALD BODE was one of the central figures in the history of electronic music in both Europe and the United States. Not only did he contribute to instrument design from the 1930's on, he was one of the principle engineers in establishing the classic tape music studios in Europe. His contributions straddled the two major design traditions of new sounds versus imitation of traditional ones without much bias since he was primarily an engineer interested in providing tools for a wide range of musicians. Other instruments which he subsequently built included the Melodium, the MELOCHORD and the Polychord (Bode's other contributions will be discussed later in this essay).

By the late 1930's there was an increase of experimental activity in both Europe and the United States. 1938 saw the installation of the ANS Synthesizer at the Moscow Experimental Music Studio. JOHN CAGE began his long fascination with electronic sound sources in 1939 with the presentation of *Imaginary Landscape No. 1*, a live performance work whose score includes a part for disc recordings performed on a variable speed phonograph. A number of similar works utilizing recorded sound and electronic sound sources followed. Cage had also been one of the most active proselytizers for electronic music through his writings, as were Edgard Varèse, Joseph Schillinger, Leopold Stokowski, Henry Cowell, Carlos Chavez and PERCY GRAINGER. It was during the 1930's that Grainger seriously began to pursue the building of technological tools capable of realizing his radical concept of *FREE MUSIC* notated as spatial non-tempered structures on graph paper. He composed such a work for an ensemble of four Theremins (1937) and began to collaborate with Burnett Cross to design a series of synchronized oscillator instruments controlled by a paper tape roll mechanism. These instruments saw a number of incarnations until Grainger's death in 1961.

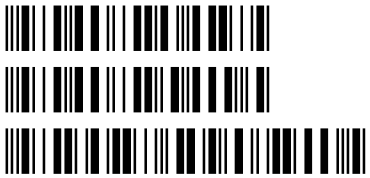
In 1939 Homer Dudley created the voder and the vocoder for non-musical applications associated with speech analysis. The VODER was a keyboard-operated encoding instrument consisting of bandpass channels for the simulation of resonances in the human voice. It also contained tone and noise sources for imitating vowels and consonants. The VOCODER was the corresponding decoder which consisted of an analyzer and synthesizer for analyzing and then reconstituting the same speech. Besides being one of the first sound modification devices, the vocoder was to take on an important role in electronic music as a voice processing device that is still widely in use today.

The important technical achievements of the 1930's included the first successful television transmission and major innovations in audio recording. Since the turn of the century, research into improving upon the magnetic wire recorder, invented by VALDEMAR POULSEN, had steadily progressed. A variety of improvements had been made, most notably the use of electrical

amplification and the invention of the Alternating Current bias technique. The next major improvement was the replacement of wire with steel bands, a fairly successful technology that played a significant role in the secret police of the Nazi party. The German scientist Fritz Pfleumer had begun to experiment with oxide-coated paper and plastic tape as early as 1927 and the I.G. Farbenindustrie introduced the first practical plastic recording tape in 1932. The most successful of the early magnetic recording devices was undoubtedly the AEG Magnetophone introduced in 1935 at the Berlin Radio Fair. This device was to become the prototypical magnetic tape recorder and was vastly superior to the wire recorders then in use. By 1945 the Magnetophone adopted oxide-coated paper tape. After World War II the patents for this technology were transfered to the United States as war booty and further improvements in tape technology progressed there. Widespread commercial manufacturing and distribution of magnetic tape recorders became a reality by 1950.

The influence of World War II upon the arts was obviously drastic. Most experimental creative activity ceased and technical innovation was almost exclusively dominated by military needs. European music was the most seriously affected with electronic music research remaining dormant until the late 1940's. However, with magnetic tape recording technology now a reality, a new period of rapid innovation took place. At the center of this new activity was the ascendancy of the tape music studio as both compositional tool and research institution. Tape recording revolutionized electronic music more than any other single event in that it provided a flexible means to both store and manipulate sound events. The result was the defining of electronic music as a true genre. While the history of this genre before 1950 has primarily focused upon instrument designers, after 1950 the emphasis shifts towards the composers who consolidated the technical gains of the first half of the 20th century.

Just prior to the event of the tape recorder, PIERRE SCHAEFFER had begun his experiments with manipulation of phonograph recordings and quickly evolved a theoretical position which he named *Musique Concrète* in order to emphasize the sculptural aspect of how the sounds were manipulated. Schaeffer predominantly used sounds of the environment that had been recorded through microphones onto disc and later tape. These "sound objects" were then manipulated as pieces of sound that could be spliced into new time relationships, processed through a variety of devices, transposed to different frequency registers through tape speed variations, and ultimately combined into a montage of various mixtures of sounds back onto tape. In 1948 Schaeffer was joined by the engineer Jacques Poullin who subsequently played a significant role in the technical evolution of tape music in France. That same year saw the initial broadcast



of Musique Concrète over French Radio and was billed as a 'concert de bruits'. The composer PIERRE HENRY then joined Schaeffer and Poullin in 1949. Together they constructed the *SYMPHONIE POUR UN HOMME SEUL*, one of the true classics of the genre completed before they had access to tape recorders.

By 1950 Schaeffer and Henry were working with magnetic tape and the evolution of musique concrète proceeded at a fast pace. The first public performance was given in that same year at the École Normale de Musique. In the following year, French National Radio installed a sophisticated studio for the *Group for Research on Musique Concrète*. Over the next few years significant composers began to be attracted to the studio including Pierre Boulez, Michel Philippot, Jean Barraqué, Phillipe Arthuys, EDGARD VARÈSE, and OLIVIER MESSIAEN. In 1954 Varèse composed the tape part to *DÉSERTS* for orchestra and tape at the studio and the work saw its infamous premiere in December of that year.

Since Musique Concrète was both a musical and aesthetic research project, a variety of theoretical writings emerged to articulate the movement's progress. Of principal importance was Schaeffer's book *A la recherche d'une musique concrète*. In it he describes the group's experiments in a pseudo-scientific manner that forms a lexicon of sounds and their distinctive characteristics which should determine compositional criteria and organization. In collaboration with A. Moles, Schaeffer specified a classification system for acoustical material according to orders of magnitude and other criteria. In many ways these efforts set the direction for the positivist philosophical bias that has dominated the "research" emphasis of electronic music institutions in France and elsewhere.

The sonic and musical characteristics of early musique concrète were pejoratively described by Olivier Messiaen as containing a high level of surrealistic agony and literary descriptivism. The movement's evolution saw most of the participating composers including Schaeffer move away from the extreme dislocations of sound and distortion associated with its early compositions and simple techniques. Underlying the early works was a farily consistent philosophy best exemplified by a statement by Schaeffer:

"I belong to a generation which is largely torn by dualisms. The catechism taught to men who are now middle-aged was a traditional one, traditionally absurd: spirit is opposed to matter, poetry to technique, progress to tradition, individual to the group and how much else. From all this it takes just one more step to conclude that the world is absurd, full of unbearable contradictions. Thus a violent desire to deny, to destroy one of the concepts, especially in the realm of form, where, according to Malraux, the Absolute is coined. Fashion faintheartedly approved this nihilism.

If musique concrète were to contribute to this movement, if, hastily adopted, stupidly understood, it had only to add its additional bellowing, its new negation, after so much smearing of the lines, denial of golden rules (such as that of the scale), I should consider myself rather unwelcome. I have the right to justify my demand, and the duty to lead possible successors to this intellectually honest work, to the extent to which I have helped to discover a new way to create sound, and the means—as yet approximate—to give it form.

... Photography, whether the fact be denied or admitted, has completely upset painting, just as the recording of sound is about to upset music .... For all that, traditional music is not denied; any more than the theatre is supplanted by the cinema. Something new is added: a new art of sound. Am I wrong in still calling it music?"

While the tape studio is still a major technical and creative force in electronic music, its early history marks a specific period of technical and stylistic activity. As recording technology began to reveal itself to composers, many of whom had been anxiously awaiting such a breakthrough, some composers began to work under the auspices of broadcast radio stations and recording studios with professional tape recorders and test equipment in off hours. Others began to scrounge and share equipment wherever possible, forming informal cooperatives based upon available technology. While Schaeffer was defining musique concrète, other independent composers were experimenting with tape and electronic sound sources. The end of 1940's saw French composer Paul Boisselet compose some of the earliest live performance works for instruments, tape recorders and electronic oscillators. In the United States, Bebe and Louis Barron began their pioneering experiments with tape collage. As early as 1948 the Canadian composer/engineer Hugh Le Caine was hired by the National Research Council of Canada to begin building electronic musical instruments.

In parallel to all of these events, another major lineage of tape studio activity began to emerge in Germany. According to the German physicist Werner Meyer-Eppler the events comprising the German electronic music history during this time are as follows. In 1948 the inventor of the Vocoder, Homer Dudley, demonstrated for Meyer-Eppler his device. Meyer-Eppler subsequently used a tape recording of the Vocoder to illustrate a lecture he gave in 1949 called *Developmental Possibilities of Sound*. In the audience was the aforementioned Robert Beyer, now employed at the Northwest German Radio, Cologne. Beyer must have been profoundly impressed by the presentation since it was decided that lectures should be formulated on the topic of "electronic music" for the International Summer School for New Music in

Darmstadt the following year. Much of the subsequent lecture by Meyer-Eppler contained material from his classic book, *Electronic Tone Generation, Electronic Music, and Synthetic Speech.*

By 1951 Meyer-Eppler began a series of experiments with synthetically generated sounds using Harald Bode's Melochord and an AEG magnetic tape recorder. Together with Robert Beyer and Herbert Eimert, Meyer-Eppler presented his research as a radio program called "The World of Sound of Electronic Music" over German Radio, Cologne. This broadcast helped to convince officials and technicians of the Cologne radio station to sponser an official studio for electronic music. From its beginning the COLOGNE STUDIO differentiated itself from the Musique Concrète activities in Paris by limiting itself to "pure" electronic sound sources that could be manipulatd through precise compositional techniques derived from Serialism.

While one of the earliest compositional outcomes from the influence of Meyer-Eppler was Bruno Maderna's collaboration with him entitled *Musica su due Dimensioni* for flute, percussion, and loudspeaker, most of the other works that followed were strictly concerned with utilizing only electronic sounds such as pure sine-waves. One of the first attempts at creating this labor intensive form of studio based additive synthesis was KARLHEINZ STOCKHAUSEN who created his *Étude* out of pure sine-waves at the Paris studio in 1952. Similar works were produced at the Cologne facilities by Beyer and Eimert at about this time and subsequently followed by the more sophisticated attempts by Stockhausen, *Studie I* (1953) and *STUDIE II* (1954). In 1954 a public concert was presented by Cologne radio that included works by Stockhausen, Goeyvaerts, Pousseur, Gredinger, and Eimert. Soon other composers began working at the Cologne studio including Koenig, Heiss, Klebe, KAGEL, LIGETI, BRÜN and ERNST KRENEK. The later composer completed his *Spiritus Intelligentiae Sanctus* at the Cologne studio in 1956. This work along with Stockhausen's *GESANG DER JÜNGLINGE*, composed at the same time, signify the end of the short-lived pure electronic emphasis claimed by the Cologne school. Both works used electronically-generated sounds in combination with techniques and sound sources associated with musique concrète.

While the distinction usually posited between the early Paris and Cologne schools of tape music composition emphasizes either the nature of the sound sources or the presence of an organizational bias such as Serialism, I tend to view this distinction more in terms of a reorganization at mid-century of the representationist versus modernist dialect which appeared in prior decades. Even though Schaeffer and his colleagues were consciously aligned in overt ways with the Futurists concern with noise, they tended to rely on dramatic expression that was dependent upon illusionistic associations to the sounds undergoing deconstruction.

The early Cologne school appears to have been concerned with an authentic and didactic display of the electronic material and its primary codes as if it were possible to reveal the metaphysical and intrinsic nature of the material as a new perceptual resource. Obviously the technical limitations of the studio at that time, in addition to the aesthetic demands imposed by the current issues of musicality, made their initial pursuit too problematic.

Concurrent with the tape studio developments in France and Germany there were significant advances occuring in the United States. While there was not yet any significant institutional support for the experimental work being pursued by independent composers, some informal projects began to emerge. The Music for Magnetic Tape Project was formed in 1951 by JOHN CAGE, Earle Brown, Christian Wolff, David Tudor, and Morton Feldman and lasted until 1954. Since the group had no permanent facility, they relied on borrowed time in commercial sound studios such as that maintained by Bebe and Louis Barron or used borrowed equipment that they could share. The most important work to have emerged from this collective was Cage's *WILLIAM'S MIX*. The composition used hundreds of prerecorded sounds from the Barron's library as the source from which to fulfill the demands of a meticulously notated score that specified not only the categories of sounds to be used at any particular time but also how the sounds were to be spliced and edited. The work required over nine months of intensive labor on the part of Cage, Brown and Tudor to assemble. While the final work may not have sounded to untutored ears as very distinct from the other tape works produced in France or Cologne at the same time, it nevertheless represented a radical compositional and philosophical challenge to these other schools of thought.

In the same year as Cage's *William's Mix*, VLADIMIR USSACHEVSKY gave a public demonstration of his tape music experiments at Columbia University. Working in almost complete isolation from the other experimenters in Europe and the United States, Ussachevsky began to explore tape manipulation of electronic and instrumental sounds with very limited resources. He was soon joined by OTTO LUENING and the two began to compose in earnest some of the first tape compositions in the United States at the home of Henry Cowell in Woodstock, New York: *Fantasy in Space*, *Low Speed*, and *Sonic Contours*. The works, after completion in Ussachevsky's living room in New York and in the basement studio of Arturo Toscanini's Riverdale home, were presented at the Museum of Modern Art in October of 1952.

Throughout the 1950's important work in electronic music experimentation only accelerated at a rapid pace. In 1953 an Italian electronic music studio (Studio de Fonologia) was established at the Radio Audizioni Italiane in Milan. During its early years the studio attracted many important international figures

including LUCIANO BERIO, Niccolo Castiglioni, Aldo Clementi, Bruno Maderna, LUIGI NONO, John Cage, Henri Pousseur, André Boucourechliev, and Bengt Hambraeus. Studios were also established at the Philips research labs in Eindhoven and at NHK (Japanese Broadcasting System) in 1955. In that same year the David Sarnoff Laboratories of RCA in Princeton, New Jersey introduced the OLSON-BELAR SOUND SYNTHESIZER to the public. As its name states, this instrument is generally considered the first modern "synthesizer" and was built with the specific intention of synthesizing traditional instrumental timbres for the manufacture of popular music. In an interesting reversal of the usual industrial absorption of artistic innovation, the machine proved inappropriate for its original intent and was later used entirely for electronic music experimentation and composition. Since the device was based upon a combination of additive and subtractive synthesis strategies, with a control system consisting of a punched paper roll or tab-card programming scheme, it was an extremely sophisticated instrument for its time. Not only could a composer generate, combine and filter sounds from the machine's tuning-fork oscillators and white-noise generators, sounds could be input from a microphone for modification. Ultimately the device's design philosophy favored fairly classical concepts of musical structure such as precise control of twelve-tone pitch material and was therefore favored by composers working within the serial genre.

The first composers to work with the Olson-Belar Sound Synthesizer (later known as the RCA Music Synthesizer) were VLADIMIR USSACHEVSKY, OTTO LEUNING and MILTON BABBITT who managed to initially gain access to it at the RCA Labs. Within a few years this trio of composers in addition to Roger Sessions managed to acquire the device on a permanent basis for the newly established Columbia-Princeton Electronic Music Center in New York City. Because of its advanced facilities and policy of encouragement to contemporary composers, the center attracted a large number of international figures such as ALICE SHIELDS, PRIL SMILEY, Michiko Toyama, Bülent Arel, Mario Davidovsky, Halim El-Dabh, Mel Powell, Jacob Druckman, Charles Wourinen, and Edgard Varèse.

In 1958 the University of Illinois at Champaign/Urbana established the Studio for Experimental Music. Under the initial direction of LEJAREN HILLER the studio became one of the most important centers for electronic music research in the United States. Two years earlier, Hiller, who was also a professional chemist, applied his scientific knowledge of digital computers to the composition of the *ILLIAC SUITE FOR STRING QUARTET*, one of the first attempts at serious computer-aided musical composition. In subsequent years the resident faculty connected with the Studio for Experimental Music included composers HERBERT