



COLUMBIA-PRINCETON
ELECTRONIC MUSIC CENTER
TENTH ANNIVERSARY CELEBRATION

COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER TENTH ANNIVERSARY ALBUM

Edgard Varèse: DESERTS (1954-1961)

with newly-realized version of organized sound

Group for Contemporary Music at Columbia University,
Charles Wuorinen, conductor

Otto Luening: IN THE BEGINNING from THEATER PIECE No. 2 (1956)

Milton Babbitt: VISION AND PRAYER (1961)

Bethany Beardslee, soprano

Vladimir Ussachevsky: COMPUTER PIECE No. 1 (1968)

TWO SKETCHES FOR A COMPUTER PIECE (1971)

Pril Smiley: KOLYOSA (1970)

Alice Shields: THE TRANSFORMATION OF ANI (1970)

Bülent Arel: STEREO ELECTRONIC MUSIC No. 2 (1970)

Mario Davidovsky: SYNCHRONISMS No. 5 (1969)

Ray Des Roches, Richard Fitz, Claire Heldrich, Donald Marccone,
Howard Van Hyning, percussion; Harvey Sollberger, conductor

DÉSERTS is the first large work using electronically recorded sounds composed by a man who has since become a major prophet of electronic music. Varèse began to gather and process the sounds as soon as he could find equipment capable of doing the job, and completed it during 1954 at the studios of the French Radio, upon the invitation of one of the pioneers in the field, Pierre Schaeffer.

The world premiere was given by Hermann Scherchen and the Orchestre Nationale, Paris, December 2, 1954. The interpolations of organized sound were revised with the technical assistance of Bülent Arel in 1961 at the Columbia-Princeton Electronic Music Center. A new master was prepared especially for this recording by Mr. Arel.

DÉSERTS consists of four instrumental sections and three interpolations of organized sound. In Varèse's own words: "The music given to the instrumental ensemble may be said to evolve in opposing planes and volumes, producing the sensation of movement in space." The mutation and movement of these "planes and volumes" are defined by intervals that are "not based on any fixed set . . . such as a scale, a series," but "determined by the exigencies of this particular work." The interpolations are "based on what may be called raw sounds (friction, percussion, hissing, swishing, grinding, puffing)," electronically processed and then composed "to fit the pre-established plan of the work." Instrumental sounds, both new and quotes from the instrumental sections are electronically "combined with these sounds as a structural and stabilizing element."

As for the title, **DÉSERTS**, Varèse wrote: "I had in mind not only all physical deserts (of sand, sea and snow, of outer space, of empty city streets) but also the deserts in the mind of man; not only those stripped aspects of nature that suggest barrenness, aloofness, timelessness, but also that remote *inner* space no telescope can reach, where man is alone, a world of mystery and essential loneliness."

EDGARD VARÈSE was born in Paris on December 22, 1883 and died in New York, where he lived most of his life, on November 6, 1965. He studied with Vincent d'Indy, Albert Roussel and Charles Widor. As a young composer he was befriended by Debussy, Richard Strauss and Ferruccio Busoni. Even as a student, he "began to think of music as spatial — as bodies of intelligent sounds moving freely in space" and conceived the idea of liberating music from the tempered scale and the limitations of musical instruments. In 1913 he met René Bertrand, from whom he later learned about the possibilities of electronics as a musical medium. As early as 1916, shortly after his arrival in New York, he said: "Our musical alphabet must be enriched. We also need new instruments . . . new mediums of expression."

During the next decade or so, however, he was preoccupied with composing, conducting and directing the International Composers' Guild, which he founded in 1921 and which, during its six years of existence, gave world or American premieres of works by over fifty composers, among them Berg, Hindemith, Schoenberg, Stravinsky and Webern. Immediately after the closing of the Guild, he began discussing with Bertrand and Harvey Fletcher, then Acoustical Research Director of the Bell Telephone Laboratories, the possibilities of developing an electronic instrument for composing, but failed to gain any financial support for it. Meanwhile he worked on several projects, none completed, involving ideas that would require electronic means for their realization. Although Leon Theremin built to his specifications two instruments for *Ecuatorial* in 1933, it was not until twenty years later that he wrote his first electronic composition, the interpolations for **DÉSERTS**.

Nevertheless, in conceiving music as sound organized yet set free, he made wholly original contributions and opened up new horizons, not in the '50s with his electronic works, but in the '20s and '30s with his works for conventional instruments. Thus, he anticipated today's musical developments by over a quarter-century.

Aside from **DÉSERTS** he produced two other electronic works, *Poème Electronique*, for presentation at the Brussels World's Fair of 1958 in the Philips Pavilion designed by Le Corbusier, and the "electronically organized sound" for the *Good Friday Procession in Verges* sequence in the film, *Around and About Juan Miró* (1956) by Thomas Bouchard.

—Chou Wen-chung

THEATER PIECE No. 2 was commissioned for Humphrey-Limon by the Juilliard Musical Foundation for the Festival of American Music in celebration of the founding of Juilliard School of Music.

The opening of the ballet, "In the Beginning", expressed the contrast of the inchoate world and the emerging human element by juxtaposing a human voice against the electronic sound. In the original production, lights, movement and mobiles on stage added to the theatrical counterpoint.

Three components are used in the work: electronic sound, instrumental sounds manipulated on tape, and a human voice recorded. The electronic sounds were made during a short visit at the Cologne Studio in 1955 through the courtesy of Herbert Eimert. The instrumental sounds were produced here and the material modified in our travelling laboratory which at this time had landed in my apartment at 405 W. 118th St. The voice is that of Ethel Luening's recording for New Music of *Night Piece* from my *Suite for Soprano and Flute*. The composition revolves around some easily recognizable tonal centers. It includes microtonal sequences, electronic sounds of varying character as well as the voice itself, singing without words. Depending on their character and relationships to preceding and following musical events, the sounds, including the voice, take place in a carefully planned time and pitch sequence so that they do not mask each other and can be readily perceived. The voice, of course, was introduced to express the human element as it emerged from the mysterious and rather cold beginning.

—Otto Luening

VISION AND PRAYER, for soprano and synthesized accompaniment, was commissioned by the Fromm Foundation, composed in 1961, and first performed in September, 1961 by Bethany Beardslee, at a concert presented by the Fromm Foundation at the Congress of the International Musicological Society. The work was the first to combine live vocal performance with a tape produced entirely on the Mark II RCA Synthesizer.

Dylan Thomas' poem, "Vision and Prayer", was first published in 1945, and consists of twelve "shaped" stanzas, each of the first six of which progresses from an initial line of a single syllable, by the addition of a syllable per line, to a syllabically maximal line of nine syllables, and then subtractively returns to a single syllabic line. The second group of six reverses the process, by progressing from an initial line of nine syllables to a center line of a single syllable, and then returning to the nine-syllable line. The temporal, sonic, and pattern characteristics of this poetic structure, as well as certain interpretations of these properties in strictly musical terms, were initial determinants of both musical details and the large-scale disposition of the compositional sections. The cumulative musical progression from these details to the sections, and to the totality of which these sections are members, is achieved by such traditional compositional procedures as trichordal and hexachordal derivation, harmonic succession through aggregates — within which the polyphony and the coun-

terpoint are shaped by the properties of the work's third-order combinatorial set, and by the increased dimensionality — the refinements within and the compoundings of primary dimensions — easily and precisely afforded by the electronic medium.

—Milton Babbitt

COMPUTER PIECE No. 1 and **SKETCHES FOR A COMPUTER PIECE** have one thing in common; they were "put together" in a conventional electronic music studio, using the sound material produced by way of the digital computers at the Bell Telephone Laboratories. It is likely that all known methods of generating sounds with the digital computer are illustrated in these two pieces. **COMPUTER PIECE No. 1** was composed from three types of material: material initially generated on the digital computer GE 635 by a composer-physicist, Jean Claude Risset, and, in a highly transformed form, used to create the beginning and closing sections of the piece; a succession of four-note clusters with spectrum characteristics of square-wave, originally synthesized for me by F. R. Moore; and material from several diversified "concrete" sound sources, such as recordings of a gong, of a distorted human speech, of a highly modulated passage on electronic organ, etc.

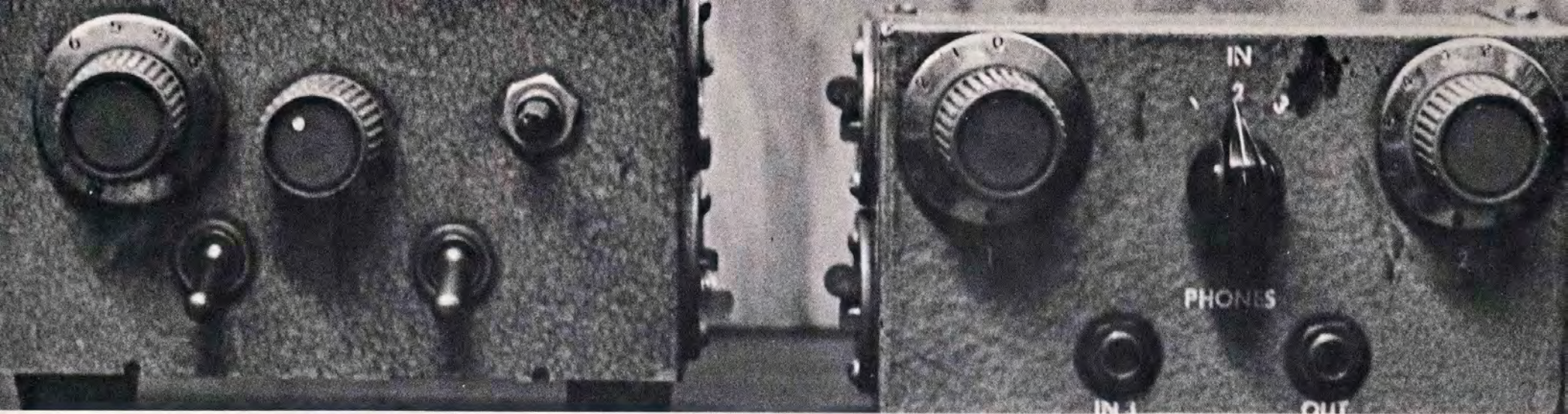
These sounds, of 9 seconds to 20 seconds in duration, were converted from analogue-to-digital form, stored in the memory of the digital computer as "files", and then recalled and converted to analogue form in pre-determined fragments by a special set of instructions. Were it not for the fact that the first set of materials was subjected by me to a post-computer modulation, using a Bode frequency shifter and reverberation at the Columbia-Princeton Electronic Music Center, the composition could have been programmed in its entirety on the digital computer. As such, it is an example of electronic music from computer-generated and computer-processed sound materials, modified and assembled according to the usual methods employed in an electronic music studio.

The method of producing sound material for **SKETCHES FOR A COMPUTER PIECE** was markedly different. A program called **GRØØVE**, developed by Dr. Max Matthews and F. R. Moore, capable of creating, storing, reproducing, and editing functions of time was used. The computer was DDP224. The **GRØØVE** program makes it possible to produce the tuneable succession of pitches in real time by playing a small keyboard connected to the computer. Additional controls in the form of ordinary small knobs and a set of foot-pedals for octave transpositions are available. The computer responds by providing voltages through digital-to-analogue converters to a set of Wavetek generators set in a saw tooth position, and 3 amplifiers with one VC band-pass filter from the Moog synthesizer. In this manner all of the horn-like sound material was obtained. One, two, or three simultaneous sounds are possible. The tuning is in tempered pitch.

A distinctly different method of computer-controlled, random production of untuned pitches, characterized by random amplitudes and either rigid or random rhythmic succession, was also used to obtain both the disjointed ping-like sounds and the rushing ostinato passages. An occasional sequence of softer percussion sounds, also from a special resonant circuit by Dr. Matthews, and controlled through the keyboard, was employed as well.

Only a moderate amount of timbre-modification was applied here and there. Otherwise, the material is largely in the form obtained in realtime sound production — a great advantage in employing the **GRØØVE** program. I am deeply grateful to both Dr. Matthews and Mr. Moore for their assistance to me in both of the above compositions.

—Vladimir Ussachevsky



COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER TENTH ANNIVERSARY CELEBRATION



ABOUT THE COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER

The Columbia-Princeton Electronic Music Center officially came into existence on February 20, 1959. This was the starting date of a five year grant from the Rockefeller Foundation, which made available a total of \$175,000 in response to a proposal by Columbia and Princeton Universities to establish working studio facilities. They were to be used by interested resident and invited composers to work in electronic music, a term that was assumed to include tape music and *musique concrète*. Working facilities were to include "an adequately equipped studio, the necessary technical assistance, and the means to initiate such programs of investigation as are necessary to facilitate the task of composers desiring to compose with the expanded sound resources available on magnetic tape or needed to be built up through sound synthesis." It was agreed that the main new studio would be housed at Columbia University, where the original Experimental Tape Studio was already housed, as it seemed advantageous to maintain such a studio in the metropolitan area.

Translating the proposal into reality — allocating and preparing suitable space, designing specialized equipment, and putting together the first adequately equipped Electronic Music Studio in the United States — took almost a year. The unexpected but welcome availability of the most advanced type of RCA Sound Synthesizer, the Mark II, altered the original plans somewhat but also gave the Center a unique device which, in some respects, still has a versatility superior to the portable synthesizers which now serve as the principle source of sound materials in most electronic studios.

Milton Babbitt, Otto Luening and Vladimir Ussachevsky had already become acquainted with this huge machine in the summer of 1958. This was accomplished through the courtesy of the David Sarnoff Laboratories in Princeton, New Jersey, after the RCA administration was contacted on their behalf by Davidson Taylor, the former Dean of the School of the Arts at Columbia. Soon after the Rockefeller Foundation grant was announced, a representative of the David Sarnoff Research Laboratories was in touch with the composers concerning their interest in the further use of the Mark II RCA Sound Synthesizer. A rental term of 20 months' duration was worked out; when it expired, RCA permitted the Center to continue to use the synthesizer without charge.

The Center started to function fully in the year 1960 and accordingly, celebrated its tenth anniversary in the year 1970. By then the Center had expanded to include three nearly identical studios at Columbia University, one located in McMillin Theater on the main campus, and two in the Prentis Building, at 632 West 125th Street in Manhattan. At the latter address a fourth studio continued to house the Mark II RCA Sound Synthesizer. A laboratory for designing, building and maintaining the studio equipment was also in its tenth year of existence under the supervision of Peter Mauzey.

ON THE COVER: top — reverberation and mixing units which comprised total electronic controls for first Experimental Tape Studio (1952); bottom — one of the four nearly-identical studios of Columbia-Princeton Electronic Music Center (1971).

A fifth studio, similar in layout to the three-studio complex at Columbia, was installed in the Woolworth Music Building on the Princeton University campus. (Several years prior to this, the Princeton Music Department had begun a vigorous program of investigation into Computer Music Analysis and Computer Sound Synthesis.)

The first public concert of works produced with the new facilities was given May 9th, 1961, and repeated the following day. All of those works subsequently appeared on a Columbia record, which is still in print some nine years later.

The Beginnings

It is unlikely that the studio could have gone into production so rapidly were it not for the fact that there already existed at Columbia an Experimental Music Studio (later renamed the Tape Music Studio). It had its beginnings in a microphone and an Ampex 400 tape recorder, purchased in 1951 for the music department by the Alice M. Ditson Fund. With this equipment, plus a pair of earphones and a borrowed Magnecord tape recorder, Ussachevsky started some experiments in transposition of piano pitches. This was soon followed by the discovery of the "feedback" principle through a casual conversation with Peter Mauzey, then an engineering student, who obligingly built a small feed-back device to assist in further experimentation.

The first examples of tape composition that resulted were presented by Ussachevsky on the Composer's Forum concert at McMillin Theatre on May 9, 1952. The following summer this equipment was taken to Bennington College, in Vermont, where Luening joined with Ussachevsky in further experimentation, testing individual flute sounds and improvised patterns in the new world of multiple echoes and, theretofore-impossible pitch ranges.

This was also an occasion to test musicians' reactions; the reactions were mixed, befitting, one supposes, the spirit of the cocktail party, during which the experiments were revealed.

Still later that summer, the first compositions by Luening—*Fantasy in Space*, *Low Speed*, and *Invention in Twelve Tones*—and some of the materials for Ussachevsky's *Sonic Contours* were produced with two tape-recorders, a microphone, and a couple of mixing and "feed-back" devices by Mauzey, all transported from New York. This took place in the Woodstock, New York cottage of Henry and Sidney Cowell. On November 22, 1952, Leopold Stokowski introduced these compositions in a concert at the Museum of Modern Art, an occasion that evoked national recognition of the possible birth of a new music medium. Oliver Daniel of BMI suggested that the new "instrument" be called a "tapesichord," and the music thus produced "tape-music." The latter name has stuck. The term "tape-music" thereafter identified a distinct American contribution.

A pattern of moving the studio about persisted for four years. It traveled a triangle between New York City, Bennington and the MacDowell Colony, in New Hampshire. Meanwhile the Louisville Orchestra commissioned Luening, and he invited Ussachevsky to join him in composing the first composition for tape-recorder and orchestra. Additional equipment was needed to realize this work, and the Rockefeller Foundation made possible an enlargement of the studio by the addition of two tape-recorders and a filter. The equipment resided in Ussachevsky's apartment for the next three years, then for six months at Luening's (his neighbors were more sensitive). In 1955 the composers addressed an urgent plea to President Grayson Kirk of Columbia for use of university space. As a consequence, the studio migrated to its first university dwelling, a small doomed-for-demolition, two-story house on campus, the last of a complex of buildings that had belonged to a former Morningside institution, the Bloomingdale Asylum for the Insane. In this quaint and isolated house, such works as the music for Orson Welles' production of *King Lear*, *Piece for Tape Recorder*, and *Metamorphoses*, were produced. During this period, Jacques Barzun, then the Dean of Graduate Faculties at Columbia, took interest and secured some University support for the studio. For a number of years thereafter, Mr. Barzun's sympathetic understanding played an important role in the studio's survival and growth. President Kirk responded to another plea, and in the fall of 1957 permanent quarters were established in Columbia's McMillin Theater. The migratory phase had ended. Other composers began to take interest.

In 1959 the Tape Music Studio then underwent further metamorphosis, which was made possible by the large Rockefeller Foundation grant to the two universities: the Columbia-Princeton Electronic Music Center had come into existence.

The Works

The number of works produced individually and jointly by Luening and Ussachevsky prior to the establishment of the Center was 25. The count since 1959 is close to 225 compositions by more than 60 composers from 11 countries. Some of these composers used the Center's facilities for a few weeks; others stayed for several years. They shared hours in the studios with students who numbered from 12 to 18 in any given year; a tight schedule had to be maintained, and late hours were commonplace. More than 60 compositions by 21 composers have been recorded on commercial disks.

Composers associated with the Center during the 4 to 9 year period developed distinctly personal techniques. The tradition of meticulous experimentation with sound materials prevails. Much has been learned from Milton Babbitt's initial explorations of the possibilities afforded by the RCA Sound Synthesizer for unprecedented accuracy in controlling electronically-generated materials.

It is characteristic of the Center that no general style, but many strongly individual styles of composition have emerged. This diversity of expression continues to flourish within the changing technological conditions, as synthesizers and computers assume a more important role in sound synthesis. So far, the largest number of works have been created for tape alone, but composers are increasingly combining pre-recorded tape with live performers. The number of the latter type has grown from the first three composed by Luening and Ussachevsky to 48. A glance at the list of works at the end of this booklet will show the interesting ways in which electronic works by the Center's composers have accommodated artists in other fields.

The Performances

Electronic music is, of course, much easier to perform than conventional music. As the traditional composer's efforts are concluded with the creation of a musical score, so the electronic composer's are concluded with the creation of his final mix on tape. But where the preparation of a performance of conventional music involves a long and often difficult effort to understand and render the composer's intentions into sound, the performance of electronic music is basically just running the tape.

Partly as a result, the percentage of performances of compositions completed at the Electronic Music Center is high. It is very likely that all of the works listed here have received hearings in public. Some works which combine tape with solo instruments or small instrumental ensembles are known to have had 100 or more public presentations. The United States, South America, Western Europe, Japan, Australia, New Zealand and, in isolated instances, some African countries have all had public performances of the Center's works. Careful count has not been kept. The number of radio performances can never be properly estimated; it is probable that for every performance the Center's composers know about, hundreds of performances take place on radio. TV performances are usually better accounted for, as are numerous presentations on lecture tours. It may be interesting to note that, after some 40 performances by 25 orchestras in the U.S., South America and Europe of works for orchestra and tape by Luening and Ussachevsky, these compositions are now being played by school orchestras. This reflects a growing interest in electronic music in educational circles, an interest which has been documented by letters and verbal inquiries and numerous requests for demonstrations by composers at the Center.

The Administration

The Center's administration, and its liaison with the two respective departments of music, is in the hands of Milton Babbitt of Princeton and Otto Luening and Vladimir Ussachevsky of Columbia. They serve as the Committee of Direction with Ussachevsky as Chairman

and Mario Davidovsky as Associate Director. Bülent Arel, though not a director, has always been a family member-in-fact, having created all his electronic works at the Center, and having been hired as Research Assistant to Ussachevsky, in which capacity he helped such composers as Varèse, Charles Whittenberg and Mel Powell realize their works. He also developed a method for scoring electronic music.

Davidovsky also teaches courses in electronic music at Columbia. Pril Smiley and Alice Shields, younger composers associated with the Center for eight and five years respectively, are also expert technicians. They carry the main burden of assisting the actual studio work of composers who are enrolled in two graduate courses in electronic music. Periodically, arrangements are made with other composers of several years' experience at the Center to instruct and help less experienced composers in the techniques of electronic music making. The studio at Princeton usually has a more informal arrangement with its instructors, and does not rely on long-term teaching assistants.

Mr. Mauzey, an associate of some 20 years, has his own staff of two engineering students as maintenance and laboratory technicians. The electronic sculptor, James Seawright, who was formerly a technical supervisor and teaching assistant, retains ties with the Center as a consultant. The versatile secretary is Mary Hoos. The Center misses the services of John Bittner, who was a Center technician for four years. He built much of the specialized equipment and convinced the Directors that electronic organs can be useful.

The Equipment

By 1969 the Center was able to achieve its long-term objective of operating four nearly identical studios. Each has a central mixing panel capable of handling 12 input signals, individually controlled by 12 potentiometers. Four of these potentiometers serve as master gain controls for 16 additional sub-mixer inputs, each with its own smaller knob potentiometer. Thus a maximum of 24 signals can be individually controlled. Above each of the 12 potentiometers associated with the 12 main inputs are eight switches which are used to send a signal input to one or all eight of the main outputs.

Each studio has four Ampex two-track stereo tape-recorders which are "normalled" through the first eight potentiometers. Thus straight mixing can be done without any patch-cords. There is also a four-track Ampex tape-recorder in two of the studios, and another one in the RCA Sound Synthesizer studio. Each of the four studios has from four to six sine-and-square-wave generators, and two sine-wave generators. In addition, six sine-sawtooth generators, two square-wave generators, and white and pink noise generators are available on Buchla synthesizer units.

Additional sound modifying equipment is provided by Buchla and non-Buchla devices. In the latter category each studio has two ring modulators, two electronic switches, two band-pass filters, two capstan

motor speed-control amplifiers, and an individual EMT-140 reverberation unit, remotely controlled. From Moog synthesizer modules a pair of envelope generators, envelope followers, and voltage-controlled amplifiers with power supply were selected for each studio. There are four KLH-6 loudspeakers and two Dynakit-70 Stereo amplifiers in each studio.

A Buchla synthesizer in two wooden enclosures is available for each studio. In addition to the above-mentioned generators, the synthesizer provides a signal control facility through either two touch-sensitive keyboards or two 16-position sequencers. Two dual attack generators, two dual voltage-controlled gates, two timing pulse generators, four voltage processors, ten input voltage-controlled mixers, a dual ring modulator, two six-input mixers, and a dual random voltage source complete the list of Buchla modules.

The mixing panel and all of the above units, including Buchla, are connected to a patch-panel. Three-conductor patch-cords are used. Additional units not common to all studios include a Bode frequency shifter, an Albis third-octave filter, a Spectrum third-octave filter, a Buchla voltage-controlled filter, a Pultec program equalizer, a staircase generator, a special bank of five saw-tooth generators, and a Shober tape reverberation unit. The Center also has miscellaneous portable mixers, several older professional tape recorders, microphones, etc.

The RCA Sound Synthesizer, Mark II, has been described in full detail in technical publications such as *The Journal of the Acoustical Society of America*. Briefly it can be said that, in effect, the Mark II consists of four identical synthesizer units, fusing common sound generating units and testing facilities. The synthesizer contains means for producing both sawtooth wave-forms and noise, and means for controlling their frequency, envelope, intensity and spectrum. Being especially designed for musical purposes, the synthesizer also contains a tremolo control (periodic amplitude modulation of an audio signal) and a portamento control (continuous variation of frequency). Basically, it is what is called a subtractive synthesis device. That part which is subtractive synthesis is the spectrum control section. Each of four synthesizer units constitutes one channel, which has its own octaver, envelope unit, volume control, spectrum control, tube tree and relay tree.

Two rolls of sprocket-driven paper control the four channels. The paper is perforated by a key-punch mechanism operated by the composer or by a technician who reads music or who acts under the composer's direction. A set of 40 key punches perforate the paper across its width. These perforations are used to code frequency, frequency division (octave), envelope, volume and spectrum. Each roll controls two channels, and the two paper drive units may be synchronized to run together. Therefore, four melodic lines can start and run in perfect synchronization.

The output of each of the Synthesizer's four channels is fed into an 8-channel mixer. The other four channels are reserved for the tape recorders which operate in conjunction with the synthesizer. These are a 2-track recorder using 6.35 mm. tape, and a 4-track recorder using 12.7 mm. tape. Each of these recorders is equipped with a photoelectric device which will start the paper-drive mechanism of the synthesizer automatically when a clear portion of tape passes through the device. Thus, exact synchronization is attained between the tape recorders and the synthesizer. (Likewise it is possible to start the tape recorders from the paper drives.) An operation such as combining 20 sounds, all starting at the same instant, onto a single track of the 2-track recorder is readily accomplished, and copying from the 4-track is done only once to achieve this mixture.

In 1961 the McMillin Theater was equipped with special performance facilities for electronic music presentation. A 12-input and 13-output mixing panel, which is placed in the center of the balcony, can be connected to 19 loudspeakers. There are six pairs of loudspeakers, each pair connected in parallel; one pair is mounted in each corner, and two pairs on the back wall of the theatre. The seven remaining loudspeakers are all single units, two in the ceiling, three on the stage, and one high on the wall on each side of the proscenium. Any of the 12 input signals can be sent to any of the 13 loudspeaker outputs. Thus sound rotation and, in general, flexible sound distribution, easily changeable during actual performance, can be achieved.

The Services

The Center's primary objectives, understandably, are to help composers to produce electronic music, and, whenever possible, to perform it. It has, however, performed many other tasks. For years in New York City there was hardly a performance of electronic music, including those in Lincoln Center, for which tape recorders, amplifiers and loudspeakers were not loaned by the Center. Until Moog, Buchla, and other synthesizers came into common use, Center members had been advisors to such college and university music departments as: Bennington, Brandeis, Case Institute of Technology, Illinois, Macalester, Michigan, New York, Pennsylvania, Southern Illinois, Texas, Toronto, Yale, plus the University of Amsterdam, the University of Chile, The American Academy in Rome, the Conservatory of Music in Vienna, Victoria University (New Zealand), the University of British Columbia and the Massachusetts Institute of Technology.

The Center continues to have visitors who come singly or in organized groups from clubs, colleges, secondary schools, among others. It has played host to over 200 composers among whom were: Luciano Berio, Elliott Carter, Aaron Copland, Luigi dalla Piccola, Iain Hamilton, Dimitri Kabalevsky, Toshiro Mayazumi, Edward Rubbra, Dimitri Shostakovich, Karlheinz Stockhausen, Igor Stravinsky and Edgard Varèse.

Innumerable inquiries, some only remotely related, have been answered by all members of the staff. Several encyclopedic articles, as well as articles in magazines, books, etc., originated with the members of the Committee of Direction. Between them, these composers have probably accounted for between 300 and 400 lecture-demonstrations of electronic music before college audiences, scientific societies, high school assemblies, clubs, and so forth, as well as a number of appearances abroad. All the other members of the staff and several closely associated composers have given some similar services.

The Associations

The Center's closest associations have been with the Group for Contemporary Music at Columbia, the computer centers at both universities, and the Bell Telephone Laboratories at Murray Hill, New Jersey.

Two directors of the Group, Charles Wuorinen and Harvey Sollberger, have both composed works in the electronic medium using the Center's facilities. Equally important has been the fact that the Group has introduced several works by other Center composers as part of its concert series at the McMillin Theater, and these performances were frequently repeated. The Center carried certain administrative responsibilities for the Group, and was instrumental in making possible the release of two CRI recordings by the Group, Mario Davidovsky's *SYNCHRONISMS NO. 5* and Edgard Varèse's *DESERTS* (CRI SD 268).

Electronic music bears a family resemblance to computer music; in fact there is reason to believe the next generation of electronic composers will be using digital computers instead of music synthesizers or, at least, computers to control synthesizers.

Composers directly or indirectly associated with both University Music Departments provide the closest link between electronic and computer centers. At Princeton, these include the composers James K. Randall and Godfrey Winham. Charles Dodge, a former student at the Center is now the Columbia Music Department's faculty representative at the Computer Center. More recently involved have been Barry Vercoe and Benjamin Boretz.

Until recently, neither university had the capability to convert digital tapes to analogue tapes (that is, tapes that can be listened to). The cooperation of a third agency was essential. This agency is the Bell Labs, where the association was made possible by the good will of Bell's Drs. John Pierce and Max Matthews.

Once again the relationship stems from personal rather than official beginnings. Both of Ussachevsky's computer pieces were made at the Center from materials developed with the assistance of Dr. Matthews and Richard Moore during Ussachevsky's numerous visits to Bell Labs, starting in 1968. Charles Dodge and Emanuel Ghent have realized compositions through the combined facilities of both places. Computer com-

posers at Princeton and Columbia, with or without direct association with the Center, have benefitted from the advice, meticulous published documentation, and technical experience generously made available from work accomplished in computer sound and speech synthesis at the Bell Telephone Laboratories.

The associations of the Center outside of the New York area are too numerous to list. Contact with the Groupe des Recherches Musicales and Pierre Schaeffer in Paris is always maintained; the same can be said for the California Institute of Fine Arts, the Toronto Studio in Canada, and the Studio Voor Elektronische Musiek in Utrecht, Holland. Other contacts are based more on personal friendships; of these there are many, and they cover three continents.

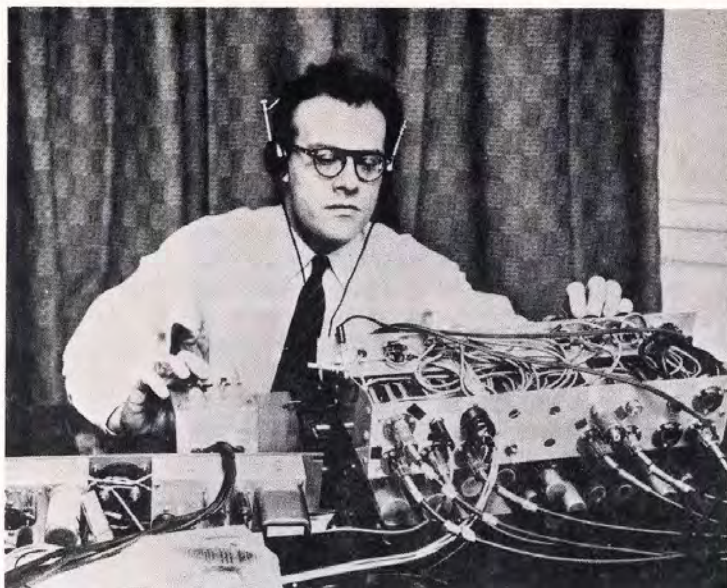
The Future

The Center has been fortunate to have had the opportunity to develop to its present function. But neither the elaborate machinery nor the expenditure would have been worthwhile had not the composing talent that it gathered together, with its variousness and acquired expertise, led to a substantial contribution to the literature of the new medium, not to mention the eye-and-ear-opening exploration of hitherto uncharted musical areas. Future plans must always take cognizance of the obvious fact that composing talent remains a studio's fundamental asset.

The end of the decade brought about acceptance of electronic music as part of the contemporary music idiom, but both the artistic climate and the environmental conditions within which serious composers can undertake to compose electronic music have changed. The Columbia-Princeton proposal to the Rockefeller Foundation of 1958 anticipated to a remarkable degree the evolutionary path of the composer's technological progress: from manual craftsmanship with tape to the present use of the synthesizer and toward an increasing use of the computer. What the report did not foresee was the suddenness with which electronic music would become a prey of commercial exploitation and a desirable adjunct in education, all the way down to the elementary school level.

Technology will continue to present composers with an ever-increasing range of possibilities. Work with the computer promises a continuous improvement of techniques for sound synthesis, for programmed manipulation of analogue material converted into digital form, and computer control of characteristic synthesizer analogue modules. The Center, as its fluctuating budget permits, will explore and adopt technological innovations that it considers important for composers.

One should look to the future, not forgetting that there is much to be learned from the past. To quote J. K. Randall, "To contend that the past is dead is to advocate that we kill some part of our own imagination."



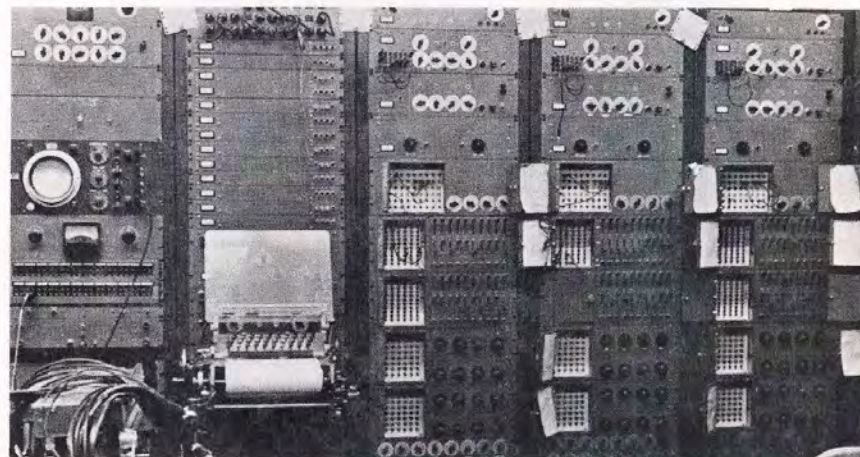
Vladimir Ussachevsky with early set-up (1953)



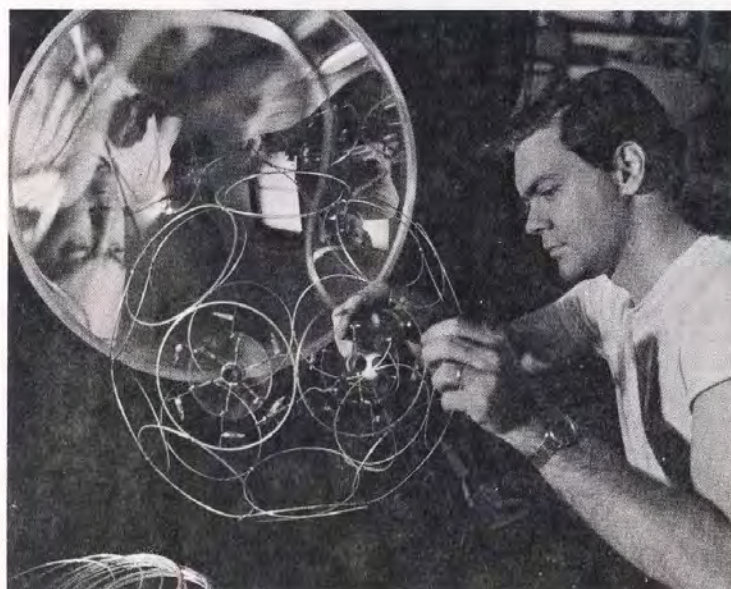
Otto Luening in 1957 studio



Ussachevsky and Peter Mauzey (1958)



RCA Sound Synthesizer, Mark II.



James Seawright

photo by Peter Moore



Electronic Music Center staff

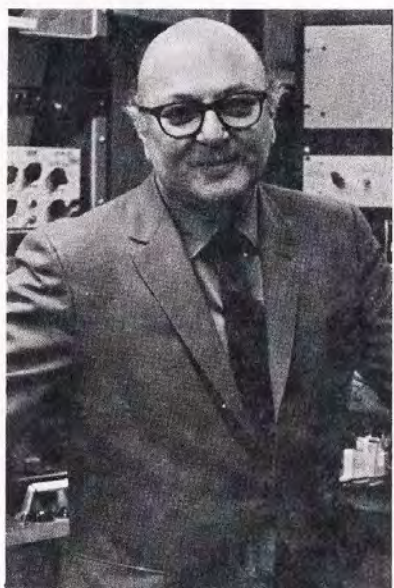
photo by vernon L. Smith



Milton Babbitt



Princeton studio with Gerald Warfield



Bülent Arel photo by Emanuel Brasil



Mario Davidovsky photo by Emanuel Brasil



Alice Shields photo by Emanuel Brasil



Pril Smiley photo by Emanuel Brasil

THE COMPOSERS AND STAFF

OTTO LUENING

Otto Luening was born in Milwaukee, Wisconsin, in 1900. He heard about electronic sound as a possible compositional tool from Ferruccio Busoni, with whom he was studying in Zurich in 1918.

Luening's career has been distinguished by his diversified activities. He has been or still is active as flutist, opera and orchestra conductor, accompanist, and Professor of Composition at Columbia, where he is now member of the Division of Music in the School of the Arts. He is a member of the National Institute of Arts and Letters, a Trustee of the American Academy in Rome and is a member of the Educational Advisory Board of the Guggenheim Foundation.

Since 1952 he has been an active pioneer in the field of tape and electronic music, often in collaboration with Vladimir Ussachevsky.

Luening's more than 300 works in other categories include much chamber music, symphonic works, an opera EVANGELINE, piano music, songs and choral works. His compositions have been played throughout the world by such orchestras as the New York Philharmonic, Los Angeles Philharmonic, Chicago, St. Louis, Mexico City, Montevideo, and the Haarlem Orchestra of Holland.

MILTON BABBITT

Milton Babbitt was born May 10, 1916 in Philadelphia, Pa. He was educated in the public schools of Jackson, Mississippi, New York University (B.A.), and Princeton University (M.F.A.). Honorary degrees: Middlebury College (D.M.); New York University (D.M.); Swarthmore (D.M.). He studied composition with Roger Sessions.

He has been a member of the Department of Music, Princeton University since 1938. At present, he is William Shubael Conant Professor of Music. He was a member of the Department of Mathematics, Princeton University, 1943-45.

He was a member of the faculty, Salzburg Seminar in American Studies, 1952; member of the Composition Faculty, Berkshire Music Center (Tanglewood), 1957, 1958; faculty member, Princeton Seminar in Advanced Musical Studies, 1959, 1960; member of the Composition Faculty, Darmstadt Summer Course, Darmstadt, Germany, 1964; Composer in Residence, New England Conservatory, Castle Hill, Massachusetts, 1968.

He is a member of the Editorial Board, *Perspectives of New Music*, and a member, National Institute of Arts and Letters. He has made intensive use of the RCA Music Synthesizer at the Electronic Music Center, resulting in the compositions VISION AND PRAYER (soprano and synthesized sound), PHILOMEL (soprano, recorded soprano and synthesized accompaniment), COMPOSITION FOR SYNTHESIZER and ENSEMBLES for synthesizer, CORRESPONDENCES for string orchestra and synthesizer and OCCASIONAL VARIATIONS for synthesizer (1971).

VLADIMIR USSACHEVSKY

Vladimir Ussachevsky was born October 21, 1911, in Hailar, Manchuria, of Russian parents. He came to the United States in 1931. He studied composition with Bernard Rogers and Howard Hanson at the Eastman School of Music, and with Otto Luening. He joined the faculty of Columbia University in 1947, and now has the rank of Professor of Music.

Prior to 1951 Ussachevsky wrote a number of compositions for conventional instruments, ranging from piano pieces to a large work for orchestra and chorus. He began to experiment with tape-recorded sounds in the fall of 1951 without any previous knowledge of the work of the *musique concrète* group in Paris. A period of collaboration with Otto Luening resulted in three joint works for tape recorder and orchestra, a score for Orson Welles' production of KING LEAR and several tape pieces.

Among his individual works from that period SONIC CONTOURS, PIECE FOR TAPE RECORDER and LINEAR CONTRASTS are best known. Among the works produced since that year he ranks as his best efforts CREATION-PROLOGUE for multiple choruses and electronic accompaniment on tape, OF WOOD AND BRASS for tape alone, and film scores for George Tabori's screen adaptation of Jean Paul Sartre's play NO EXIT and LINE OF APOGEE, a surrealist film by Lloyd Williams, and a background score for a play, WE—a CBC Radio production.

He has written a number of articles on electronic music and lectured in over 150 colleges and universities in the United States, as well as in Great Britain, France, Yugoslavia, Soviet Union, Venezuela, Chile, Peru, Brazil and Argentina. He has served as an American delegate to the First Congress of Experimental Music in Paris, 1953; to an International Conference on Music in Caracas, Venezuela, in 1966 and again in 1969 to the Inter-American Music Festival in Rio de Janeiro, Brazil.

BÜLENT AREL

Bülent Arel was born in Istanbul, Turkey in 1919. He attended the state conservatory of Ankara, where he graduated in 1947 with a diploma in composition, piano, and conducting. He taught harmony and counterpoint in the same conservatory, and piano and history of music at the teachers college in Ankara. He was one of the founders of the Helikon Society of Contemporary Arts, and was the regular conductor of the Helikon Chamber Orchestra for four years.

He studied sound engineering in 1951 in Ankara under Jozé Bernard and Willfried Garret of the Radio Diffusion Francaise, both members of the Club d'Essai of Paris. This collaboration marked the start of his interest in *musique concrète*, which later led him to electronic music. From 1951 until 1959 he worked at Radio Ankara, as a "tonmeister" and recording engineer and then as the Musical Director. In 1958 he pio-

neered in the field of electronic music combined with conventional instruments, with *Music for String Quartet and Oscillator* (revised at the Columbia-Princeton Center in 1962 as *Music for String Quartet and Tape*).

In 1959 he came to the United States as the recipient of a Rockefeller Research Grant for work at the Columbia-Princeton Electronic Music Center. He remained in the United States until 1963, working at the Center as an assistant to Vladimir Ussachevsky and, during 1961-1962, as Lecturer at Yale University, where he installed an electronic music studio.

From 1963 to 1965 he was again in Turkey, heading the Ankara State Radio middle-wave music programs and founding and directing a Madrigal Chorus for the State Radio. He also composed the score for a musical which ran in Istanbul for over a year.

Since July 1965 he has been a member of the music faculty of Yale University, and in July 1969 he became Associate Professor and Director of the Electronic Music Studio. He has been appointed Professor of Music and Director of the Electronic Music Studio which he is designing and installing at the State University of New York at Stony Brook, Long Island.

He has composed symphonic works, including a *Short Piece for Orchestra* (1967) commissioned by the New Haven Symphony, and chamber works including *For Violin and Piano* (1966), which is recorded on CRI SD 264.

His electronic works are *SHORT STUDY*, stage music for "The Scapegoat"; *ELECTRONIC MUSIC NO. 1. IMPPRESSIONS OF WALL STREET*; *MUSIC FOR A SACRED SERVICE* (Prelude and Postlude); *STEREO ELECTRONIC MUSIC NO. 1* (five-channel and two channel versions) recorded on Columbia MS 6566; *MUSIC FOR STRING QUARTET AND TAPE*; *MIMIANA I* (music for dancers and film); *MIMIANA II* (music for dance); *CAPRICCIO FOR T.V.* (music for film), and *STEREO ELECTRONIC MUSIC NO. 2*.

MARIO DAVIDOVSKY

Mario Davidovsky was born in Argentina in 1934, and has lived in New York since 1960. He is presently Associate Director of the Columbia-Princeton Electronic Music Center, and Associate Professor of Music at CCNY. He is a winner of numerous awards and fellowships including: American Academy of Arts and Letters; Brandeis University Creative Arts Award; Aaron Copland-Tanglewood Award; two Guggenheim Fellowships; two Rockefeller Fellowships, and the Pulitzer Prize. He has won numerous national and international prizes for orchestral and chamber compositions and has received numerous commissions from, among others, the Koussevitzky Foundation of the Library of Congress, the Fromm Foundation, the Pan-American Union.

PRIL SMILEY

Pril Smiley was born at Mohonk Lake, N. Y. in 1943. She studied composition with Henry Brant, Louis Calabro, and Vivian Fine at Bennington College from which she graduated in 1965. She came to the Columbia-Princeton Electronic Music Center in 1962 and by

1965 was a full-time technician and composer at the Center.

Her first electronic composition, *ECLIPSE*, was a winner of the Dartmouth Arts Council Prize in 1968—the First International Electronic Music Competition. She has been Electronic Music Consultant for the Lincoln Center Repertory Theatre since 1968 and writes electronic music for many of their productions in addition to doing free-lance work for other theatres and film productions.

ALICE SHIELDS

Alice Shields was born in New York City in 1943. She studied composition at Columbia University with, primarily, Vladimir Ussachevsky and Otto Luening, and earned a B.S. and M.A. Among the performances of her music have been *SPRING MUSIC* for soprano, trumpet, and oboe, performed at Town Hall in 1967; *STUDY FOR VOICE AND TAPE*, played at the League-ISCM concert in April, 1968 in New York; *DOMINO* (electronic music for dance) commissioned by the Mimi Garrard Dance Theater, performed at the Henry Street Playhouse in 1967, with several performances since then. She is now completing a chamber opera called *ODYSSEY* which was performed in a piano and percussion version at the Lake George Opera Festival in August, 1970 with the aid of a Presser Foundation grant.

She is at present a teaching assistant in electronic music at Columbia University, and a professional singer.

PETER MAUZEY

Peter Mauzey was born in Poughkeepsie, N. Y. He received the B.S. degree in electrical engineering in 1952 from Columbia University and taught at Columbia from 1952 to 1962. During that period, he received the M.S. degree in 1954 and the E.E. degree in 1958.

He has been a consultant to the Columbia Music Department since 1950 and was director of engineering of the Electronic Music Center until 1962. He is presently a member of the technical staff of Bell Telephone Laboratories. He is a member of the Acoustical Society of America, the Audio Engineering Society, the Institute of Electrical and Electronics Engineers, and the Society of Motion Picture and Television Engineers.

JAMES SEAWRIGHT

James Seawright has had one-man exhibitions of his electronic sculptures in 1966, 1968, and 1970, and has had his work in numerous museum shows. In 1970, he was awarded a fellowship from the Graham Foundation for Advanced Studies in the Fine Arts. He is currently a visiting lecturer and sculptor at Princeton University. He was born in Jackson, Mississippi in 1936. He graduated from the University of Mississippi in 1957 and studied with José De Creeft at the Art Students' League of New York during 1961-62. He was assistant to the choreographer Alwin Nikolais, following which, in 1963, he came to the Columbia-Princeton Electronic Music Center. He remains a part-time consultant with the Center.

COMPOSITIONS CREATED AT THE CENTER

RECORDED

- ANHALT, ISTVAN (Canada)
Electronic Composition No. 4 (1961)
- APPLETON, JON (USA)
Study No. 3 (1965)
Infantasy (1965) Flying Dutchman 103
Georganna's Fancy (1966) Flying Dutchman 103
Columbia Etude No. 1 (1966)
- AREL, BULENT (Turkey)
Electronic Music No. 1 (1960) Son Nova 1988
Stereo Electronic Music No. 1 (1960)
Columbia: ML5966, MS6566
The Scapegoat (theatre) (1960-1)
Fragment from "The Scapegoat"
(1961) Son Nova 1988
Wall Street Impressions (film) (1960-1)
The Scapegoat Suite (1961)
Short Electronic Study (1961)
Sacred Service: Prelude and Postlude
(1961) Son Nova 1988
Music for String Quartet and Electronic
Sound (second version) (1962)
Flux (Mimiana I) (film and dance score) (1968)
Frieze (Mimiana II) (1969)
Capriccio for TV (1969)
Medium is the Medium (film) (1969)
Stereo Electronic Music No. 2 (1970) CRI SD 268
- AVNI, TZVI (Israel)
Vocalise (1964) Turnabout TV4004
TV34004S
- BABBITT, MILTON (USA)
Composition for Synthesizer
(1960-1) Columbia: ML5966, MS6566
Vision and Prayer
for soprano and synthesized
accompaniment (1961) CRI SD 268
Ensembles for Synthesizer
(1962-4) Columbia MS7051
Philomel AR 1
for soprano, recorded soprano, and
synthesized tape (1963)
Correspondences for String Orchestra
and Synthesized Tape (1968)
Occasional Variations (1970)
- BEECROFT, NORMA (USA)
From Dreams of Brass
for narrator, solo soprano, mixed
chorus, orchestra and tapes (1964)
- BERIO, LUCIANO (USA)
Laborintus II
per mimi, recitanti, in sieme vocale,
orchestra da camera e nastro magnetico (1962)
- BETJEMAN, PAUL (England)
Six Breaths, for electronic sounds
and soprano (1969)
Fat Cat, three movements for
forty-one sounds (1970)
- BOUTILIER, THOMAS (USA)
Masks (ballet) (1966)
Pococurante (ballet) (1967)
- Concrete sounds for "Tongues of Fire"
(ballet) (1968)
Homunculus (ballet) (1968)
Concrete sounds for "The Clowns"
(ballet) (1969)
Prelude and Entracte for "The Poppet"
(ballet) (1969)
- CARLOS, WALTER (USA)
Composition for Four Loudspeakers (1963)
Dialogues, for piano and two
loudspeakers (1963)
Sacred Sonorities (1963)
Variations, for flute and electronic
sounds (1964) Turnabout
TV4004, TV34004S
Image, for instruments and tape (film) (1964)
Epitaph for Man (with narrator) (1964)
Noah, for voices, chamber orchestra
and tape (opera) (1965)
Pomposities (with narrator) (1965)
- DAVIDOVSKY, MARIO (Argentina)
Electronic Study No. 1 (1960) Columbia: ML5966,
MS6566
Electronic Study No. 2 (1962) Son Nova 1988
Synchronisms No. 1, for flute and
electronic sounds (1963) CRI SD 204
Contrastes No. 1, for string orchestra
and tape (1964)
Synchronisms No. 2, for flute, violin, cello, clarinet
and electronic sounds (1964) CRI SD 204
Synchronisms No. 3, for cello and
electronic sounds (1964-5) CRI SD 204
Electronic Study No. 3 (1965-6)
Synchronisms No. 4—Psalm No. 70,
for boys' or mixed chorus and tape (1966-7)
Synchronisms No. 5, for five
percussionists and tape (1970) CRI SD 268
Synchronisms No. 6, for piano and tape (1970)
- DEL MONACO, ALFREDO (Venezuela)
Electronic Study No. 2 (1970)
Three Choreographic Pieces for
Sonia Sanojã (dance) (1970)
- DODGE, CHARLES (USA)
A Composition for Converted Digital Tape
(computer piece) (1967)
†Changes (computer piece) (1970) Nonesuch 71245
†Earth's Magnetic Field (computer piece)
(1970) Nonesuch 71250
- DRUCKMAN, JACOB (USA)
Animus I, for trombone and tape
(1966) Turnabout 34177
Animus II, for mezzo soprano, two
percussion players, and tape (1967) CRI SD 255
Animus III, for clarinet and tape
(1969) Nonesuch: H-71253
Look Park (film) (1969)
Orison, for organ and tape (1970)
Traité du Rossignol (film) (1970)
Synapses (four track electronic)
(1970) Nonesuch H-71253
- DUGGER, EDWIN (USA)
Three Pieces, for six instruments and
synthesizer (1966)
†Partial use of C-PEMC facilities.

EL-DABH, HALIM (Egypt)
 Leilya and the Poet (1961) Columbia: ML5966,
 MS6566

EL-DABH and LUENING

Electronic Fanfare, for percussion, recorder,
 and synthesized sounds (1960)
 Percussive Mixtures (1961)
 Diffusion of Bells (1961)

EZAKI, KENJIRO (Japan)

Electronic Music 225 (1966)
 Fantasy (1966)
 Metamorphism of One Short Attack (1966)
 Study of Orchestra, Voices, and
 Electronic Sound (1966)
 Gagaku (1966)
 Electronic Music 402 (1966)
 Meiso No. 1 (1966)
 Meiso No. 2 (1966)
 Electronic Music 313 (1966)
 Subway in New York (1966)
 Piece for Orchestra and Electronic Sound (1967)
 Undine (ballet) (1967)

FINNEY, ROSS LEE (USA)

Still Are New Worlds, for narrator, chorus,
 orchestra and tape (1963)
 Three Pieces, for strings, winds, percussion,
 and tape recorder (1963)

FRIEDMAN, GARY (USA)

Suite from Macbeth (theatre) (1966)
 Music for Art (1966)
 Dream (theatre) (1966)
 Concerto for alto saxophone and tape (1967)

GHENT, EMMANUEL (USA)

Triality I and II, for violin, trumpet, bassoon
 and coordinating signal tracks on magnetic
 tape (1964)

Dithyrambos, a brass quintet with coordinating
 signal tracks on magnetic tape (1965)

*Hex, An Ellipsis for Trumpet, 11 Instruments
 and Tape (1966)

**Helices, for violin, piano and tape (1968)

**Danger: High Voltage (1969)

**Battery Park (1969)

*Lady Chatterly's Lover (1969)

*Galloping Pentagonism is a Condition Marked by
 Bouts of Delirium and Disorientation (1970)

*L'Après-midi d'un Summit Meeting (1970)

*Our Daily Bread (1970)

GOLDSTEIN, MALCOLM (USA)

Lamentations of Jeremiah, a theatre cantata
 for dancers, soprano, and electronic tape (1962)

It seemed to me . . . (ballet) (1963)

Ludlow Blues, for flute, alto sax, trombone,
 and tape (1963)

Judson No. 6 Piece (1963)

HELLERMANN, WILLIAM (USA)

Ariel (1967)

Ek-Stasis (1968)

Mai 1968 (theatre) (1969)

HOWE, HUBERT (USA)

Composition for Two Speakers (1965-6)

Computer Variations (1967)

*composed at C-PEMC and RA Moog Studio,
 Trumansburg, N. Y.

**composed at C-PEMC and Bell Telephone
 Laboratories, Murray Hill, N. J.

KIMMEL, WALTER (USA)

Cronaca (1967)

Hide and Seek (1968)

KRAFT, LEO (USA)

Fyre and Yse, for mixed chorus and tape (1967)

Dialogues for Flute and Tape (1968)

LANZA, ALCIDES (Argentina)

Exercise I (1965)

Plectros II, for piano and electronic

sounds (1966) Jornadas de Musica

Experimental: JME ME 1-2

Interferences I, for two groups of wind
 instruments and electronic sounds (1966)

Kromoplastics (for an exhibition) (1966)

Interferences II, for percussion ensemble
 and electronic sounds (1967)

Two times too (film) (1967)

Strobo I, for double bass, miscellaneous
 percussion instruments, lights, audience
 participation and electronic sounds (1967)

Ekphonesis II, for voice, piano, and
 electronic sounds (1968)

Out of . . . (1969)

Penetrations I (for light and sound event) (1969)

Ekphonesis III, for any three instruments, with
 voice, lights, electronic extensions, and
 electronic sounds (1969)

Penetrations II, for winds, strings, percussion
 and keyboard instruments, voices, lights,
 electronic sounds, and electronic
 extensions (1969) Mainstream: to be released

Penetrations IV (1970)

kron'ikelz, 70, for two choruses, two narrators,
 orchestra, and electronic sounds (1970)

Penetrations V, for a minimum of ten sound
 sources, with voices, lights, electronic sounds,
 and electronic extensions (1970)

Electronic Music for Children (1970)

LEWIN-RICHTER, ANDRES (Spain)

The Gondola Eye (film) (1963)

Sublimated Birth (film) (1963)

Electronic Study No. 1 (1964) Turnabout TV4004
 TV34004S

Electronic Study No. 2 (1965)

LUENING, OTTO (USA)

Invention in 12 Notes (1952) Desto: DC 6466

Low Speed for Tape Recorder (1952)

Fantasy in Space (1952) Folkways: FX6169

Theatre Piece No. 11 (ballet) for tape, piano,
 soprano, narrator, percussion and wind
 instruments (revision of "Opening" 1965)
 (1956)

Dynamophonic Suite (1958)

Gargoyles, for violin solo and synthesized
 sounds (1960) Columbia: ML5966, MS6566

A Day in the Country, for violin and tape
 recorder (1961)

Study in Synthesized Sounds (1961)

Synthesis, for orchestra and electronic
 sound (1962) CRI SD 227

Sonority Canon (1962)

Moonlight, for tape recorder (1968) Desto: DC 6466

Theatre Piece No. 11—Introduction
 (1970) CRI SD 268

LUENING and USSACHEVSKY

Incantation (1953) Desto: DC 6466

Rhapsodic Variations, for tape recorder
 and orchestra (1953-4) Louisville: Lou 545-5

- Of Identity (ballet) (1954)
 A Poem in Cycles and Bells, for tape recorder and orchestra (1954) CRI 112
 Carlsbad Caverns (TV) (sequence for "Wide, Wide World") (1955) RCA-Victor: LPM 1280
 King Lear (theatre) (expanded version 1966) (1956)
 Suite from King Lear (1956) CRI 112
 Mathematics (TV) (1957)
 Back to Methuselah (Theater) (1958)
 Concerted Piece, for tape recorder and orchestra (1960) CRI SD 227
 Incredible Voyage (with assistance of Shields & Smiley) (TV film 1968)
- MAAYANI, AMI (Israel)
 Microtonus (1965)
 The Frame (film) (1965)
- MAC INNIS, DONALD (USA)
 Intersections, for tape recorder and orchestra (1963)
- MAKSIMOVIC, RAJKO (Yugoslavia)
 Two Basho's Haiku, for female voice, flute, violin, piano and tape (1966)
- MIMAROGLU, ILHAN (Turkey)
 Four the News (1963-64)
 (Visual Study No. 1 after Jasper Johns)
 Green on a Black (1964)
 (Visual Study No. 2 after Ahmet Gursoy)
 Nocturne, for strings and tape (1964)
 Bowery Bum (1964) Turnabout TV 34004S
 (Visual Study No. 3 after Jean Dubuffet)
 Le Tombeau d'Edgar Poe
 (1964) Turnabout TV 34004S
 Intermezzo (1964) Turnabout TV 34004S
 Anacolutha (1965)
 Transitive I (1965)
 Agony (1965) Turnabout TV 34046S
 Transitive II (1966)
 Sodome et Gomorrhe (1966)
 (Music for Jean Giraudoux's play)
 White Cockatoo (1966)
 (Visual Study No. 5 after Jackson Pollock)
 Parmak Cocuk (1966-67) Ezgi 33-109
 (Music for a children's record)
 Fondation Maeght (1966-67)
 (Film music)
 Twelve Preludes for Magnetic Tape
 (1966-67) Turnabout TV 34177S
 Piano Music for Performer and Composer
 (1967) Turnabout TV 34177S
 Preludes Nos. 2 and 12 (Second versions for the film "Fellini Satyricon") (1969)
 Wings of the Delirious Demon (1969)
 Music Plus One, for violin and tape
 (1970) Turnabout (to be released)
 Sing Me a Song of Songmy
 (1970) Atlantic SD 1576
 (for magnetic tape with pre-recorded jazz quintet, reciters, string orchestra, Hammond organ and chorus)
- NIKOLAIS, ALWIN (USA)
 †Totem—The World of Nikolaïs (ballet-film) (1962)
 †Sanctum (ballet) (1964)
 †A Gothic Tale (ballet) (1964)
 †Galaxy (ballet) (1965)
 †Vaudeville of the Elements (ballet) (1965)
- NIKOLAIS and SEAWRIGHT
 Imago (ballet) (1963)
- OBRADOVIC, ALEKSANDER (Yugoslavia)
 Mikro-simfonija, for orchestra and tape (1968)
- PINILLA, ENRIQUE (Peru)
 Prisma (1967)
- POWELL, MEL (USA)
 Electronic Setting I (1961)
- ERIC SALZMAN (USA)
 Nude Paper Sermon Nonesuch 71231
- SHIELDS, ALICE (USA)
 Domino (dance 1967)
 Witches Scenes from Macbeth (1967)
 Barabbas (theater 1968)
 Walking on the Surface of the Sun (1966)
 Electronic Music for the Ghost scenes in Hamlet (1967)
 Study for Voice and Tape (1969)
 The Transformation of Ani (1970) CRI SD 268
- SMILEY, PRIL (USA)
 Macbeth (theater 1966)
 Can you hear me? (TV 1967)
 Richard III (theater 1967)
 The Balcony (theater 1967)
 Eclipse (four electronic tracks 1967) Turnabout 34301
 St. Joan (theater 1968)
 Tiger at the Gates (theater 1968)
 Richard III (theater 1968)
 Elephant Steps (occult opera 1968)
 King Lear (theater 1968)
 Incredible Voyage (TV film 1969)
 Bananas (theater 1969)
 Satyricon (theater 1969)
 Inner Journey (theater 1969)
 The Increased Difficulty of Concentration (theater 1970)
 Operation Sidewinder (theater 1970)
 Kolyosa (1970) CRI SD 268
 The Trip (film 1970)
- SMITH, WILLIAM O. (USA)
 Improvisation for clarinet and recorded clarinet (1960)
- SOLLBERGER, HARVEY (USA)
 Antigone (theater) (1966)
 Antigone (concert version for actor and tape 1966)
- SWICKARD, RALPH (USA)
 Electronic Study No. 1 (1964)
- TOYAMA, MICHIKO (Japan)
 Waka, for speaking voice and tape (1959) Folkways: FW 8881
- USSACHEVSKY, VLADIMIR (USA)
 Transposition, Reverberation, Experiment, Composition (1951-2) Folkways: FX 6169
 Underwater Valse (1952) Folkways: FX 6169
 Sonic Contours (1952) Desto: DC 6466
 To Catch A Thief (film 1954—sound effects only)
 Piece for Tape Recorder (1956) CRI 112
 Metamorphoses (1957) Son Nova 1988
 Improvisation 4711 (1958) Son Nova 1988
 Linear Contrasts (1958) Son Nova 1988
 Studies in Sound, Plus (1959)
 The Boy Who Saw Through (film) (1959)
 Wireless Fantasy (originally De Forrest Murmurs) (1960) CRI SD 227
 Creation Prologue, for four choruses and electronic accompaniment (1960-1) Columbia: ML5966, MS6566

- No Exit (film) (1962)
 Scenes from No Exit, for speaking voice
 and taped sounds (1963)
 Of Wood and Brass (1964-5) CRI SD 227
 Mourning Becomes Electra (Sound effects
 for Marvin Levy's opera 1967)
 Line of Apogee (with assistance of
 Shields & Smiley) (film) (1967)
 Suite from Music for Films (1967)
 **Piece for Computer (1968)
 Incidental music to "The Cannibals" (1969)
 American Theatre Production
 Two Images for the Computer Piece (film) (1969)
 Duck, Duck (film 1970),
 We, CBC Radio play,
 (with assistance of Shields 1970)
 produced by Robert Chesterman
 **Two Sketches for Computer Piece No. 2
 (1971) CRI SD 268
 VALCARCEL, EDGAR (Peru)
 Cantata, for chorus and tape (1967)
 Invención, para sonidos electronicos (1967)
 VARÈSE, EDGARD (USA)
 Déserts, for wind, percussion, and magnetic
 tapes (definitive version or organized
 sound done at Columbia-Princeton
 Electronic Music Center with assistance
 of Arel)
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 CRI SD 268
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COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER

TENTH ANNIVERSARY ALBUM

Edgard Varèse: DÉSERTS (1954-1961)

with newly-realized version of organized sound

Group for Contemporary Music at Columbia University,
Charles Wuorinen, conductor

Otto Luening: IN THE BEGINNING from THEATER PIECE No. 2 (1956)

Milton Babbitt: VISION AND PRAYER (1961)

Bethany Beardslee, soprano

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Mario Davidovsky: SYNCHRONISMS No. 5 (1969)

Ray Des Roches, Richard Fitz, Claire Heldrich, Donald Marcone,
Howard Van Hyning, percussion; Harvey Sollberger, conductor

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CRI SD 268

I

Who
Are you

Who is born
In the next room
So loud to my own
That I can hear the womb
Opening and the dark run
Over the ghost and the dropped son
Behind the wall thin as a wren's bone? And the midwives of miracle sing
In the birth bloody room unknown
To the burn and turn of time
And the heart print of man
Bows no baptism
But dark alone
Blessing on
The wild
Child.

I

Must lie

Still as stone
By the wren bone
Wall hearing the moan
Of the mother hidden
And the shadowed head of pain
Casting to-morrow like a thorn
Until the turbulent new born
Burns me his name and his flame
And the winged wall is torn
By his torrid crown
And the dark thrown
From his loin
To bright
Light.

When

The wren
Bone writhes down
And the first dawn
Furied by his stream
Swarms on the kingdom come
Of the dazzler of heaven
And the splashed mothering maiden
Who bore him with a bonfire in
His mouth and rocked him like a storm
I shall run lost in sudden
Terror and shining from
The once hooded room
Crying in vain
In the caldron
Of his
Kiss

In

The spin
Of the sun
In the spuming
Cyclone of his wing
For I was lost who am
Crying at the man drenched throne
In the first fury of his stream
And the lightnings of adoration
Back to black silence melt and mourn
For I was lost who have come
To dumbfounding haven
And the finding one
And the high noon
Of his wound
Blinds my
Cry.

There

Crouched bare
In the shrine
Of his blazing
Breast I shall waken
To the judge blown bedlam
Of the uncaged sea bottom
The cloud climb of the exhaling tomb
And the bidden dust upsailing
With his flame in every grain.
O spiral of ascension
From the vultured urn
Of the morning
Of man when
The land
And

The

Born sea
Praised the sun
The finding one
And upright Adam
Sang upon origin!
O the wings of the children!
The woundward flight of the ancient
Young from the canyons of oblivion!
The sky stride of the always slain
In battle! the happening
Of saints to their vision!
The world winding home!
And the whole pain
Flows open
And I
Die.

II

In the name of the lost who glory in
The swinish plains of carrion
Under the burial song
Of the birds of burden
Heavy with the drowned
And the green dust
And bearing
The ghost
From
The ground
Like pollen
On the black plume
And the beak of slime
I pray though I belong
Not wholly to that lamenting
Brethren for joy has moved within
The inmost marrow of my heart bone

That he who learns now the sun and moon
Of his mother's milk may return
Before the lips blaze and bloom
To the birth bloody room
Behind the wall's wren
Bone and be dumb
And the womb
That bore
For
All men
The adored
Infant light or
The dazzling prison
Yawn to his upcoming.
In the name of the wanton
Lost on the unchristened mountain
In the centre of dark I pray him

That he let the dead lie though they moan
For his briared hands to hoist them
To the shrine of his world's wound
And the blood drop's garden
Endure the stone
Blind host to sleep
In the dark
And deep
Rock
A wake
No heart bone
But let it break
On the mountain crown
Unbidden by the sun
And the beating dust be blown
Down to the river rooting plain
Under the night forever falling.

Forever falling night is a known
Star and country to the legion
Of sleepers whose tongue I toll
To mourn his deluging
Light through sea and soil
And we have come
To know all
Places
Ways
Mazes
Passages
Quarters and graves
Of the endless fall.
Now common lazarus
Of the charting sleepers prays
Never to awake and arise
For the country of death is the heart's size

And the star of the lost the shape of the eyes.
In the name of the fatherless
In the name of the unborn
And the undesirers
Of midwiving morning's
Hands or instruments
O in the name
Of no one
Now or
No
One to
Be I pray
May the crimson
Sun spin a grave grey
And the colour of clay
Stream upon his martyrdom
In the interpreted evening
And the known dark of the earth amen.

I turn the corner of prayer and burn
In a blessing of the sudden
Sun. In the name of the damned
I would turn back and run
To the hidden land
But the loud sun
Christens down
The sky.
I
Am found.
O let him
Scald me and drown
Me in his world's wound.
His lightning answers my
Cry. My voice burns in his hand.
Now I am lost in the blinding
One. The sun roars at the prayer's end.

CRI SD 268

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**Ray Des Roches, Richard Fitz, Claire Heidrich, Donald Marcone, Howard Van
Hynning, percussion; Harvey Sollberger, conductor**

DÉSERTS is the first large work using electronically recorded sounds composed by a man who has since become a major prophet of electronic music. Varèse began to gather and process the sounds as soon as he could find equipment capable of doing the job, and completed it during 1954 at the studios of the French Radio, upon the invitation of one of the pioneers in the field, Pierre Schaeffer.

The world premiere was given by Hermann Scherchen and the Orchestre Nationale, Paris, December 2, 1954. The interpolations of organized sound were revised with the technical assistance of Bülent Arel in 1961 at the Columbia-Princeton Electronic Music Center. A new master was prepared especially for this recording by Mr. Arel.

DÉSERTS consists of four instrumental sections and three interpolations of organized sound. In Varèse's own words: "The music given to the instrumental ensemble may be said to evolve in opposing planes and volumes, producing the sensation of movement in space." The mutation and movement of these "planes and volumes" are defined by intervals that are "not based on any fixed set ... such as a scale, a series," but "determined by the exigencies of this particular work." The interpolations are "based on what may be called raw sounds (friction, percussion, hissing, swishing, grinding, puffing)," electronically processed and then composed "to fit the pre-established plan of the work." Instrumental sounds, both new and quotes from the instrumental sections are electronically "combined with these sounds as a structural and stabilizing element."

As for the title, DÉSERTS, Varèse wrote:

"I had in mind not only all physical deserts (of sand, sea and snow, of outer space, of empty city streets) but also the deserts in the mind of man: not only those stripped aspects of nature that suggest barrenness, aloofness, timelessness, but also that remote *inner* space no telescope can reach, where man is alone, a world of mystery and essential loneliness."

EDGARD VARÈSE was born in Paris on December 22, 1883 and died in New York, where he lived most of his life, on November 6, 1965. He studied with Vincent d'Indy, Albert Roussel and Charles Widor. As a young composer he was befriended by Debussy, Richard Strauss and Ferruccio Busoni. Even as a student, he "began to think of music as spatial — as bodies of intelligent sounds moving freely in space" and conceived the idea of liberating music from the tempered scale and the limitations of musical instruments. In 1913 he met René Bertrand, from whom he later learned about the possibilities of electronics as a musical medium. As early as 1916, shortly after his arrival in New York, he said: "Our musical alphabet must be enriched. We also need new instruments . . . new mediums of expression."

During the next decade or so, however, he was preoccupied with composing, conducting and directing the International Composers' Guild, which he founded in 1921 and which, during its six years of existence, gave world or American premieres of works by over fifty composers, among them Berg, Hindemith, Schoenberg, Stravinsky and Webern. Immediately after the closing of the Guild, he began discussing with Bertrand and Harvey Fletcher, then Acoustical Research Director of the Bell Telephone Laboratories, the possibilities of developing an electronic instrument for composing, but failed to gain any financial support for it. Meanwhile he worked on several projects, none completed, involving ideas that would require electronic means for their realization. Although Leon Theremin built to his specifications two instruments for *Ecuatorial* in 1933, it was not until twenty years later that he wrote his first electronic composition, the interpolations for DÉSERTS.

Nevertheless, in conceiving music as sound organized yet set free, he made wholly original contributions and opened up new horizons, not in the '50s with his electronic works, but in the '20s and '30s with his works for conventional instruments. Thus, he anticipated today's musical developments by over a quarter-century.

Aside from DÉSERTS he produced two other electronic works, *Poème Electronique*, for presentation at the Brussels World's Fair of 1958 in the Philips Pavilion designed by Le Corbusier, and the "electronically organized sound" for the *Good Friday Procession in Verges* sequence in the film, *Around and About Juan Miró* (1956) by Thomas Bouchard.

—Chou Wen-chung

THEATER PIECE No. 2 was commissioned for Humphrey-Limon by the Juilliard Musical Foundation for the Festival of American Music in celebration of the founding of Juilliard School of Music.

The opening of the ballet, "In the Beginning", expressed the contrast of the inchoate world and the emerging human element by juxtaposing a human voice against the electronic sound. In the original production, lights, movement and mobiles on stage added to the theatrical counterpoint.

Three components are used in the work: electronic sound, instrumental sounds manipulated on tape, and a human voice recorded. The electronic sounds were made during a short visit at the Cologne Studio in 1955 through the courtesy of Herbert Eimert. The instrumental sounds were produced here and the material modified in our traveling laboratory which at this time had landed in my apartment at 405 W. 118th St. The voice is that of Ethel Luening's recording for New Music of *Night Piece* from my *Suite for Soprano and Flute*. The composition revolves around some easily recognizable tonal centers. It includes microtonal sequences, electronic sounds of varying character as well as the voice itself, singing without words. Depending on their character and relationships to preceding and following musical events, the sounds, including the voice, take place in a carefully planned time and pitch sequence so that they do not mask each other and can be readily perceived. The voice, of course, was introduced to express the human element as it emerged from the mysterious and rather cold beginning. —Otto Luening

VISION AND PRAYER, for soprano and synthesized accompaniment, was commissioned by the Fromm Foundation, composed in 1961, and first performed in September, 1961 by Bethany Beardslee, at a concert presented by the Fromm Foundation at the Congress of the International Musicological Society. The work was the first to combine live vocal performance with a tape produced entirely on the Mark II RCA Synthesizer.

Dylan Thomas' poem, "Vision and Prayer", was first published in 1945, and consists of twelve "shaped" stanzas, each of the first six of which progresses from an initial line of a single syllable, by the addition of a syllable per line, to a syllabically maximal line of nine syllables, and then subtractively returns to a single syllabic line. The second group of six reverses the process, by progressing from an initial line of nine syllables to a center line of a single syllable, and then returning to the nine-syllable line. The temporal, sonic, and pattern characteristics of this poetic structure, as well as certain interpretations of these properties in strictly musical terms, were initial determinants of both musical details and the large-scale disposition of the compositional sections. The cumulative musical progression from these details to the sections, and to the totality of which these sections are members, is achieved by such traditional compositional procedures as trichordal and hexachordal derivation, harmonic succession through aggregates — within which the polyphony and the counterpoint are shaped by the properties of the work's third-order combinatorial set, and by the increased dimensionality — the refinements within and the compoundings of primary dimensions — easily and precisely afforded by the electronic medium.

- Milton Babbitt

COMPUTER PIECE No. 1 and **SKETCHES FOR A COMPUTER PIECE** have one thing in common; they were "put together" in a conventional electronic music studio, using the sound material produced by way of the digital computers at the Bell Telephone Laboratories. It is likely that all known methods of generating sounds with the digital computer are illustrated in these two pieces. **COMPUTER PIECE No. 1** was composed from three types of material: material initially generated on the digital computer GE 635 by a composer-physicist, Jean Claude Risset, and, in highly transformed form, used to create the beginning and closing sections of the piece; a succession of four-note clusters with spectrum characteristics of square-wave, originally synthesized for me by F. R. Moore; and material from several diversified "concrete" sound sources, such as recordings of a gong, of a distorted human speech, of a highly modulated passage on electronic organ, etc.

These sounds, of 9 seconds to 20 seconds in duration, were converted from analogue-to-digital form, stored in the memory of the digital computer as "files", and then recalled and reconverted to analogue form in predetermined fragments by a special set of instructions. Were it not for the fact that the first set of materials was subjected by me to a post-computer modulation, using a Bode frequency shifter and reverberation at the Columbia-Princeton Electronic Music Center, the composition could have been programmed in its entirety on the digital computer. As such, it is an example of electronic music from computer-generated and computer-processed sound materials, modified and assembled according to the usual methods employed in an electronic music studio.

The method of producing sound material for **SKETCHES FOR A COMPUTER PIECE** was markedly different. A program caller **GRØØVE**, developed by Dr. Max Mathews and F. R. Moore, capable of creating, storing, reproducing, and editing functions of time was used. The computer was DDP224. The **GRØØVE** program makes it possible to produce the tunable succession of pitches in real time by playing a small keyboard connected to the computer. Additional controls in the form of ordinary small knobs and a set of foot-pedals for octave transpositions are available. The computer responds by providing voltages through digital-to-analogue converters to a set of Wavetek generators set in a saw-tooth position, and 3 amplifiers with one VC band-pass filter from the Moog synthesizer. In this manner all of the horn-like sound material was obtained. One, two, or three simultaneous sounds are possible. The tuning is in tempered pitch.

A distinctly different method of computer-controlled, random production of untuned pitches, characterized by random amplitudes and either rigid or random rhythmic succession, was also used to obtain both the disjointed ping-like sounds and the rushing ostinato passages. An occasional sequence of softer percussion sounds, also from a special resonant circuit by Dr Mathews, and controlled through the keyboard, was employed as well.

Only a moderate amount of timbre-modification was applied here and there. Otherwise, the material is largely in the form obtained in realtime sound production — a great advantage in employing the GROOVE program. I am deeply grateful to both Dr. Mathews and Mr. Moore for their assistance to me in both of the above compositions.

—Vladimir Ussachevsky

KOLYOSA

KOLYOSA (the Russian word for wheels) is a portrayal in sound of an abstract hypocycloidal concept relating to images of whirlwinds, windmills, spinning wheels, and interlocking ellipses.

It was composed during the month of April, 1970 using the Buchla Synthesizer.

— Pril Smiley

The text of THE TRANSFORMATION OF ANI is taken from the Egyptian Book of the Dead, as translated into English by E. A. Budge. Most sounds in the piece were made from my own voice, speaking and singing the words of the text. Each letter of the English translation was assigned a pitch, and each hieroglyph of the Egyptian was given a particular sound or short phrase, of mostly indefinite pitch. Each series, the one derived from the English translation, and the one derived from the original hieroglyphs, was then improvised upon to create material I thought appropriate to the way in which I wanted to develop the meaning of the text, which I divided into three sections. — Alice Shields

Saith Osiris, the scribe Ani:
I have obtained the mastery over the animals,
with the knife in their heads and their locks of hair,
who live among their emeralds,
the aged and shining beings who prepare the moment of
Osiris Ani,
triumphant in peace.

My seasons are in my body.
I do not speak evil in the place of right and truth,
every day advancing in right and truth,
being shrouded in darkness,
sailing to keep the festival of the dead one,
embracing the old man,
the guardian of the earth,
Osiris,
the scribe Ani,
triumphant.

I have not entered into the cavern of the starchy deities.
I ascribe glory to Osiris,
I have pacified the heart of those deities who follow him.
Not am I afraid of those who create terror,
or of those who live on their lands.
Behold me,
I am exalted up my standard,
upon my seat.
I am Nu,

not shall I be overcome by the doer of evil.
I am Shu of primaeval matter.
My soul is the God,
my soul is eternity.
I am the creator of the darkness,
making its place in the bounds of the sky,
the prince of eternity.

STEREO ELECTRONIC MUSIC No. 2 was commissioned by the Electronic Music Center for its tenth anniversary celebration. The general plan of the composition is based on the idea of a very smooth curve reaching two main climactic sections. The composition starts smoothly with a continuously thickening cluster of sounds which builds up in dynamic range at the same time that it gives importance to some pitch elements within its nebulous structure. Interruptions following it lead into steady single repetitive pitches. These pitches in their turn are interrupted by percussive arabesques before they ascend, splitting apart in very close pitch relationships which continue to be interrupted.

With the introduction of ostinatos in the bass range, the introduction ends and the first section begins, leading into the first curve-like thematic ideas. The first climax is nothing but the superimposition of the same curving phrases piling up to build the first big tension in the piece. Up to this point the structure of the piece can be considered as linear and continuous.

Following this climactic area, the previous arpeggios re-appear in the shape of fast-moving, pointillistic, half-percussive elements.

A third section is characterized by a low rumble and machine-gun-like percussive interruptions at various pitches. Toward the end of this section minimization at high pitches of the previous long elements taken from the first section emerges bound to very small-range woven continuous arabesques, articulated melodically and interrupted occasionally by new percussive elements. After each percussive interruption these groups of high-pitched clustered arabesques re-establish themselves and get thinner and thinner until they completely disappear, ending the composition. This last section can be considered as a coda.

The composition is based on two elements: long lines and percussive sounds constantly interrupting them. Modification of previously introduced elements occurs throughout the piece. All the sounds are electronically produced.

The composition was finished on 16 May 1970.

— Bülent Arel

SYNCHRONISMS No. 5 for Percussion Ensemble and Electronic Sounds, was commissioned by the Thorne Music Fund, Inc. of New York City, and completed in 1969. The ensemble requires five percussion players. The electronic sounds appear approximately three minutes from the beginning of the score and run all the way through to the end of the piece. As in previous compositions of this series, one of the most obvious objectives of the composer is to create a homogeneous musical space with the combination of the two media, the electronic and the traditional instruments. The electronic sounds, in many cases, extend and modulate the acoustical characteristics of the percussion instruments used, by affecting their attack and/or decay characteristics. We could say, in general, that the characteristic of the electronic sounds is percussive while the percussion instruments are, in most of the piece, treated as if they were melodic instruments. The piece is in one movement.

— Mario Davidovsky

This recording was made possible by grants from the Alice M. Ditson Fund of Columbia University, the Martha Baird Rockefeller Fund for Music, the Fromm Music Foundation, the Contemporary Music Society, Mrs. Ernest Heller and Prof. Joseph Machlis.

ABOUT THE COLUMBIA-PRINCETON ELECTRONIC MUSIC CENTER

The Columbia-Princeton Electronic Music Center officially came into existence on February 20, 1959. This was the starting date of a five year grant from the Rockefeller Foundation, which made available a total of \$175,000 in response to a proposal by Columbia and Princeton Universities to establish working studio facilities. They were to be used by interested resident and invited composers to work in electronic music, a term that was assumed to include tape music and *musique concrète*. Working facilities were to include "an adequately equipped studio, the necessary technical assistance, and the means to initiate such programs of investigation as are necessary to facilitate the task of composers desiring to compose with the expanded sound resources available on magnetic tape or needed to be built up through sound synthesis." It was agreed that the main new studio would be housed at Columbia University, where the original Experimental Tape Studio was already housed, as it seemed advantageous to maintain such a studio in the metropolitan area.

Translating the proposal into reality — allocating and preparing suitable space, designing specialized equipment, and putting together the first adequately equipped Electronic Music Studio in the United States — took almost a year. The unexpected but welcome availability of the most advanced type of RCA Sound Synthesizer, the Mark II, altered the original plans somewhat but also gave the Center a unique device which, in some respects, still has a versatility superior to the portable synthesizers which now serve as the principle source of sound materials in most electronic studios.

Milton Babbitt, Otto Luening and Vladimir Ussachevsky had already become acquainted with this huge machine in the summer of 1958. This was accomplished through the courtesy of the David Sarnoff Laboratories in Princeton, New Jersey, after the RCA administration was contacted on their behalf by Davidson Taylor, the former Dean of the School of the Arts at Columbia. Soon after the Rockefeller Foundation grant was announced, a representative of the David Sarnoff Research Laboratories was in touch with the composers concerning their interest in the further use of the Mark II RCA Sound Synthesizer. A rental term of 20 months' duration was worked out; when it expired, RCA permitted the Center to continue to use the synthesizer without charge.

The Center started to function fully in the year 1960 and accordingly, celebrated its tenth anniversary in the year 1970. By then the Center had expanded to include three nearly identical studios at Columbia University, one located in McMillin Theater on the main campus, and two in the Prentis Building, at 632 West 125th Street in Manhattan. At the latter address a fourth studio continued to house the Mark II RCA Sound Synthesizer. A laboratory for designing, building and maintaining the studio equipment was also in its tenth year of existence under the supervision of Peter Mauzey.

A fifth studio, similar in layout to the three-studio complex at Columbia, was installed in the Woolworth Music Building on the Princeton University campus. (Several years prior to this, the Princeton Music Department had begun a vigorous program of investigation into Computer Music Analysis and Computer Sound Synthesis.)

The first public concert of works produced with the new facilities was given May 9th, 1961, and repeated the following day. All of those works subsequently appeared on a Columbia record, which is still in print some nine years later.

The Beginnings

It is unlikely that the studio could have gone into production so rapidly were it not for the fact that there already existed at Columbia an Experimental Music Studio (later renamed the Tape Music Studio). It had its beginnings in a microphone and an Ampex 400 tape recorder, purchased in 1951 for the music department by the Alice M. Ditson Fund. With this equipment, plus a pair of earphones and a borrowed Magnecord tape recorder, Ussachevsky started some experiments in transposition of piano pitches. This was soon followed by the discovery of the "feedback" principle through a casual conversation with Peter Mauzey, then an engineering student, who obligingly built a small feed-back device to assist in further experimentation.

The first examples of tape composition that resulted were presented by Ussachevsky on the Composer's Forum concert at McMillin Theatre on May 9, 1952. The following summer this equipment was taken to Bennington College, in Vermont, where Luening joined with Ussachevsky in further experimentation, testing individual flute sounds and improvised patterns in the new world of multiple echoes and, theretofore-impossible pitch ranges.

This was also an occasion to test musicians' reactions; the reactions were mixed, befitting, one supposes, the spirit of the cocktail party, during which the experiments were revealed.

Still later that summer, the first compositions by Luening—*Fantasy in Space*, *Low Speed*, and *Invention in Twelve Tones*—and some of the materials for Ussachevsky's *Sonic Contours* were produced with two tape-recorders, a microphone, and a couple of mixing and "feed-back" devices by Mauzey, all transported from New York. This took place in the Woodstock, New York cottage of Henry and Sidney Cowell. On November 22, 1952, Leopold Stokowski introduced these compositions in a concert at the Museum of Modern Art, an occasion that evoked national recognition of the possible birth of a new music medium. Oliver Daniel of BMI suggested that the new "instrument" be called a "tapesichord," and the music thus produced "tape-music." The latter name has stuck. The term "tape-music" thereafter identified a distinct American contribution.

A pattern of moving the studio about persisted for four years. It traveled a triangle between New York City, Bennington and the MacDowell Colony, in New Hampshire. Meanwhile the Louisville Orchestra commissioned Luening, and he invited Ussachevsky to join him in composing the first composition for tape-recorder and orchestra. Additional equipment was needed to realize this work, and the Rockefeller Foundation made possible an enlargement of the studio by the addition of two tape-recorders and a filter. The equipment resided in Ussachevsky's apartment for the next three years, then for six months at Luening's (his neighbors were more sensitive). In 1955 the composers addressed an urgent plea to President Grayson Kirk of Columbia for use of university space. As a consequence, the studio migrated to its first university dwelling, a small doomed-for-demolition, two-story house on campus, the last of a complex of buildings that had belonged to a former Morningside institution, the Bloomingdale Asylum for the Insane. In this quaint and isolated house, such works as the music for Orson Welles' production of *King Lear*, *Piece for Tape Recorder*, and *Metamorphoses*, were produced. During this period, Jacques Barzun, then the Dean of Graduate Faculties at Columbia, took interest and secured some University support for the studio. For a number of years thereafter, Mr. Barzun's sympathetic understanding played an important role in the studio's survival and growth. President Kirk responded to another plea, and in the fall of 1957 permanent quarters were established in Columbia's McMillin Theater. The migratory phase had ended. Other composers began to take interest.

In 1959 the Tape Music Studio then underwent further metamorphosis, which was made possible by the large Rockefeller Foundation grant to the two universities: the Columbia-Princeton Electronic Music Center had come into existence.

The Works

The number of works produced individually and jointly by Luening and Ussachevsky prior to the establishment of the Center was 25. The count since 1959 is close to 225 compositions by more than 60 composers from 11 countries. Some of these composers used the Center's facilities for a few weeks; others stayed for several years. They shared hours in the studios with students who numbered from 12 to 18 in any given year; a tight schedule had to be maintained, and late hours were commonplace. More than 60 compositions by 21 composers have been recorded on commercial disks.

Composers associated with the Center during the 4 to 9 year period developed distinctly personal techniques. The tradition of meticulous experimentation with sound materials prevails. Much has been learned from Milton Babbitt's initial explorations of the possibilities afforded by the RCA Sound Synthesizer for unprecedented accuracy in controlling electronically-generated materials.

It is characteristic of the Center that no general style, but many strongly individual styles of composition have emerged. This diversity of expression continues to flourish within the changing technological conditions, as synthesizers and computers assume a more important role in sound synthesis. So far, the largest number of works have been created for tape alone, but composers are increasingly combining pre-recorded tape with live performers. The number of the latter type has grown from the first three composed by Luening and Ussachevsky to 48. A glance at the list of works at the end of this booklet will show the interesting ways in which electronic works by the Center's composers have accommodated artists in other fields.

The Performances

Electronic music is, of course, much easier to perform than conventional music. As the traditional composer's efforts are concluded with the creation of a musical score, so the electronic composer's are concluded with the creation of his final mix on tape. But where the preparation of a performance of conventional music involves a long and often difficult effort to understand and render the composer's intentions into sound, the performance of electronic music is basically just running the tape.

Partly as a result, the percentage of performances of compositions completed at the Electronic Music Center is high. It is very likely that all of the works listed here have received hearings in public. Some works which combine tape with solo instruments or small instrumental ensembles are known to have had 100 or more public presentations. The United States, South America, Western Europe, Japan, Australia, New Zealand and, in isolated instances, some African countries have all had public performances of the Center's works. Careful count has not been kept. The number of radio performances can never be properly estimated; it is probable that for every performance the Center's composers know about, hundreds of performances take place on radio. TV performances are usually better accounted for, as are numerous presentations on lecture tours. It may be interesting to note that, after some 40 performances by 25 orchestras in the U.S., South America and Europe of works for orchestra and tape by Luening and Ussachevsky, these compositions are now being played by school orchestras. This reflects a growing interest in electronic music in educational circles, an interest which has been documented by letters and verbal inquiries and numerous requests for demonstrations by composers at the Center.

The Administration

The Center's administration, and its liaison with the two respective departments of music, is in the hands of Milton Babbitt of Princeton and Otto Luening and Vladimir Ussachevsky of Columbia. They serve as the Committee of Direction with Ussachevsky as Chairman and Mario Davidovsky as Associate Director. Bülent Arel, though not a director, has always been a family member-in-fact, having created all his electronic works at the Center, and having been hired as Research Assistant to Ussachevsky, in which capacity he helped such composers as Varèse, Charles Whittenberg and Mel Powell realize their works. He also developed a method for scoring electronic music.

Davidovsky also teaches courses in electronic music at Columbia. Pril Smiley and Alice Shields, younger composers associated with the Center for eight and five years respectively, are also expert technicians. They carry the main burden of assisting the actual studio work of composers who are enrolled in two graduate courses in electronic music. Periodically, arrangements are made with other composers of several years' experience at the Center to instruct and help less experienced composers in the techniques of electronic music making. The studio at Princeton usually has a more informal arrangement with its instructors, and does not rely on long-term teaching assistants.

Mr. Mauzey, an associate of some 20 years, has his own staff of two engineering students as maintenance and laboratory technicians. The electronic sculptor, James Seawright, who was formerly a technical supervisor and teaching assistant, retains ties with the Center as a consultant. The versatile secretary is Mary Hoos. The Center misses the services of John Bittner, who was a Center technician for four years. He built much of the specialized equipment and convinced the Directors that electronic organs can be useful.

The Equipment

By 1969 the Center was able to achieve its long-term objective of operating four nearly identical studios. Each has a central mixing panel capable of handling 12 input signals, individually controlled by 12 potentiometers. Four of these potentiometers serve as master gain controls for 16 additional sub-mixer inputs, each with its own smaller knob potentiometer. Thus a maximum of 24 signals can be individually controlled. Above each of the 12 potentiometers associated with the 12 main inputs are eight switches which are used to send a signal input to one or all eight of the main outputs.

Each studio has four Ampex two-track stereo tape-recorders which are "normalised" through the first eight potentiometers. Thus straight mixing can be done without any patch-cords. There is also a four-track Ampex tape-recorder in two of the studios, and another one in the RCA Sound Synthesizer studio. Each of the four

studios has from four to six sine-and-square-wave generators, and two sine-wave generators. In addition, six sine-sawtooth generators, two square-wave generators, and white and pink noise generators are available on Buchla synthesizer units.

Additional sound modifying equipment is provided by Buchla and non-Buchla devices. In the latter category each studio has two ring modulators, two electronic switches, two band-pass filters, two capstan motor speed-control amplifiers, and an individual EMT-140 reverberation unit, remotely controlled. From Moog synthesizer modules a pair of envelope generators, envelope followers, and voltage-controlled amplifiers with power supply were selected for each studio. There are four KLH-6 loudspeakers and two Dynakit-70 Stereo amplifiers in each studio.

A Buchla synthesizer in two wooden enclosures is available for each studio. In addition to the above-mentioned generators, the synthesizer provides a signal control facility through either two touch-sensitive keyboards or two 16-position sequencers. Two dual attack generators, two dual voltage-controlled gates, two timing pulse generators, four voltage processors, ten input voltage-controlled mixers, a dual ring modulator, two six-input mixers, and a dual random voltage source complete the list of Buchla modules.

The mixing panel and all of the above units, including Buchla, are connected to a patch-panel. Three-conductor patch-cords are used. Additional units not common to all studios include a Bode frequency shifter, an Albis third-octave filter, a Spectrum third-octave filter, a Buchla voltage-controlled filter, a Pultec program equalizer, a staircase generator, a special bank of five saw-tooth generators, and a Shober tape reverberation unit. The Center also has miscellaneous portable mixers, several older professional tape recorders, microphones, etc.

The RCA Sound Synthesizer, Mark II, has been described in full detail in technical publications such as *The Journal of the Acoustical Society of America*. Briefly it can be said that, in effect, the Mark II consists of four identical synthesizer units, fusing common sound generating units and testing facilities. The synthesizer contains means for producing both sawtooth wave-forms and noise, and means for controlling their frequency, envelope, intensity and spectrum. Being especially designed for musical purposes, the synthesizer also contains a tremolo control (periodic amplitude modulation of an audio signal) and a portamento control (continuous variation of frequency). Basically, it is what is called a subtractive synthesis device. That part which is subtractive synthesis is the spectrum control section. Each of four synthesizer units constitutes one channel, which has its own octaver, envelope unit, volume control, spectrum control, tube tree and relay tree.

Two rolls of sprocket-driven paper control the four channels. The paper is perforated by a key-punch mechanism operated by the composer or by a technician who reads music or who acts under the composer's direction. A set of 40 key punches perforate the paper across its width. These perforations are used to code frequency, frequency division (octave), envelope, volume and spectrum. Each roll controls two channels, and the two paper drive units may be synchronized to run together. Therefore, four melodic lines can start and run in perfect synchronization.

The output of each of the Synthesizer's four channels is fed into an 8-channel mixer. The other four channels are reserved for the tape recorders which operate in conjunction with the synthesizer. These are a 2-track recorder using 6.35 mm. tape, and a 4-track recorder using 12.7 mm. tape. Each of these recorders is equipped with a photoelectric device which will start the paper-drive mechanism of the synthesizer automatically when a clear portion of tape passes through the device. Thus, exact synchronization is attained between the tape recorders and the synthesizer. (Likewise it is possible to start the tape recorders from the paper drives.) An operation such as combining 20 sounds, all starting at the same instant, onto a single track of the 2-track recorder is readily accomplished, and copying from the 4-track is done only once to achieve this mixture.

In 1961 the McMillin Theater was equipped with special performance facilities for electronic music presentation. A 12-input and 13-output mixing panel, which is placed in the center of the balcony, can be connected to 19 loudspeakers. There are six pairs of loudspeakers, each pair connected in parallel; one pair is mounted in each corner, and two pairs on the back wall of the theatre. The seven remaining loudspeakers are all single units, two in the ceiling, three on the stage, and one high on the wall on each side of the proscenium. Any of the 12 input signals can be sent to any of the 13 loudspeaker outputs. Thus sound rotation and, in general, flexible sound distribution, easily changeable during actual performance, can be achieved.

The Services

The Center's primary objectives, understandably, are to help composers to produce electronic music, and, whenever possible, to perform it. It has, however, performed many other tasks. For years in New York City there was hardly a performance of electronic music, including those in Lincoln Center, for which tape recorders, amplifiers and loudspeakers were not loaned by the Center. Until Moog, Buchla, and other synthesizers came into common use, Center members had been advisors to such college and university music departments as: Bennington, Brandeis, Case Institute of Technology, Illinois, Macalester, Michigan, New York, Pennsylvania, Southern Illinois, Texas, Toronto, Yale, plus the University of Amsterdam, the University of Chile, The American Academy in Rome, the Conservatory of Music in Vienna, Victoria University (New Zealand), the University of British Columbia and the Massachusetts Institute of Technology.

The Center continues to have visitors who come singly or in organized groups from clubs, colleges, secondary schools, among others. It has played host to over 200 composers among whom were: Luciano Berio, Elliott Carter, Aaron Copland, Luigi Dall'Piacola, Iain Hamilton, Dimitri Kabalevsky, Toshiro Mayazumi, Edward Rubbra, Dimitri Shostakovich, Karlheinz Stockhausen, Igor Stravinsky and Edgard Varèse.

Innumerable inquiries, some only remotely related, have been answered by all members of the staff. Several encyclopedic articles, as well as articles in magazines, books, etc., originated with the members of the Committee of Direction. Between them, these composers have probably accounted for between 300 and 400 lecture-demonstrations of electronic music before college audiences, scientific societies, high school assemblies, clubs, and so forth, as well as a number of appearances abroad. All the other members of the staff and several closely associated composers have given some similar services.

The Associations

The Center's closest associations have been with the Group for Contemporary Music at Columbia, the computer centers at both universities, and the Bell Telephone Laboratories at Murray Hill, New Jersey.

Two directors of the Group, Charles Wuorinen and Harvey Sollberger, have both composed works in the electronic medium using the Center's facilities. Equally important has been the fact that the Group has introduced several works by other Center composers as part of its concert series at the McMillin Theater, and these performances were frequently repeated. The Center carried certain administrative responsibilities for the Group, and was instrumental in making possible the release of two CRI recordings by the Group, Mario Davidovsky's *SYNCHRONISMS NO. 5* and Edgard Varèse's *DESERTS* (CRI SD 268).

Electronic music bears a family resemblance to computer music; in fact there is reason to believe the next generation of electronic composers will be using digital computers instead of music synthesizers or, at least, computers to control synthesizers.

Composers directly or indirectly associated with both University Music Departments provide the closest link between electronic and computer centers. At Princeton, these include the composers James K. Randall and Godfrey Winham. Charles Dodge, a former student at the Center is now the Columbia Music Department's faculty representative at the Computer Center. More recently involved have been Barry Vercoe and Benjamin Boretz.

Until recently, neither university had the capability to convert digital tapes to analogue tapes (that is, tapes that can be listened to). The cooperation of a third agency was essential. This agency is the Bell Labs, where the association was made possible by the good will of Bell's Drs. John Pierce and Max Matthews.

Once again the relationship stems from personal rather than official beginnings. Both of Ussachevsky's computer pieces were made at the Center from materials developed with the assistance of Dr. Matthews and Richard Moore during Ussachevsky's numerous visits to Bell Labs, starting in 1968. Charles Dodge and Emanuel Ghent have realized compositions through the combined facilities of both places. Computer composers at Princeton and Columbia, with or without direct association with the Center, have benefited from the advice, meticulous published documentation, and technical experience generously made available from work accomplished in computer sound and speech synthesis at the Bell Telephone Laboratories.

The associations of the Center outside of the New York area are too numerous to list. Contact with the Groupe des Recherches Musicales and Pierre Schaeffer in Paris is always maintained; the same can be said for the

California Institute of Fine Arts, the Toronto Studio in Canada, and the Studio Voor Elektronische Musiek in Utrecht, Holland. Other contacts are based more on personal friendships; of these there are many, and they cover three continents.

The Future

The Center has been fortunate to have had the opportunity to develop to its present function. But neither the elaborate machinery nor the expenditure would have been worthwhile had not the composing talent that it gathered together, with its variousness and acquired expertise, led to a substantial contribution to the literature of the new medium, not to mention the eye-and-ear-opening exploration of hitherto uncharted musical areas. Future plans must always take cognizance of the obvious fact that composing talent remains a studio's fundamental asset.

The end of the decade brought about acceptance of electronic music as part of the contemporary music idiom, but both the artistic climate and the environmental conditions within which serious composers can undertake to compose electronic music have changed. The Columbia-Princeton proposal to the Rockefeller Foundation of 1958 anticipated to a remarkable degree the evolutionary path of the composer's technological progress: from manual craftsmanship with tape to the present use of the synthesizer and toward an increasing use of the computer. What the report did not foresee was the suddenness with which electronic music would become a prey of commercial exploitation and a desirable adjunct in education, all the way down to the elementary school level.

Technology will continue to present composers with an ever-increasing range of possibilities. Work with the computer promises a continuous improvement of techniques for sound synthesis, for programmed manipulation of analogue material converted into digital form, and computer control of characteristic synthesizer analogue modules. The Center, as its fluctuating budget permits, will explore and adopt technological innovations that it considers important for composers.

One should look to the future, not forgetting that there is much to be learned from the past. To quote J. K. Randall, "To contend that the past is dead is to advocate that we kill some part of our own imagination."

THE COMPOSERS AND STAFF

OTTO LUENING

Otto Luening was born in Milwaukee, Wisconsin, in 1900. He heard about electronic sound as a possible compositional tool from Ferruccio Busoni, with whom he was studying in Zurich in 1918.

Luening's career has been distinguished by his diversified activities. He has been or still is active as flutist, opera and orchestra conductor, accompanist, and Professor of Composition at Columbia, where he is now member of the Division of Music in the School of the Arts. He is a member of the National Institute of Arts and Letters, a Trustee of the American Academy in Rome and is a member of the Educational Advisory Board of the Guggenheim Foundation.

Since 1952 he has been an active pioneer in the field of tape and electronic music, often in collaboration with Vladimir Ussachevsky.

Luening's more than 300 works in other categories include much chamber music, symphonic works, an opera *EVANGELINE*, piano music, songs and choral works. His compositions have been played throughout the world by such orchestras as the New York Philharmonic, Los Angeles Philharmonic, Chicago, St. Louis, Mexico City, Montevideo, and the Haarlem Orchestra of Holland.

MILTON BABBITT

Milton Babbitt was born May 10, 1916 in Philadelphia, Pa. He was educated in the public schools of Jackson, Mississippi, New York University (B.A.), and Princeton University (M.F.A.). Honorary degrees: Middlebury College (D.M.); New York University (D.M.); Swarthmore (D.M.). He studied composition with Roger Sessions.

He has been a member of the Department of Music, Princeton University since 1938. At present, he is William Shubael Conant Professor of Music. He was a member of the Department of Mathematics, Princeton University, 1943-45.

He was a member of the faculty, Salzburg Seminar in American Studies, 1952; member of the Composition Faculty, Berkshire Music Center (Tanglewood), 1957, 1958; faculty member, Princeton Seminar in Advanced Musical Studies, 1959, 1960; member of the Composition Faculty, Darmstadt Summer Course, Darmstadt, Germany, 1964; Composer in Residence, New England Conservatory, Castle Hill, Massachusetts, 1968.

He is a member of the Editorial Board, Perspectives of New Music, and a member, National Institute of Arts and Letters. He has made intensive use of the RCA Music Synthesizer at the Electronic Music Center, resulting in the compositions VISION AND PRAYER (soprano and synthesized sound), PHILOMEL (soprano, recorded soprano and synthesized accompaniment), COMPOSITION FOR SYNTHESIZER and ENSEMBLES for synthesizer, CORRESPONDENCES for string orchestra and synthesizer and OCCASIONAL VARIATIONS for synthesizer (1971).

VLADIMIR USSACHEVSKY

Vladimir Ussachevsky was born October 21, 1911, in Hailar, Manchuria, of Russian parents. He came to the United States in 1931. He studied composition with Bernard Rogers and Howard Hanson at the Eastman School of Music, and with Otto Luening. He joined the faculty of Columbia University in 1947, and now has the rank of Professor of Music.

Prior to 1951 Ussachevsky wrote a number of compositions for conventional instruments, ranging from piano pieces to a large work for orchestra and chorus. He began to experiment with tape-recorded sounds in the fall of 1951 without any previous knowledge of the work of the *musique concrète* group in Paris. A period of collaboration with Otto Luening resulted in three joint works for tape recorder and orchestra, a score for Orson Welles' production of KING LEAR and several tape pieces.

Among his individual works from that period SONIC CONTOURS, PIECE FOR TAPE RECORDER and LINEAR CONTRASTS are best known. Among the works produced since that year he ranks as his best efforts CREATION-PROLOGUE for multiple choruses and electronic accompaniment on tape, OF WOOD AND BRASS for tape alone, and film scores for George Tabori's screen adaptation of Jean Paul Sartre's play NO EXIT and LINE OF APOGEE, a surrealist film by Lloyd Williams, and a background score for a play, WE—a CBC Radio production.

He has written a number of articles on electronic music and lectured in over 150 colleges and universities in the United States, as well as in Great Britain, France, Yugoslavia, Soviet Union, Venezuela, Chile, Peru, Brazil and Argentina. He has served as an American delegate to the First Congress of Experimental Music in Paris, 1953; to an International Conference on Music in Caracas, Venezuela, in 1966 and again in 1969 to the Inter-American Music Festival in Rio de Janeiro, Brazil.

BÜLENT AREL

Bülent Arel was born in Istanbul, Turkey in 1919. He attended the state conservatory of Ankara, where he graduated in 1947 with a diploma in composition, piano, and conducting. He taught harmony and counterpoint in the same conservatory, and piano and history of music at the teachers college in Ankara. He was one of the founders of the Helikon Society of Contemporary Arts, and was the regular conductor of the Helikon Chamber Orchestra for four years.

He studied sound engineering in 1951 in Ankara under Jozé Bernard and Willfried Garret of the Radio Diffusion Française, both members of the Club d'Essai of Paris. This collaboration marked the start of his interest in *musique concrète*, which later led him to electronic music. From 1951 until 1959 he worked at Radio Ankara, as a "tonmeister" and recording engineer and then as the Musical Director. In 1958 he pioneered in the field of electronic music combined with conventional instruments, with *Music for String Quartet and Oscillator* (revised at the Columbia-Princeton Center in 1962 as *Music for String Quartet and Tape*).

In 1959 he came to the United States as the recipient of a Rockefeller Research Grant for work at the Columbia-Princeton Electronic Music Center. He remained in the United States until 1963, working at the Center as an assistant to Vladimir Ussachevsky and, during 1961-1962, as Lecturer at Yale University, where he installed an

electronic music studio.

From 1963 to 1965 he was again in Turkey, heading the Ankara State Radio middle-wave music programs and founding and directing a Madrigal Chorus for the State Radio. He also composed the score for a musical which ran in Istanbul for over a year.

Since July 1965 he has been a member of the music faculty of Yale University, and in July 1969 he became Associate Professor and Director of the Electronic Music Studio. He has been appointed Professor of Music and Director of the Electronic Music Studio which he is designing and installing at the State University of New York at Stony Brook, Long Island.

He has composed symphonic works, including a *Short Piece for Orchestra* (1967) commissioned by the New Haven Symphony, and chamber works including *For Violin and Piano* (1966), which is recorded on CRI SD 264.

His electronic works are SHORT STUDY, stage music for "The Scapegoat"; ELECTRONIC MUSIC NO. 1. IMPRESSIONS OF WALL STREET; MUSIC FOR A SACRED SERVICE (Prelude and Postlude); STEREO ELECTRONIC MUSIC NO. 1 (five-channel and two-channel versions) recorded on Columbia MS 6566; MUSIC FOR STRING QUARTET AND TAPE; MIMIANA I (music for dancers and film); MIMIANA II (music for dance); CAPRICCIO FOR T.V. (music for film), and STEREO ELECTRONIC MUSIC NO. 2,

MARIO DAVIDOVSKY

Mario Davidovsky was born in Argentina in 1934, and has lived in New York since 1960. He is presently Associate Director of the Columbia-Princeton Electronic Music Center, and Associate Professor of Music at CCNY. He is a winner of numerous awards and fellowships including: American Academy of Arts and Letters; Brandeis University Creative Arts Award; Aaron Copland-Tanglewood Award; two Guggenheim Fellowships; two Rockefeller Fellowships, and the Pulitzer Prize. He has won numerous national and international prizes for orchestral and chamber compositions and has received numerous commissions from, among others, the Koussevitzky Foundation of the Library of Congress, the Fromm Foundation, the Pan-American Union.

PRIL SMILEY

Pril Smiley was born at Mohonk Lake, N. Y. in 1943. She studied composition with Henry Brant, Louis Calabro, and Vivian Fine at Bennington College from which she graduated in 1965. She came to the Columbia-Princeton Electronic Music Center in 1962 and by 1965 was a full-time technician and composer at the Center.

Her first electronic composition, ECLIPSE, was a winner of the Dartmouth Arts Council Prize in 1968—the First International Electronic Music Competition. She has been Electronic Music Consultant for the Lincoln Center Repertory Theatre since 1968 and writes electronic music for many of their productions in addition to doing free-lance work for other theatres and film productions.

ALICE SHIELDS

Alice Shields was born in New York City in 1943. She studied composition at Columbia University with, primarily, Vladimir Ussachevsky and Otto Luening, and earned a B.S. and M.A. Among the performances of her music have been SPRING MUSIC for soprano, trumpet, and oboe, performed at Town Hall in 1967; STUDY FOR VOICE AND TAPE, played at the League-ISCN concert in April, 1968 in New York; DOMINO (electronic music for dance) commissioned by the Mimi Garrard Dance Theater, performed at the Henry Street Playhouse in 1967, with several performances since then. She is now completing a chamber opera called ODYSSEY which was performed in a piano and percussion version at the Lake George Opera Festival in August, 1970 with the aid of a Presser Foundation grant.

She is at present a teaching assistant in electronic music at Columbia University, and a professional singer.

PETER MAUZEY

Peter Mauzey was born in Poughkeepsie, N. Y. He received the B.S. degree in electrical engineering in 1952 from Columbia University and taught at Columbia from 1952 to 1962. During that period, he received the M.S. degree in 1954 and the E.E. degree in 1958.

He has been a consultant to the Columbia Music Department since 1950 and was director of engineering of the Electronic Music Center until 1962. He is presently a member of the technical staff of Bell Telephone Laboratories. He is a member of the Acoustical Society of America, the Audio Engineering Society, the Institute of Electrical and Electronics Engineers, and the Society of Motion Picture and Television Engineers.

JAMES SEAWRIGHT

James Seawright has had one-man exhibitions of his electronic sculptures in 1966, 1968, and 1970, and has had his work in numerous museum shows. In 1970, he was awarded a fellowship from the Graham Foundation for Advanced Studies in the Fine Arts. He is currently a visiting lecturer and sculptor at Princeton University. He was born in Jackson, Mississippi in 1936. He graduated from the University of Mississippi in 1957 and studied with José De Creeft at the Art Students' League of New York during 1961-62. He was assistant to the choreographer Alwin Nikolais, following which, in 1963, he came to the Columbia-Princeton Electronic Music Center. He remains a part-time consultant with the Center.

COMPOSITIONS CREATED AT THE CENTER

ANHALT, ISTVAN (Canada)

Electronic Composition No. 4 (1961)

APPLETON, JON (USA)

Study No. 3 (1965)

Infantasy (1965)

Georganna's Fancy (1966)

Columbia Etude No. 1 (1966)

Flying Dutchman 103

Flying Dutchman 103

AREL, BÜLENT (Turkey)

Electronic Music No. 1 (1960)

Stereo Electronic Music No. 1 (1960)

The Scapegoat (theatre) (1960-1)

Fragment from "The Scapegoat" (1961)

Wall Street Impressions (film) (1960-1)

The Scapegoat Suite (1961)

Short Electronic Study (1961)

Sacred Service: Prelude and Postlude (1961)

Music for String Quartet and Electronic Sound

(second version) (1962)

Flux (Mimiana I) (film and dance score) (1968)

Frieze (Mimiana II) (1969)

Capriccio for TV (1969)

Medium is the Medium (film) (1969)

Stereo Electronic Music No. 2 (1970)

Son Nova 1988

Columbia: ML5966, MS6566

Son Nova 1988

Son Nova 1988

CRI SD 268

AVNI, TZVI (Israel)

Vocalise (1964)

Turnabout TV4004, TV34004S

BABBITT, MILTON (USA)

Composition for Synthesizer (1960-1)

Vision and Prayer

for soprano and synthesized

accompaniment (1961)

Ensembles for Synthesizer (1962-4)

Philomel

for soprano, recorded soprano, and

Columbia: ML5966, MS6566

CRI SD 268

Columbia MS7051

AR 1

synthesized tape (1963)
Correspondences for String Orchestra
and Synthesized Tape (1968)
Occasional Variations (1970)

BEECROFT, NORMA (USA)

From Dreams of Brass
for narrator, solo soprano, mixed chorus,
orchestra and tapes (1964)

BERIO, LUCIANO (USA)

Laborintus II
per mimi, recitanti, in sieme vocale,
orchestra da camera e nastro magnetico (1962)

BETJEMAN, PAUL (England)

Six Breaths, for electronic sounds and soprano (1969)
Fat Cat, three movements for forty-one sounds (1970)

BOUTILIER, THOMAS (USA) Masks (ballet) (1966)

Pococurante (ballet) (1967)
Concrete sounds for "Tongues of Fire" (ballet) (1968)
Homunculus (ballet) (1968)
Concrete sounds for "The Clowns" (ballet) (1969)
Prelude and Entracte for The Poppet" (ballet) (1969)

CARLOS, WALTER (USA)

Composition for Four Loudspeakers (1963)
Dialogues, for piano and two loudspeakers (1963)
Sacred Sonorities (1963)
Variations, for flute and electronic sounds (1964) Turnabout TV4004, TV340045
Image, for instruments and tape (film) (1964)
Epitaph for Man (with narrator) (1964)
Noah, for voices, chamber orchestra
and tape (opera) (1965)
Pomposities (with narrator) (1965)

DAVIDOVSKY, MARIO (Argentina)

Electronic Study No. 1 (1960) Columbia: ML5966, MS6566
Electronic Study No. 2 (1962) Son Nova 1988
Synchronisms No. 1, for flute and
electronic sounds (1963) CRI SD 204
Contrastes No. 1, for string orchestra
and tape (1964)
Synchronisms No. 2, for flute, violin, cello, clarinet
and electronic sounds (1964) CRI SD 204
Synchronisms No. 3, for cello and
electronic sounds (1964-5) CRI SD 204
Electronic Study No. 3 (1965-6)
Synchronisms No. 4—Psalm No. 70,
for boys' or mixed chorus and tape (1966-7)
Synchronisms No. 5, for five
percussionists and tape (1970) CRI SD 268
Synchronisms No. 6, for piano and tape (1970)

DEL MONACO, ALFREDO (Venezuela) Electronic Study No. 2 (1970)

Three Choreographic Pieces for
Sonia Sanoja (dance) (1970)

DODGE, CHARLES (USA)

A Composition for Converted Digital Tape
(computer piece) (1967)

Changes (computer piece) (1970) Nonesuch 71245
Earth's Magnetic Field (computer piece) (1970) Nonesuch 71250

DRUCKMAN, JACOB (USA)
 Animus I, for trombone and tape (1966) Turnabout 34177
 Animus II, for mezzo soprano, two
 percussion players, and tape (1967) CRI SD 255
 Animus III, for clarinet and tape (1969) Nonesuch: H-71253
 Look Park (film) (1969)
 Orison, for organ and tape (1970)
 Traite du Rossignol (film) (1970)
 Synapses (four track electronic) (1970) Nonesuch H-71253

BUGGER, EDWIN (USA)
 Three Pieces, for six instruments and synthesizer (1966)

EL-DABH, HALIM (Egypt)
 Leiyla and the Poet (1961) Columbia: ML5966, MS6566

EL-DABH and LUENING
 Electronic Fanfare,
 for percussion, recorder, and synthesized sounds (1960)
 Percussive Mixtures (1961)
 Diffusion of Bells (1961)

EZAKI, KENJIRO (Japan) Electronic Music 225 (1966)
 Fantasy (1966)
 Metamorphism of One Short Attack (1966)
 Study of Orchestra, Voices, and Electronic Sound (1966)
 Gagaku (1966)
 Electronic Music 402 (1966)
 Meiso No. 1 (1966)
 Meiso No. 2 (1966)
 Electronic Music 313 (1966)
 Subway in New York (1966)
 Piece for Orchestra and Electronic Sound (1967)
 Undine (ballet) (1967)

FINNEY, ROSS LEE (USA)
 Still Are New Worlds, for narrator, chorus,
 orchestra and tape (1963)
 Three Pieces, for strings, winds, percussion,
 and tape recorder (1963)

FRIEDMAN, GARY (USA)
 Suite from Macbeth (theatre) (1966)
 Music for Art (1966)
 Dream (theatre) (1966)
 Concerto for alto saxophone and tape (1967)

GHENT, EMMANUEL (USA)
 Triality I and II, for violin, trumpet, bassoon
 and coordinating signal tracks on magnetic tape (1964)
 Dithyrambos, a brass quintet with coordinating
 signal tracks on magnetic tape (1965)
 Hex, An Ellipsis for Trumpet, 11 Instruments
 and Tape (1966)
 Helices, for violin, piano and tape (1968) **Danger: High Voltage (1969)
 Battery Park (1969)
 Lady Chatterly's Lover (1969)
 Galloping Pentagonism is a Condition Marked by
 Bouts of Delirium and Disorientation (1970)
 L'Apres-midi d'un Summit Meeting (1970)
 Our Daily Bread (1970)

GOLDSTEIN, MALCOLM (USA)
 Lamentations of Jeremiah, a theatre cantata
 for dancers, soprano, and electronic tape (1962)

It seemed to me (ballet) (1963)
Ludlow Blues, for flute, alto sax, trombone, and tape (1963)
Judson No. 6 Piece (1963)

HELLERMANN, WILLIAM (USA) Ariel (1967)
Ek-Stasis (1968)
Mai 1968 (theatre) (1969)

HOWE, HUBERT (USA)
Composition for Two Speakers (1965-6)
Computer Variations (1967)

KIMMEL, WALTER (USA)
Cronaca (1967)
Hide and Seek (1968)

KRAFT, LEO (USA)
Fyre and Yse, for mixed chorus and tape (1967)
Dialogues for Flute and Tape (1968)

LANZA, ALCIDES (Argentina)
Exercise I (1965)
Plectros II, for piano and electronic
sounds (1966)
Jornadas de Musica Experimental:
JME ME 1-2 Interferences I, for two groups of wind
instruments and electronic sounds (1966)
Kromoplastics (for an exhibition) (1966)
Interferences II, for percussion ensemble
and electronic sounds (1967)
Two times too (film) (1967)
Strobe I, for double bass, miscellaneous
percussion instruments, lights, audience participation
and electronic sounds (1967)
Ekphonesis II, for voice, piano, and
electronic sounds (1968)
Out of (1969)
Penetrations I (for light and sound event) (1969)
Ekphonesis III, for any three instruments,
with voice, lights, electronic extensions, and
electronic sounds (1969)
Penetrations II, for winds, strings, percussion
and keyboard instruments, voices, lights,
electronic sounds, and electronic extensions (1969)
Penetrations IV (1970)
kron'ikelz, 70, for two choruses, two narrators,
orchestra, and electronic sounds (1970)
Penetrations V, for a minimum of ten sound
sources, with voices, lights,
electronic sounds, and electronic extensions (1970)
Electronic Music for Children (1970)

Mainstream: to be released

LEWIN-RICHTER, ANDRES (Spain)
The Gondola Eye (film) (1963)
Sublimated Birth (film) (1963)
Electronic Study No. 1 (1964)
Electronic Study No. 2 (1965)

Turnabout TV4004,TV34004S

LUENING, OTTO (USA)
Invention in 12 Notes (1952)
Low Speed for Tape Recorder (1952)
Fantasy in Space (1952)
Theatre Piece No. 11 (ballet) for tape, piano,
soprano, narrator, percussion
and wind instruments

Desto: DC 6466

Folkways: FX6169

(revision of "Opening" 1965) (1956)
 Dynamophonic Suite (1958)
 Gargoyles, for violin solo and synthesized sounds (1960) Columbia: ML5966, MS6566
 A Day in the Country, for violin and tape recorder (1961)
 Study in Synthesized Sounds (1961)
 Synthesis, for orchestra and electronic sound (1962) CRI SD 227
 Sonority Canon (1962)
 Moonlight, for tape recorder (1968) Desto: DC 6466
 Theatre Piece No. 11—Introduction (1970) CRI SD 268

LUENING and USSACHEVSKY
 Incantation (1953) Desto: DC 6466
 Rhapsodic Variations, for tape recorder
 and orchestra (1953-4) Louisville: Lou 545-5
 Of Identity (ballet) (1954)
 A Poem in Cycles and Bells, for tape
 recorder and orchestra (1954) CRI 112
 Carlsbad Caverns (TV)
 (sequence for "Wide, Wide World") (1955) RCA-Victor: LPM 1280
 King Lear (theatre) (expanded version 1966) (1956)
 Suite from King Lear (1956) CRI 112
 Mathematics (TV) (1957)
 Back to Methuselah (Theater) (1958)
 Concerted Piece, for tape recorder and
 orchestra (1960) CRI SD 227
 Incredible Voyage (with assistance of Shields & Smiley)
 (TV film 1968)

MAAYANI, AMI (Israel)
 Microtonus (1965)
 The Frame (film) (1965)

MAC INNIS, DONALD (USA)
 Intersections, for tape recorder and orchestra (1963)

MAKSIMOVIC, RAJKO (Yugoslavia)
 Two Basho's Haiku, for female voice, flute,
 violin, piano and tape (1966)

MIMAROGLU, ILHAN (Turkey)
 Four the News (1963-64)
 (Visual Study No. 1 after Jasper Johns)
 Green on a Black (1964)
 (Visual Study No. 2 after Ahmet Gursoy)
 Nocturne, for strings and tape (1964)
 Bowery Bum (1964) Turnabout TV 34004S
 (Visual Study No. 3 after Jean Dubuffet)
 Le Tombeau d'Edgar Poe (1964) Turnabout TV 34004S
 Intermezzo (1964) Turnabout TV 34004S
 Anacolutha (1965)
 Transitive I (1965)
 Agony (1965) Turnabout TV 34046S
 Transitive II (1966)
 Sodome et Gomorrhe (1966)
 (Music for Jean Giraudoux's play)
 White Cockatoo (1966)
 (Visual Study No. 5 after Jackson Pollock)
 Parmak Cocuk (1966-67) Ezgi 33-109
 (Music for a children's record)
 Fondation Maeght (1966-67)
 (Film music)
 Twelve Preludes for Magnetic Tape
 (1966-67) Turnabout TV 34177S
 Piano Music for Performer and Composer
 (1967) Turnabout TV 34177S

Preludes Nos. 2 and 12 (Second versions for
 the film "Fellini Satyricon") (1969)
 Wings of the Delirious Demon (1969)
 Music Plus One, for violin and tape
 (1970) Turnabout (to be released)
 Sing Me a Song of Songmy
 (1970) Atlantic SD 1576
 (for magnetic tape with pre-recorded jazz
 quintet, reciters, string orchestra,
 Hammond organ and chorus)

NIKOLAIS, ALWIN (USA)
 Totem—The World of Nikolaïs (ballet-film) (1962)
 Sanctum (ballet) (1964)
 to Gothic Tale (ballet) (1964)
 Galaxy (ballet) (1965)
 Vaudeville of the Elements (ballet) (1965)

NIKOLAIS and SEAWRIGHT
 Imago (ballet) (1963)

OBRADOVIC, ALEKSANDER (Yugoslavia)
 Mikro-simfonija, for orchestra and tape (1968)

PINILLA, ENRIQUE (Peru) Prisma (1967)

POWELL, MEL (USA) Electronic Setting I (1961)

ERIC SALZMAN (USA)
 Nude Paper Sermon Nonesuch 71231

SHIELDS, ALICE (USA)
 Domino (dance 1967)
 Witches Scenes from Macbeth (1967)
 Barabbas (theater 1968)
 Walking on the Surface of the Sun (1966)
 Electronic Music for the Ghost scenes in Hamlet (1967)
 Study for Voice and Tape (1969)
 The Transformation of Ani (1970) CRI SD 268

SMILEY, PRIL (USA)
 Macbeth (theater 1966)
 Can you hear me? (TV 1967)
 Richard III (theater 1967)
 The Balcony (theater 1967)
 Eclipse (four electronic tracks) (1967) Turnabout 34301
 St. Joan (theater 1968)
 Tiger at the Gates (theater 1968)
 Richard III (theater 1968)
 Elephant Steps (occult opera 1968)
 King Lear (theater 1968)
 Incredible Voyage (TV film 1969)
 Bananas (theater 1969)
 Satyricon (theater 1969)
 Inner Journey (theater 1969)
 The Increased Difficulty of Concentration
 (theater 1970)
 Operation Sidewinder (theater 1970)
 Kolyosa (1970) CRI SD 268
 The Trip (film 1970)

SMITH, WILLIAM O. (USA)
 Improvisation for clarinet and recorded clarinet (1960)

SOLLBERGER, HARVEY (USA)

Antigone (theater) (1966)
Antigone (concert version for actor and tape 1966)

SWICKARD, RALPH (USA)
Electronic Study No. 1 (1964)

TOYAMA, MICHIKO (Japan)
Waka, for speaking voice and tape (1959)

Folkways: FW 8881

USSACHEVSKY, VLADIMIR (USA)
Transposition, Reverberation, Experiment,
Composition (1951-2)
Underwater Valse (1952)
Sonic Contours (1952)
To Catch A Thief (film 1954—sound
effects only)

Folkways: FX 6169
Folkways: FX 6169
Desto: DC 6466

Piece for Tape Recorder (1956)

CRI 112

Metamorphoses (1957)

Son Nova 1988

Improvisation 4711 (1958)

Son Nova 1988

Linear Contrasts (1958)

Son Nova 1988

Studies in Sound, Plus (1959)

The Boy Who Saw Through (film) (1959)

Wireless Fantasy (originally De Forrest
Murmurs) (1960)

CRI SD 227

Creation Prologue, for four choruses and
electronic accompaniment (1960-1)

Columbia: ML5966, MS6566

No Exit (film) (1962)

Scenes from No Exit, for speaking voice
and taped sounds (1963)

Of Wood and Brass (1964-5)

CRI SD 227

Mourning Becomes Electra (Sound effects
for Marvin Levy's opera 1967)

Line of Apogee (with assistance of
Shields & Smiley) (film) (1967)

Suite from Music for Films (1967)

Piece for Computer (1968)

Incidental music to "The Cannibals" (1969)

American Theatre Production

Two Images for the Computer Piece (film) (1969)

Duck, Duck (film 1970),

We, CBC Radio play,

(with assistance of Shields 1970)

produced by Robert Chesterman

Two Sketches for Computer Piece No. 2
(1971)

CRI SD 268

VALCARCEL, EDGAR (Peru)

Cantata, for chorus and tape (1967)

Invención, para sonidos electronicos (1967)

VARÈSE, EDGARD (USA)

Deserts, for wind, percussion, and magnetic
tapes (definitive version or organized
sound done at Columbia-Princeton

Electronic Music Center with assistance
of Arel) (1949-54) (1960-1)

Columbia: ML 5762, MS 6362
CRI SD 268

WHITTENBERG, CHARLES (USA)

Electronic Study No. 2, with contrabass (1962)

Advance: FGR-1

Event, for chamber orchestra with tape (1964)

WINKLER, PETER (USA) Agamemnon (theatre) (1966)

WUORINEN, CHARLES (USA)

Consort from Voice and Instruments (1960)
 Symphonia Sacra, for 3 voices,
 5 instruments and tape (1960-1)
 Orchestral and Electronic Exchanges, for
 orchestra and tape (1965)
 Time's Encomium, for synthesized and
 processed synthesized sound (1969)

Nonesuch: H 71225

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BABBITT, MILTON

"Electronic Music: The Revolution in Sound", University Magazine, No. 4, Spring 1960, pp. 4-8. "Twelve-Tone Rhythmic Structure in the Electronic Medium", Perspective of New Music, Vol. 1, No. 1, Fall 1962, pp. 49-79.
 "The Synthesis, Perception, and Specification of Musical Time", The Journal of the International Folk Music Council, Vol. XVI, 1964, pp. 92-95.
 "An Introduction to the RCA Synthesizer", The Journal of Music Theory, Winter, 1964, Vol. 8, No. 2, pp. 251-265.
 "An Interview with Milton Babbitt", The Music Educators Journal, November 1968, pp. 23-27, 79-81.

LUENING, OTTO

"Widening Horizons for Music", The Story of Our Times, Grolier Encyclopedia Yearbook, Grolier Society, New York, 1954.
 "New Sound Techniques in Music", Art and Artists, University of California Press, Berkeley, 1956. "Karlheinz Stockhausen", Juilliard Review, Vol. 6, Winter, 1958-1959.
 "Electronic Music: A practical guide", Music Today, Vol. 3, No. 1, November-December.
 "Some Random Remarks About Electronic Music", Journal of Music Theory, VIII, 1, 1964, p. 89. "Experimental Music in the United States", U.S. Information Agency, 1965.
 "Experimentelle Musik in der U.S.A.", Neue Zuercher Zeitung, Switzerland, 1965.
 "An Unfinished History of Electronic Music", Music Educators Journal, November, 1968.

MAUZEY, PETER

"Specialized Equipment Used at the Columbia University Studio for the Production of Tape Music," Audio Engineering Society Preprint, No. 57, New York, New York, 7 pp., October, 1958, (Presented at the Tenth Annual AES Convention, September 29, 1958).
 "The Electronic Music Center of Columbia and Princeton Universities", Columbia Engineering Quarterly, Vol. 13, No. 2, Columbia University, New York, New York, pp. 20-21, January, 1960.
 "A Control Console for Multi-Speaker Presentations of Electronic Music", Journal of the Audio- Engineering Society, Vol. 10, No. 4, p. 338 ff, October, 1962.

SEAWRIGHT, JAMES

"What is Electronic Music?" Radio Electronics, XXXVI, p. 36, June, 1965.

USSACHEVSKY, VLADIMIR

"Sound Materials in the Experimental Media of Musiquo Concrete, Tape Music and Electronic Music." (Abstract), Journal of the Acoustical Society of America, XXIX, 1957, 768.
 "The Processes of Experimental Music", Journal of the Audio Engineering Society, Vol. 6, No. 3, July, 1958.
 "Columbia-Princeton Electronic Music Center", Revue Beige de Musicologie, Vol. XIII, 1959.
 "Music in the Tape Medium", The Juilliard Review, Spring, 1959.
 "Notes on a Piece for Tape Recorder", Musical Quarterly, Vol. XLVI, No. 2, April, 1960, reprinted in the The Problems of Modern Music, Ed. by P. H. Lang, Norton paperback.
 "Synthetic Means", The Modern Composer and his World, Beckwith and Kasemets, eds., Toronto: University of Toronto Press, 1961.
 "Musical Timbre by Means of the Klangumwandler", Audio Engineering Society Preprint, No. 65. "Electronic Music", Tape Recording, Vol. 14, No. 1, December, 1966.
 "The Making of Four Miniatures—an Analysis", The Music Educators Journal, November 1968, pp. 45-48.
 "Applications of Modern Technology in Musicology, Music Theory, and Composition", a paper with an extensive bibliography on Computer application in various musical disciplines included among the Papers of the Yugoslav—American Seminar on Music, 1968, edited by Malcome H. Brown, and published by Indiana University, Bloomington, III. 1970.
 "Ussachevsky and Nowak on Electronic Music", Quadrille, Vol. III, No. 2, Bennington College, Bennington, Vermont, January, 1969.

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