CHAPTER TWO

THE GREAT OPENING UP OF MUSIC TO ALL SOUNDS

As if models of a synchronous universe, every musical composition and painting of the Newtonian period—roughly from 1600 to 1900—reflected one line of time. In every musical composition, there was but one line of chord progressions to which all notes were synchronized. In every painting, there was but one line of travel for a viewer's eyes, one perspective to which all objects were synchronized. Newton, in his *Principia* (1687), called that one line of time *Absolute Time*:

> Absolute, True, and Mathematical Time, of itself, and from its own nature flows . . . All motions may be accelerated and retarded, but the True, or equable progress, of Absolute Time is liable to no change . . .

It was and still is a matter of common sense to view the universe as synchronous. When we say "We'll see you at 7," we do so knowing full well that our watches are ticking at the same rate, that we are all synchronized to a single line of time.

But common sense is not the only reality. At the beginning of the twentieth century, it had become clear that the universe—atoms, light quanta, stars—extended to smaller and larger items than could be seen by the naked eye. And Einstein, in the Special Theory (1905), portrayed an asynchronous universe of

multiple clocks, where each clock relative to other clocks ticked faster or slower according to the speed with which it traveled through space.

The idea of relative speed is easy to understand. A train that moves at 60 mph, for example, is in fact moving at 60 mph faster than the surface of the earth; and when we pour coffee in that train, the coffee pours straight down because it too is moving at 60 mph and is, consequently, at rest relative to the train. What is neither easy to understand nor verifiable in common sense is that, because it is moving faster than the surface of the earth, the train's "clock" is ticking more slowly than a clock on the surface of the earth. As proposed in the Special Theory, the faster something moves, the more slowly its time passes. Einstein's universe, in short, was a multiplicity of parallel and asynchronous timelines.

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The idea of an asynchronous universe was in the air. It's not that early twentieth-century poets, musicians, and artists read Einstein. It's just that some of them sniffed the new idea and saw things in a new way. As they looked around, they saw simultaneous and asynchronous activities, or processes, or "stories," each developing at its own rate. In *Lundi Rue Christine* (1913), for example, Guillaume Appollinaire juxtaposed unrelated phrases and fragments as if they were "plucked" from independent and parallel storylines:

> *Three lit gas jets*
> *The proprietress has bad lungs*
> *When you've finished we'll play a hand of backgammon*
> *An orchestra conductor who has a sore throat*
> *When you come to Tunis I'll give you some kef to smoke*
>
> *This seems to rhyme*

It was liberating. Indeed, *anything* could seem to rhyme. Anything could go together with anything else. It was as if the world had opened up. "We must throw wide the window to the open sky," Claude Debussy wrote through Monsieur Croche. "Music was born free; and to win freedom is its destiny," Ferruccio Busoni wrote in his *Sketch of a New Aesthetic of Music*. In the new music of the early twentieth century, chords and melodies were "plucked" from different keys and juxtaposed in a multiplicity of new combinations; as in, for example, Igor Stravinsky's *Le Sacre du Printemps* (1913), so large in scale, so complex in its combinations and superimpositions of rhythms, chords and melodies, so rich in the originality of its musical invention, that the riot at its premiere seems a reasonable public reaction; or as in Charles Ives' *Putnam's Camp*, finished in 1914 as part of his orchestral suite *Three Places in New England*, where campfire songs and marches are superimposed as asynchronous and simultaneous processes in a free-for-all celebration of the Fourth of July.

Everything thinkable was possible, including the plucking of *found objects* from their normal environments and contexts and juxtaposing them with other found objects in artworks. Pablo Picasso's *Still Life with Chair Caning* (1912), for example, contains a piece of oilcloth and hemp rope. *Man with a Hat*, one of several *papiers collés* finished by Picasso also in 1912, is a cubist drawing in charcoal and black ink of a man's face and upper torso, with blue paper and newspaper cutouts glued to the surface. Nor was Picasso alone in using found objects. His first assemblages were the beginning of a twentieth-century mainstream that included works by Georges Braque, Juan Gris, Marcel Duchamp, Kurt Schwitters, Hannah Höch, Man Ray, Jean Tinguely, Robert Rauschenberg, and many other artists. Although Duchamp, in particular, did raise a few eyebrows from time to time, particularly with his so-called *ready-mades*, the use of found objects in the visual arts was normal.

In music, on the other hand, the use of found sounds was abnormal, controversial, and sometimes technically problematic. *Parade*, for example, produced at the Châtelet Theatre in Paris on May 18, 1917, conceived by Jean Cocteau, designed by Pablo Picasso, choreographed by Léonid Massine, with music by Eric Satie, was received with scant applause and an abundance of critical hostility. Satie, doubtless speaking for generations of composers before and after, responded to one of the more negative critics with the postcard: "Sir and Dear Friend, You are only an arse, but an arse without music." And the critic, demonstrating thereby how right Satie was, sued Satie. At the conclusion of an excited trial, during which Cocteau was in momentary physical conflict with the courtroom police, Satie was given an eight-day suspended sentence. Yes, *Parade* was controversial. And there were technical problems. The found-sound devices planned by Cocteau hadn't worked well. Cocteau later wrote:

> The score of *Parade* was intended to serve as a background to suggestive noises . . . in effect, noises played an important role in *Parade*. Practical problems (lack of compressed air, among others) deprived us of these "trompe l'oreille" sounds—dynamo, Morse code machine, sirens, steam engine, airplane motor—which I used just like "trompe l'oeil"—newspaper, cornice, artificial wood—is used by painters. We could hardly make the typewriters heard.

The sweetest example of found sounds in those early days was the use of recorded nightingales during a performance of Ottorino Respighi's orchestral piece *Pines of Rome* in 1924. The loudest example was George Antheil's use of an airplane engine on stage for his *Ballet Mécanique* in 1926. The *Ballet Mécanique* was noted by, among others, Ezra Pound, who wrote:

> Antheil has made a beginning; that is in writing music that couldn't have been written before. His musical world is a world of steel bars, not of old

stone and ivy. With the performance of the *Ballet Mécanique* one can conceive the possibility of organizing the sounds of a factory, let us say, of boiler plate or any other clangorous noisiness, the actual sounds of the labor, the various tones of the grindings . . .

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John Cage was the first composer to focus on the use of found sounds, and one route to Cage is through Marcel Duchamp. At first as an amusement, Duchamp mounted a bicycle wheel upside down on a stool in his studio. Later, in 1913, he saw it in a more serious context, as a prototype *readymade*, as he called it. Other readymades followed, among them *In Advance of a Broken Arm* (1915), a snow shovel with the title written on the back of the blade, and *Fountain* (1917), a porcelain urinal with the inscription "R. Mutt, 1917" painted on the front. Of *Fountain*, Duchamp wrote:

> Now Mr. Mutt's fountain is not immoral, that is absurd, no more than a bathtub is immoral. It is a fixture that you see every day in plumbers' show windows.
>
> Whether Mr. Mutt with his own hands made the fountain or not has no importance. He CHOSE it. He took an ordinary article of life, placed it so that its useful significance disappeared under the title and point of view—created a new thought for that object.

L.H.O.O.Q. from 1919, a so-called "rectified" readymade, was a reproduction of the *Mona Lisa* with a mustache and goatee drawn on it. It was described by its creator as:

> a combination readymade and iconoclastic dadaism. The original, I mean the original readymade is a cheap chromo 8 x 5 on which I inscribed at the bottom four letters which pronounced like initials in French, made a very risqué joke on the *Gioconda*.

La Gioconda is the Italian name for the *Mona Lisa*. *L.H.O.O.Q.* is in fact five letters (but who's counting?). The risqué joke is in the French pronunciation of the five letters as *elle a chaud au cul*, which means, in roughly equivalent jargon, "she's got a hot ass"—which, as Duchamp remarked, explained her smile. Duchamp had a talent for scandal, as did John Cage. And Cage, from his point of view, felt a particular affinity for Duchamp's work, as well as a friendship for the man and, one might guess, empathy with the mischievousness of his personality. Several of Cage's compositions involve Duchamp in the title or in some other way. There is a series of graphics from 1969 called *Not Wanting to Say Anything About Marcel* and a wonderful mesostic, one of the *36 Mesostics Re and Not Re Duchamp*, which is:

since other Men
mAke
aRt,
he Cannot.
timE
is vaLuable.

But whereas Duchamp started by discovering a readymade in his own studio, Cage started by defining concepts of musical structure that were independent of any particular sound. As he said, "Structure in music is its divisibility into successive parts . . ." Of his *Construction in Metal* (1939), Cage wrote:

> I felt the need of finding some structural means adequate to composing for percussion. This led me eventually to a basic reexamination of the physical nature of sound. Sounds, including noises, it seemed to me, had four characteristics (pitch, loudness, timbre and duration), while silence had only one (duration). I therefore devised a rhythmic structure based on the duration, not of notes, but of spaces of time . . .

Cage defined the parts before putting in the sounds. Of his *Sonatas and Interludes* (1948), he wrote, "the structure . . . was one hundred measures of two-two time, divided into ten units of ten measures each . . . combined in the proportion three, three, two, two . . ." In other words, Cage conceptualized musical structure as an array of empty glasses of predetermined sizes to be filled with sounds or silences. His silent piano piece, originally titled *4'33"*, makes the idea crystal clear. It is, in effect, three empty glasses. The score specifies only a structure of three silent parts, and the note to the score explains, partly by example, the concept:

> The title of this work is the total length in minutes and seconds of its performance. At Woodstock, NY, August 29, 1952, the title was 4'33" and the three parts were 33", 2'40", and 1'20". It was performed by David Tudor, pianist, who indicated the beginnings of parts by closing, the endings by opening, the keyboard lid. However, the work may be performed by any instrumentalist or combination of instrumentalists and last any length of time.

Cage's idea of structure had its most important consequence in his corollary idea that any sound or silence might fill the glasses. In *Construction in Metal*, Cage filled them with percussion sounds. In *Sonatas and Interludes*, he filled them with prepared piano sounds produced by various rubber wedges, screws, and other items placed between the strings of a piano, the goal of which was to turn a piano into a keyboard-controlled percussion ensemble. He also filled the glasses with found sounds. In *Imaginary Landscape #1* (1939), he

called for variable-speed phonograph turntables. In *Imaginary Landscape #3* (1942), it was tin cans and electronic oscillators. *Imaginary Landscape #4* (1951) was for twelve radios, and *Imaginary Landscape #5*, finished in January 1952, used material from forty-two phonograph records. Cage had expressed his interest in found sounds as early as 1937 when he said:

> I believe that the use of noise to make music will continue and increase until we reach a music produced through the aid of electrical instruments which will make available for musical purposes any and all sounds that can be heard . . . whereas, in the past, the point of disagreement has been between dissonance and consonance, it will be, in the immediate future, between noise and so-called musical sounds.

By "noise," Cage meant found sounds. By "musical sounds," he meant, well . . . As he put it:

> Wherever we are, what we hear is mostly noise. When we ignore it, it disturbs us. When we listen to it, we find it fascinating. The sound of a truck at fifty miles per hour. Static between the stations. Rain. We want to capture and control these sounds, to use them not as sound effects but as musical instruments . . . If this word "music" is sacred and reserved for eighteenth- and nineteenth-century instruments, we can substitute a more meaningful term: organization of sound.

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In his approach to using found sounds, Pierre Schaeffer, in Paris, followed Cage's lead. By training a radio engineer and by profession an announcer for Radiodiffusion Française (RF), Schaeffer had been able to establish an embryonic research facility at RF in Paris as early as 1942, during the German occupation. At first called Studio d'Essai, it was renamed Club d'Essai in 1946 and served as a base for experiments in radio-theater and music.

In 1948, Schaeffer got another idea. As he wrote at Easter: "Certainly the idea of a concert of locomotives is exciting. Sensational." On May 3, he wrote, "Here I am en route to the station at Batignolles, with a sound truck and naively treasuring my false good idea." The composition, which contains juxtaposed sections of locomotive steam and wheel sounds, their periodic rhythms punctuated with whistles, was called *Etude aux Chemins de Fer* (Railroad Study). It was significant because it was the first recorded assemblage of sounds and, as such, it launched a new technique and gave rise to a new way of thinking about music. In an entry dated May 15, Schaeffer introduced his term *musique concrète*:

> This determination to compose with materials taken from an existing collection of experimental sounds, I name *musique concrète* to mark well the place in which we find ourselves, no longer dependent upon preconceived sound abstractions, but now using fragments of sound existing concretely and considered as sound objects defined and whole . . .

Schaeffer completed a series of five short musique concrète studies in 1948: *Etude aux Chemins de Fer* was the first, to be followed by *Etude aux Tourniquets*, with sounds from toy tops and percussion instruments; *Etude Violette*, using piano sounds recorded for Schaeffer by Pierre Boulez; *Etude Noire*, also using piano sounds recorded for Schaeffer by Boulez; and *Etude Pathétique*, using sounds from saucepans, canal boats, words sung and spoken, a harmonica, and a piano. There was one more piece in 1948, the *Diapason Concertino*, based on piano sounds recorded for Schaeffer by Jean-Jacques Grunenwald.

Following a spirited reception of the *Etudes* as heard in a radio concert called *Concert de Bruits* (Concert of Noises), broadcast on October 5, 1948, Schaeffer asked the RF administration for a team of assistants. In 1949, he was joined by Pierre Henry as co-researcher and Jacques Poullin as technician and the first culmination of their joint efforts was a live concert of musique concrète on March 18, 1950, at the Ecole Normale de Musique in Paris. The concert included the first performance of *Symphonie pour un Homme Seul* (Symphony for One Man Alone), a Schaeffer-Henry collaboration. The original version, as played in that concert, contained twenty-two movements—some of them called by classical names such as *Partita*, *Valse*, and *Scherzo*, and some using spoken words and rhythmic patterns produced by percussion instruments. A later version by Henry reduced the number of movements to twelve.

Pierre Henry was important in the collaboration. As a free-lance musician, he had made the music for a film called *Voir l'Invisible* (To See the Invisible), and as he recalls, "At that point I wanted to meet Pierre Schaeffer—I had heard the *Etudes de Bruit* and I wanted to show him what I'd done because I thought he was very close to what I wanted to do." Henry had gone to see Schaeffer just as Schaeffer was looking for a composer to work with him on research in sound. Henry started to work on *Symphonie pour un Homme Seul* and, as he puts it, "I found my voice." Henry continues:

> A lot of the *Symphonie*. . . was taken from pieces that I'd composed before. We transformed them. We worked with very primitive equipment and, even more, the loudspeakers weren't very good so we couldn't hear very well what we should do. It needed a lot of imagination. And I was very surprised at the success of the first experiments. People wanted to hear them. They were interested because we made new sounds that suggested an extraordinary instrument.
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> Working with Schaeffer was an intellectual challenge. I was very young, twenty or twenty-one years old, and it was formative for me. I was there twelve hours each day. He came from time to time and modified

what I had done. He was perhaps more intellectual than I was at the time, and I was more of a musician. He was more theoretical, I was more expressive. The first years were the discovery of sound. After that it became more formal—"Pierre, do this phrase, do more of that sequence . . ." Schaeffer gave ideas, suggestions, orders . . . He was in charge of the studio and I was a salaried employee. Afterwards, I worked for myself. But there, I worked for Schaeffer.

In those days before RF acquired tape recorders, Schaeffer and Henry recorded sound by cutting directly into a disc with a lathe. Sounds were edited by playing back several discs simultaneously and switching between them with a mixer. Henry's description of composing *Symphonie pour un Homme Seul* with, as he put it, "primitive equipment" was from today's perspective certainly appropriate.

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Other composers had also experimented with found sounds. During the 1920s and 1930s, Darius Milhaud, Percy Grainger, Paul Hindemith, and Ernest Toch, at different times and with different intents, had experimented with variable-speed phonographs as a means to transform recorded sound. Primitive perhaps, but at the time it was the only technology available. The phonograph with a hollow cylinder had been invented by Thomas Edison in 1877; the gramophone with a flat disc had been invented ten years later by Emile Berliner; and by the 1920s, the gramophone, often called a phonograph, had become a commercial item. The serious problem in phonograph technology, however, was that a phonograph recording could not be edited. For a period during the 1930s, optical recording, in particular the early work of Norman McLaren in Canada and Yevgeny Sholpo in Russia, seemed to have possibilities. But the first real solution to editing was magnetic recording on tape.

The history of magnetic recording begins in the late nineteenth century. The September 8, 1888 issue of *The Electrical World* carried an article entitled "Some Possible Forms of Phonograph," written by Oberlin Smith, an American engineer. Smith began as follows:

> There being nowadays throughout the scientific world great activity of thought regarding listening and talking machines, the readers of *The Electrical World* may be interested in a description of two or three possible methods of making a phonograph which the writer contrived some years ago, but which were laid aside and never brought to completion on account of a press of other work.

Smith, in other words, published his ideas in the hope that others, less pressed for time than he was, might develop them. He went on to suggest that a thread or ribbon of magnetizable material, or possibly material coated with magnetizable dust, could provide a basis for recording and playing back sound.

In 1898 in Denmark, Valdemar Poulsen had the same idea. He proceeded to invent what he called the Telegraphone, a machine which recorded sound magnetically on a steel wire, and presented it at the Paris Exposition in 1900, winning the grand prix for scientific invention. Articles were published in scientific magazines, among them *Scientific American*, *The Electrician*, *Annalen der Physik*, and *Comptes Rendus*.

In 1903, American Telegraphone Company was founded to manufacture and market Poulsen's device. Advertisements appeared featuring Phoebe Snow, a famous model of the time, happily playing stenographer with her dictating-machine Telegraphone. Phoebe Snow, however, was far more beautiful than the Telegraphone, which remained ugly, heavy, difficult to use, and expensive. There were, nonetheless, occasional sales, among them to E. I. Dupont de Nemours & Company for a central dictation facility in their Wilmington, Delaware, office. And there were more than occasional lawsuits, one of them brought by E. I. Dupont de Nemours & Company because the dictation machines did not work. Other lawsuits were brought by unhappy shareholders. By the 1920s, all manufacture had ceased and the sole activity of the American Telegraphone Company was litigation.

In 1925, Kurt Stille and partners founded Telegraphie-Patent Syndikat Company in Germany to license the manufacture of magnetic recorders. There were two important licensees: Ludwig Blattner and Karl Bauer. Blattner developed the Blattnerphone, which used a steel band instead of a wire as the recording medium (an idea, incidentally, which had also occurred to Poulsen). In 1930, the British Marconi Company bought Blattner's company and, with the cooperation of Stille Laboratories, developed an improved Marconi-Stille steel tape machine that was used by the BBC at its studios at Maida Vale in London. It was described as presenting the "risk of instantly decapitating anyone within reach of its whirling steel tape . . ." The reels weighed twenty-two pounds and turned at an impressive speed. The recording engineers were located in an adjoining room in case the steel tape broke and "thrashed ungovernably about . . ." Editing the tape was a matter of welding. Although not user friendly by later standards, its use was occasionally distinctive, as on Christmas Day, 1932, when it was used to broadcast a speech by King George V.

Karl Bauer, meanwhile, organized Echophone Company to manufacture the Dailygraph, a wire recorder that featured cartridge containment of the wire. Echophone Company was purchased in 1932 by C. Lorenz Company which manufactured and marketed an office dictation machine called the Textophone.

In 1927, a United States patent describing a recording tape of powdered magnetic material was issued to J. A. O'Neill. In 1928, a German patent describing a recording tape of powdered magnetic material was issued to Fritz Pfleumer. In 1931, Pfleumer succeeded in interesting I. G. Farben in developing plastic-backed tape. He also interested Allgemeine Electrizitäts Gesellschaft (AEG) in developing tape machines. In 1935, AEG introduced the new

Magnetophone at the German Annual Radio Exposition in Berlin with the first example of plastic tape. It was less expensive than steel tape, which was a major benefit, but it felt like sandpaper and created clouds of dust as it passed through the recorder.

By the mid-1930s, magnetic recording was established as an emerging technology. Wire and steel tape recording were of acceptable quality; plastic tape seemed promising; Lee De Forest's audion had become commercially available for use in the amplification of weak signals; and AC biasing techniques, invented in 1921 by Wendell L. Carson and Glenn W. Carpenter of the United States Naval Research Laboratory, were used to improve the signal-to-noise ratio in recording and playback. In 1936, the London Philharmonic Orchestra, Sir Thomas Beecham conducting, was recorded at I. G. Farben headquarters at Ludwigshafen, Germany.

Improvements, of course, continued during World War II. Several American companies, among them Brush Development Company, Armour Research Foundation, H. G. Fischer Company, and General Electric, developed wire recorders for military and commercial use. During the same period, AEG improved the use of plastic tape. By 1945, the AEG Magnetophone had a frequency response of up to fifteen kilohertz at a tape speed of thirty inches per second. Colonel Richard Ranger, a pioneer in the design and manufacture of tape recorders, recounts his entry into Berlin with the allies in 1945 :

> The center of the Magnetophone production was the AEG in the part of Berlin which finally came under the French. I found that there were parts for eighteen machines available which had not been assembled. The French agreed to let them be assembled and the eighteen were to be apportioned six to the French, six to the British and six to the United States. When I came back some weeks later, I found that the first had gone to the French, the second to the British and the third was to go to the French. Well, we finally got that straightened out . . .

Additional examples were shipped to the United States from Frankfurt. And interest in tape recording took a major jump forward. Magnecord, Rangertone, and Ampex were formed in 1946, spurring interest at Minnesota Mining and Manufacture (3M) to develop a better plastic tape. The problems with the AEG tape were low output, the necessity of playing it at high speed, and lack of uniformity in its response. Dr. W. W. Wetzel, then head of the physics section of the 3M research division, put together a team to develop a new oxide coating for plastic tape, while other groups at 3M developed manufacturing technologies. In 1947, the first commercial tape was produced with a black oxide coating. And Bing Crosby entered the field. Again, Richard Ranger:

> Bing Crosby started transcription broadcasting using discs in 1946. But building a finished program on disc by retranscribing from disc to disc took time and degraded the quality with successive generations, so it was decided to test out all the available media . . . In the summer of 1947 Bing came to New York for a program and it was recorded at WJZ in New York, on disc and film. . . They then asked us how long it would take us to come up with a tape version. We quite surprised them by saying, "Would tomorrow evening be all right?" . . . In a couple of months all the Crosby shows were from tape spliced together . . .

In the fall of 1947, 3M finished the development of a new magnetic material, a red oxide, which made possible a fifteen-kilohertz frequency response at a lower tape speed (seven and one-half inches per second) and greatly improved uniformity, all of which, in short, resulted in a lower cost, longer playing, and higher fidelity tape. In 1948, the market began major expansion as Bing Crosby Enterprises became a distributor for the new Ampex 200 tape machine. In 1949, two things happened: Magnecord introduced the first stereo tape machine. And the first commercial splicing block was introduced.

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The story of the Paris studio continues. The first performance of *Symphonie pour un Homme Seul* on March 18, 1950, had been problematic, in large part because of technical complexities in manipulating turntables and mixers. Those problems led Schaeffer to suggest, in 1951, that Jacques Poullin build the *pupitre d'espace*, a mechanism for distributing sound throughout the space of a concert hall. Schaeffer also conceived of two special tape recorders—the *Phonogène*, a variable-speed variable-pitch tape recorder, and the *Morphophone*, a tape recorder with multiple heads allowing for various delay and desynchronizing effects—which were built by Poullin. Pierre Henry composed *Aube*, *Microphone Bien Tempéré*, *Musique sans Titre*, *Concerto des Ambiguités*, and *Astrologie*, among other pieces, and he worked with Schaeffer on *Orphée*, a musique concrète opera first performed at the Théâtre de l'Empire in Paris on July 6, 1951.

In 1951, Schaeffer reestablished the studio, with tape recorders, as the Groupe de Recherche de Musique Concrète. It quickly got busy: André Hodeir composed *Jazz et Jazz* (1951), for piano and tape; Pierre Boulez composed *Etude I sur un Son* (1952) and *Etude II sur Sept Sons* (1952); Olivier Messiaen composed *Timbres-Durées* (1952); Karlheinz Stockhausen composed *Etude* (1952); Michel Philippot composed *Etude I* (1952); and Pierre Henry composed *Vocalises* (1952) and *Antiphonie* (1952), among other works, while working on revisions to *Orphée*. Schaeffer was mainly engaged in the formulation of a theory of sound objects.

Orphée was performed again as *Orphée 53* at the Donaueschingen Musiktage, a prestigious festival in Germany, on October 10 and 11, 1953. Its reception at Donaueschingen, however, was problematic. Henry recalls:

Pierre Henry at the pupitre d'espace in a concert at the Salle de L'Ancien Conservatoire in Paris in 1952. Induction coils were used to pass the signal from channel to channel. Photo courtesy Pierre Henry.

> There was a riot. Everyone in the room was against it. They shouted. They made more noise than the loudspeakers. But that was normal because there were so many new sounds. It wasn't in the tradition of the contemporary music of the time, and it was for this reason that the German public revolted against it. But I was happy that the public took it so seriously. And it gave me taste for combat, to battle against the public until they understood the music.

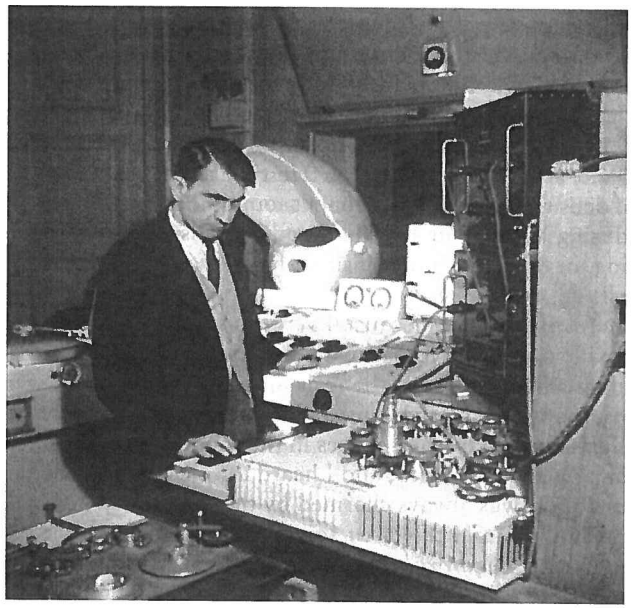
Shortly after the performance at Donaueschingen, Schaeffer became occupied with radio projects in the French colonies in North Africa. Henry remained at the studio in Paris and composed *Le Voile d'Orphée* (1953), among other works. As he explained, "*Le Voile d'Orphée* existed within the larger *Orphée*, but because Pierre Schaeffer had nothing to do with its composition, I kept it as my own." And the studio remained generally busy. Jean Barraqué composed *Etude* (1953); Darius Milhaud composed *La Rivière Endormie (Etude Poétique)* (1954), for mezzo soprano, narrators, orchestra, and tape; and Edgard Varèse came to the studio from New York, at Schaeffer's invitation, to compose some of the tape part to *Déserts* (1954), for orchestra and tape. Schaeffer kept in touch and came back from time to time.

In 1955, Maurice Béjart visited the studio and that same year choreographed *Symphonie pour un Homme Seul*. It was successful. As Henry said, "It was the *Symphonie* . . . that made Béjart famous." In 1956, Henry composed *Haut Voltage* specifically for Béjart's dance company. As he said, "It gave me a taste to make concerts theatrical—the effectiveness of the lights, the visual activities . . ." Henry and Béjart began a fifteen year collaboration.

In 1957, Schaeffer returned to Paris. In 1958, Henry left his position at RF and, in 1959, established the Studio Apsome and began to work again as a professional composer. Henry remembers:

> I left because he wanted me to leave. All of the studio equipment that was used before 1958 was locked up because Schaeffer wanted to start from zero. He thought that I was dangerous for the formation and functioning of a new group. And, yes, I did want to work independently. I financed the Studio Apsome by my professional work. I made recordings. I made montages for my clients. I did publicity, films. It was auto-financed, with-

Pierre Schaeffer in 1952 with two different versions of the phonogène, a variable-speed tape recorder built by Jacques Poullin. On the left is the phonogène à coulisse, in which the tape speed is controlled with a handle to produce continuous change from 0 to 76 centimeters per second. On the right is the phonogène à clavier, in which the tape speed is controlled by a keyboard to produce twelve discrete pitch levels. Photo courtesy GRM.



out help. There was a lot of music for film, lots of discs, lots of events with the public, with lights . . .

Henry worked with other composers, among them Eliane Radigue. And into the 1960s, he composed several important works, including *La Noire à Soixante* (1961), *Le Voyage* (1962), *Variations pour une Porte et un Soupir* (1963), and *Apocalypse de Jean* (1968). *Variations pour une Porte et un Soupir* (Variations on a Door and a Sigh) was exceptional in the simplicity of its sound sources and the ingenuity with which the sounds were used. As Henry describes it, "It was a question of recording a door in a way that there was a form to the sound, a grain, a color, like an instrument, and the rest was the sound of a sigh, a breath—there was no transposition, no treatment, it was only a montage and little bit of mixing."

Meanwhile, in 1958, with Luc Ferrari and François-Bernard Mâche, and also with Michel Philippot and Iannis Xenakis, Schaeffer established a new studio called Groupe de Recherches Musicales (GRM). Xenakis, in particular, emerged as an original and significant voice. As he put it, "The idea of musique concrète was that you could use all sorts of sounds or noises—I discovered the noises." And what was it like to work at GRM? Xenakis describes it:

> At that time, there was no teaching of the system there. We didn't have any specific training. It was really free. We had some people working with us, helping, and they did whatever you told them to do. They were paid.

He adds, pensively, "I was not paid." In his early tape pieces at GRM, he used recorded acoustic sounds modified by tape manipulations—changing speed, playing backward, splicing—and mixing, but without electronic processing such as filtering and modulation. His compositions, however, were not juxtaposed "objects," as in normal musique concrète, so much as they were complex sound-masses that transformed in time as the result of shifting distributions and densities of small, component sounds. His experiences in the Greek resistance during World War II had shaped his sense of sound as sharp, powerful, striking, never pretty, never insipid. In his words:

> It's interesting for me because I've been in musical environments that were made not only with individual sounds but also with large numbers of sounds. When I was in the resistance in Athens, there were multiple sounds, many people shouting at the same time, in thousands of cries. And I was amazed by the changes in the sounds. Another thing. I used to go camping around Attica, and I heard the cicadas and the raindrops on my tent, and I was always charmed by these noises.

In composing *Diamorphoses* (1957), Xenakis used the sounds of jet engines, car crashes, earthquake shocks, textures of sliding pitches, and other noiselike sounds, and sometimes contrasted them with thin, high bell sounds. *Concret P.H.* (1958) is a minimal, short piece based on the grainy, sandy sounds of burning charcoal, with varying density and register achieved by the overlays of tapes played at different speeds. *Orient-Occident* (1960), composed for a UNESCO film by Enrico Fulchignioni comparing sculpture and art of different cultures and times, was based on the sounds of bowed boxes, bells, and metal rods, sounds from the ionosphere, and a speed-altered excerpt from Xenakis' orchestral work *Pithoprakta*. In composing *Bohor* (1962), Xenakis used the sounds of bracelets, other jewelry, and a Laotian mouth organ. He remembers:

> I did *Bohor* with all sorts of sounds with bracelets. I had some necklaces from Iran. I was interested in the tiny sounds because you could expand them and find different sounds in them. I dedicated the piece to Schaeffer. He hated the piece.

By 1960, Radiodiffusion Française had become Radio Télévision Française (RTF) and in the new context of television, Schaeffer proposed to the RTF administration a plan to create Le Service de la Recherche, an organization that would include GRM but expand its experiments to include visuals. The administration accepted Schaeffer's proposal, and the new *Service* was established in a beautiful ivy-lined brownstone in Passy, an elegant section of Paris. Also in 1960, François Bayle began to work with Schaeffer in the dual capacity of student and general administrative and public relations assistant.

In 1963, Bayle became a salaried administrator in GRM, Radio Télévision Française became Office de Radio Télévision Française (ORTF), and Schaeffer was writing *Traité des Objets Musicaux*, a book of essays on musique concrète. In 1966, Schaeffer's book was published and Bayle became Director of GRM. In 1974, ORTF was partitioned into several organizations, among them Radio France and Institut National Audiovisuel (INA). GRM was administratively incorporated into INA and relocated inside the remarkable, round Radio France building in Paris. It was the beginning of a new line of technical development. And looking back, Bayle makes an important point:

> Musique concrète wasn't at all a music of noises, not at all a music of provocation. It was the contrary. It was a music that uses all the resources that are available to us, a music that uses all the sounds of life. Musique concrète sounds have meanings for us, as photographs and films have meanings. They show life as we experience it, as we live it in the everyday world.

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The story of the Cologne studio begins in 1948. Homer Dudley, from Bell Telephone Laboratories at Murray Hill, New Jersey, visited Werner Meyer-Eppler, director of the Institute of Phonetics at the University of Bonn,

Germany. Dudley showed Meyer-Eppler a newly developed *vocoder*, a device for electronically processing vocal sounds.

What followed was a two-year flurry of lectures, demonstrations, meetings, and collaborations. Meyer-Eppler used taped examples of the vocoder's sounds to illustrate a lecture called "Developmental Possibilities of Sound" at a Tonmeister conference in Detmold in 1949. Robert Beyer, from the Westdeutscher Rundfunk (WDR) in Cologne, at that time called the Nordwestdeutscher Rundfunk (NWDR), heard the lecture and began a cooperative relationship with Meyer-Eppler to advance the cause of electronic music. In August 1950, Meyer-Eppler and Beyer presented lectures under the general heading of "The World of Sound of Electronic Music" at the International Summer School for New Music at Darmstadt. Herbert Eimert heard the lectures and joined forces with Meyer-Eppler and Beyer. Later in 1950, Harald Bode delivered a *Melochord*, his keyboard-controlled electronic instrument, to Meyer-Eppler in Bonn. Meyer-Eppler used Bode's Melochord to create examples of electronically generated sounds, which he then presented in a lecture called "Possibilities of Electronic Sound Production" at Darmstadt in July 1951. Beyer gave a lecture entitled "Music and Technology," and Eimert delivered a lecture called "Music on the Borderline." Later, in October, at another Tonmeister conference in Detmold, Meyer-Eppler gave another lecture, this time called "Sound Experiments," to a group which included Fritz Enkel, technical director of the WDR. The culminating event took place on October 18, 1951, at the WDR in Cologne. It was a meeting involving Meyer-Eppler, Beyer, Eimert, Enkel, and others of the WDR technical staff at which it was resolved to establish a studio at the WDR "to follow the process suggested by Dr. Meyer-Eppler to compose directly onto magnetic tape." That same day, the WDR broadcast "The World of Sound of Electronic Music," a forum with Meyer-Eppler, Beyer, and Eimert as participants.

Construction of the Cologne studio started in late 1951 and went into 1952. Meanwhile, in early 1952, Bruno Maderna worked with Meyer-Eppler in Bonn to compose *Musica su Due Dimensioni*, for flute, percussion, and tape, which was performed that summer at Darmstadt to an audience that included Pierre Boulez, Karel Goeyvaerts, Gottfried Michael Koenig, and Karlheinz Stockhausen, all of whom were invited to work in the Cologne studio. The program notes read, in part: "*Musica su Due Dimensioni* is a first attempt to combine the past possibilities of mechanical instrumental music with the new possibilities of electronic tone generation . . ."

Maderna's piece, the first composition associated with the Cologne studio, was nonetheless not typical of the studio's philosophy. It was Eimert, as the studio's first director, who initially set the tone, so to speak. His idea was that electronic music, or *elektronische Musik* as the Cologne approach came to be called, was an extension of serialism.

Serialism was an approach to musical structure that was considered by many composers during the 1950s to be extremely important, indeed so important as to approach the status of historical imperative. One may retrospectively wonder how something so cold as serialism could generate such heat, but apparently it did. As Pierre Boulez most emphatically put it, "I, in turn, assert that any musician who has not experienced—I do not say understood, but, in all exactness, experienced—the necessity for serialism is *useless*."

Historically, serialism was an outgrowth of the so-called "twelve-tone system," formulated by Arnold Schoenberg during the early 1920s as a method for basing an entire composition on a single "row" of twelve notes. The German symphonic tradition, with its fundamental aesthetic of unity and economy of material, had been based largely on techniques of motivic development; and for Schoenberg, who saw himself as taking the next step in that tradition, manipulating the row was the contemporary equivalent of developing motives. But Schoenberg had structured only notes according to the row and, further, used his rows intuitively to create traditional textures of melody and accompaniment. It was Anton Webern, Schoenberg's student and far more radical than Schoenberg, who provided the model for the European serialists. In his *Symphony, Opus 21* (1928), for example, Webern used the row to derive a timbral structure as well as a pitch structure. And the notes were undifferentiated as melody and accompaniment. In a lecture in 1932, he referred to the idea of notes as all deriving equally from the row and all forms of the row as being equally important: "Goethe's primeval plant; the root is in fact no different from the stalk, the stalk no different from the leaf, and the leaf no different from the flower; variations of the same idea."

The European serialists of the early 1950s considered themselves post-Webern. For them, serialism was a compositional technique wherein every aspect of a composition—not only notes, but also loudness, timbre, duration, type of attack, and every other imaginable parameter of a sound—could be based on and derived from the same row, or *series*, thereby producing a kind of total structure wherein every detail was organized. For Eimert, the promise of elektronische Musik was more things in sound to organize. He saw the possibility for a microscopic resolution of sound to the level of the individual partial. He wrote:

> It is certain that no means of musical control could have been established over electronic material had it not been for the revolutionary thought of Anton Webern . . . Alone among the twelve-tone composers, Anton Webern conceived the row non-subjectively . . . In his work, for the first time, we see the beginnings of a three-dimensional row technique—of what, in short, we know as *serial technique* . . . everything, to the last element of the single note, is subjected to serial permutation . . . This electronic music is not 'another' music, but is serial music . . . Talk of 'humanised' electronic sound may be left to unimaginative instrument makers.

Karlheinz Stockhausen began to work at the WDR studio in May 1953. His first pieces in Cologne were *Studie I* (1953) and *Studie II* (1954), in which

he used serialist techniques to determine the frequencies of sine waves. In distinct contrast with the Paris school, which focused on sounds recorded with a microphone, *Studie I* and *Studie II* were produced from electronic sound sources only. It was, in fact, an extremely laborious process, as the WDR studio at the time had very few electronic sound sources. Its sound-generating equipment consisted of a single sine wave generator, a white noise generator, Bode's Melochord, and a Monochord, actually a modified Trautonium built expressly by Trautwein for the WDR studio.

At the beginning, the sine wave generator was the preferred source because it offered the finest resolution in controlling sound according to serialist procedures. A *partial* (or *overtone*, as it is sometimes called) is a sine wave, and the idea was that by combining several sine waves at different frequencies any sound could be constructed. Since there was only one sine wave generator, however, the technique was to record four sine waves successively on each track of a four-track tape recorder, then play them back together through a mixer onto a monophonic tape recorder, then copy the result back onto one track of the four-track tape recorder, then record three additional sine waves onto the three remaining tracks, then play them back together onto a monophonic tape recorder, and so on. Finally, echo and reverberation effects were used to shape the final sound. As Stockhausen described it:

> a sine-wave is recorded on tape, a second, third, etc., is added. Electrically controlled, each sine-wave is given its own intensity curve, and then the intensity curve of the entire complex ("envelope") is once more regulated. The duration of the sound is fixed by measuring the tape in centimetres in cutting it—the speed of the tape is 30 or 15 inches per second. Thus, one by one, the sounds are put together and catalogued. When all the sounds for a composition have been prepared on the tape, the pieces are stuck together according to the score, and if necessary, are superimposed again by means of several synchronised tape-recorders . . .

During 1953 and 1954 , many composers worked at Cologne, and the works of these first years—Stockhausen's *Studie I* and *Studie II*, Herbert Eimert's *Glockenspiel* and *Etüde über Tongemische*, Karel Goeyvaerts' *Komposition #5*, Henri Pousseur's *Seismogramme*, and Paul Gredinger's *Formanten I/II*—were presented on October 19, 1954, at a concert called "Music of Our Time," which was subsequently broadcast by the WDR on December 9. As Gottfried Michael Koenig recalls, "When I went to Cologne in 1954, the studio was full of activity—it was an atelier-like situation, very attractive, where people were busy doing things."

Stockhausen, in particular, was moving into a position of leadership. He had studied with Olivier Messiaen at the Paris Conservatory from January 1952 to May 1953, and during that time in Paris, he had worked in Pierre Schaeffer's studio. That work had led him to reflect upon the structure and distinction of different sounds:

> Wherein lies the difference between instrumental sounds, between any audible events: violin, piano, the vowel "a," the consonant "sh," the wind? In the group "musique concrète" in Paris during 1952 and 1953, I made many analyses of instrumental sounds—especially percussion, recorded in the Musée de l'Homme—also of speech and noises of all kinds. The sounds and noises were recorded in various kinds of rooms (anechoic chamber, room with normal acoustic, reverberation room). Electro-acoustic apparatus: filters, oscillographs, etc., was used to determine the sound characteristics . . .

In Stockhausen's *Gesang der Jünglinge* (1956), the first major work to be composed in the Cologne studio, the sounds recorded with a microphone were of a boy soprano's voice reading from the apocrypha to the Book of Daniel. Of the nine verses used, three words—*Preiset den Herrn* (Praise the Lord)—are often repeated, and according to the context, *jubelt* (exalt) is often substituted for *preiset*. About the semantic content of the words, Stockhausen wrote:

> The lines and words can also be permutated without altering the actual meaning . . . if the word "preiset" occurs at one moment and the word "Herrn" at another—or vice versa—the listener is reminded of a word connection which he has always known . . . the concentration is directed upon the sacredness; speech becomes ritual.

Concerning the sounds of the words, he continued:

> In the composition, sung tones must be blended with electronically produced ones to form a mutual sound-continuum . . . in a selected scale of electronically-produced sounds, single steps are replaced by sung speech-sounds. We only have a homogenous sound-family if sung sounds sound at certain places like electronic sounds, electronic sounds like sung ones. In order to achieve the greatest possible homogeneity . . . a twelve-year old boy sang all the necessary sounds, syllables, words and at times groups of words, too, which we recorded on tape and transformed, employing various methods of orientation as to pitch, duration, intensity and articulation of timbre . . .
>
> According to the "colour"-continuum, the composition was based on the idea of a "speech-continuum": at certain points in the composition, sung groups of words become comprehensible speech-symbols, words; at others they remain pure sound qualities, sound-symbols; between these extremes there are various degrees of comprehensibility of the word. These are brought about either by the degree of permutation of the words in the sentence, syllables in the word, phonemes in the syllable, or by blending one form of speech with speech- or sound-elements foreign to the context . . .

The intention, therefore, is, by selecting individual steps from a sound-word continuum, to let "speech" proceed from the composition . . .

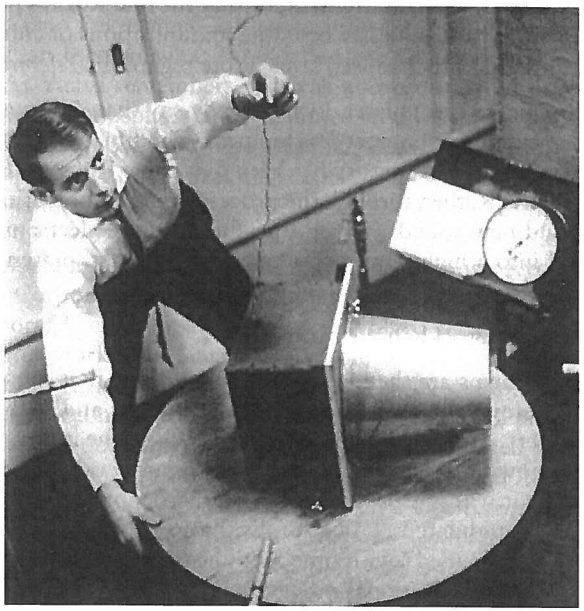
The original version was in five tracks, played through five loudspeaker groups arranged around the hall. Different strains of material were made to circulate through the space in carefully calculated paths—one sound-group, for example, might move in a trajectory from loudspeaker-group 1 to loudspeaker-group 2, while another sound-group might travel a different trajectory through other loudspeakers—with the goal of making them more differentiated, more clearly heard, more comprehensible. Stockhausen wrote:

> In my *Gesang der Jünglinge*, I attempted to form the direction and movement of sound in space, and to make them accessible as a new dimension for musical experience. The work was composed for five groups of loudspeakers, which should be placed around the listeners in the hall. From which side, by how many loudspeakers at once, whether with rotation to left or right, whether motionless or moving —*how* the sounds and sound-groups should be projected into space: all this is decisive for the comprehension of this work. The first performance took place on May 30th, 1956, in the main broadcasting studio at Cologne Radio Station. Today there are already quite a number of electronic spatial compositions . . .

In its organization of a sound continuum in discrete and gradated steps, in the permutations of the elements of sounds, and in the structural significance of musical detail including the spatial distribution of sound, *Gesang der Jünglinge* projects a serialist way of thinking. But it also represents a step taken away from serialism in its warmth, in its intuitive musicality, and in its pointillistic "clouds" of sound which were composed in what Stockhausen referred to as *statistical form*.

In 1960, Stockhausen finished *Kontakte*, his next major electronic work, after two years of practical experimentation. Yet further from serialism, *Kontakte* was based on what Stockhausen called *moment form*, wherein each moment was a miniature structure that stood on its own, independent from any overall structural continuity. And although the sounds were generated electronically, the musical phrases and the nature of the sounds were in large part suggestive of performance with percussion instruments and piano. Indeed, the title *Kontakte* (Contacts) points to connections between electronics and acoustic instruments. *Kontakte* exists in two versions, one for tape alone and another for performance with metal, skin, and wooden percussion instruments and piano. The first performance, on July 11, 1960, at a WDR music festival, was of the combined version: Christoph Caskel played percussion and David Tudor played piano and percussion.

By the mid-1960s, Stockhausen's tape compositions had become increasingly like musical films conceived as international epics. As a camera records



Karlheinz Stockhausen at the rotation table in the WDR Studio in 1958. This photo shows Stockhausen's method at the time for achieving sound distribution in a concert hall. As the table is turned, the loudspeaker on it projects a sound in different directions. The sound is picked up at slightly different times by four directional microphones, placed at different positions around the table, and the signal from each microphone is recorded on one track of a four-track tape. When the tape is played back in a concert hall, the signal from each track is routed through a different loudspeaker. Photo courtesy Stockhausen-Verlag.

visual events that are then brought together and edited into their final continuity as a film, so Stockhausen increasingly used a microphone to record sounds, and sounds that were recorded apart in space and/or time were brought together and electronically processed, edited, and mixed into their final continuity on tape. His *Telemusik*, for example, composed during a visit to Japan in 1966, contained sounds "from the Imperial Japanese Court (the Gagaku Players), from the happy isle of Bali, from the southern Sahara, from a Spanish village fiesta, from Hungary, from the Shipibos of the Amazon . . ." *Hymnen* (Anthems), finished in Cologne in 1967 but global in its geography and time scale, contained the national anthems of countries around the world. Further, in both *Telemusik* and *Hymnen*, the sounds were transformed by a process that Stockhausen called *intermodulation*, which meant that certain characteristics of one sound were used to transform certain characteristics of another thereby achieving, since the sounds came from so many countries, a poetic metaphor for international interaction. Would that real countries in the

real world could intermodulate so easily, or that the real world's perceptions of structure could grow so seamlessly from the juxtapositions of collage forms to interconnectedness. As Stockhausen later wrote regarding *Telemusik*:

> Today, only three years later, I can already say that *Telemusik* has come to be the beginning of a new development. The situation of the "collage" of the first half of this century has been overcome. *Telemusik* is *not* a collage anymore. Rather, through the process of intermodulation, old objets trouvés and new sounds, which I produced in the electronic studio, are combined into a higher unity: a universality of past, present and future, of distant places and spaces: *Tele-Musik*.

Regarding *Hymnen*, Stockhausen wrote:

> National anthems are the most well known music that one can imagine. Everyone knows the anthem of his own country, and perhaps those of several others, or at least their beginnings. When one integrates in a composition known music with unknown, new music, one can hear especially well *how* it was integrated: untransformed, more or less transformed, transposed, modulated . . . Naturally, national anthems are more than that: they are "loaded" with time, with history . . .
>
> Numerous compositional processes of inter-modulation were applied in *Hymnen*. For example, the rhythm of one anthem is modulated with the harmony of another; this result is modulated with the dynamic envelope of a third anthem; this result in turn is modulated with the timbral constellation and melodic contour of chosen electronic sounds . . .

Stockhausen had succeeded Eimert as Director of the WDR studio in 1962, and during his tenure to 1980, the studio's equipment list grew more diverse to include eventually analog and digital synthesizers, among them an EMS Synthi-100, an EMS vocoder, and an Emulator. And although his work was the best known work to come out of the studio, Stockhausen was by no means the only composer to work at the WDR. The first group of composers, as represented in the 1954 concert, continued to work at the studio and they were joined through the years by many others, among them Giselher Klebe, Gottfried Michael Koenig, Ernst Krenek, Bengt Hambraeus, Franco Evangelisti, György Ligeti, Herbert Brun, Bo Nilson, Mauricio Kagel, Konrad Boehmer, Petr Kotik, Michael von Biel, Johannes Fritsch, Wlodzimierz Kotonski, Eugeniusz Rudnik, Peter Eötvös, David Johnson, Mesias Maiguashca, Bernd Alois Zimmermann, York Höller, Roger Smalley, Jean-Claude Eloy, Tim Souster, Luc Ferrari, Rolf Gehlhaar, Iannis Xenakis, Thomas Kessler, and Joseph Riedl.

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Roughly simultaneously with the establishment of the Cologne studio in 1951, in Tokyo a group of four composers—Joji Yuasa, Toru Takemitsu, Hiroyoshi Suzuki, and Kazuo Fukushima—along with several painters, a poet, a pianist, and a technician formed what they called the Jikken Kobo (Experimental Workshop). As Yuasa remembers, "It was an experimental time in Tokyo—there was a lively atmosphere and we aimed to do things in combined arts." Nobody in the group owned a tape recorder, but in 1953, Sony (at that time called Tokyo Tsushin Kogyo) provided access to its studio so that experiments in tape music could begin.

Also in 1953, a group of radio producers, engineers, and composers began tape music experiments at NHK (Nippon Houso Kyokai / Japanese Broadcasting Corporation) in Tokyo. In late 1954, the NHK studio officially opened its doors. The principal composers involved were Toshiro Mayuzumi, who had earlier worked in Schaeffer's studio in Paris, and Minao Shibata. Mayuzumi's first work had in fact predated the NHK studio. His *XYZ* (1953), a study in musique concrète done at the studio of the Bunka Hoso, was among the first tape pieces done in Japan. His first pieces composed at the NHK studio were *Etude I* (1955), a study in different techniques, and *Aoi no Ue* (1957), an integration of technology and tradition which used electronics in a Noh-theater context. Shibata's first piece was *Musique Concrète for Stereophonic Broadcast* (1955) which was simulcast that year on two different bands to achieve its called-for stereo effect. Makoto Maroi, a younger composer, visited Cologne for several months in 1955 and subsequently influenced the development of the NHK studio along Cologne lines. And he worked with Mayuzumi in composing *Shichi no Variation* (1956, Variations on Seven), which was influenced by the tuning proportions in Stockhausen's *Studie II*.

Eventually, other composers also worked in the NHK studio, among them Toshi Ichiyanagi and Joji Yuasa. Ichiyanagi had studied in New York from 1956 to 1961, first at Juilliard (he recalls, "but there was of course no electronic studio at that time"), then at the New School with Henry Cowell and John Cage, and later privately with Cage at Stony Point. In 1961, when he returned to Tokyo, he was commissioned by NHK to work in the new studio where he finished *Parallel Music* (1962), a combination of taped sounds and live sounds processed via a microphone. As he recalls, "It was very lively, very stimulating, and we had a very good relationship with engineers so we could try things."

Yuasa had previously worked at the NHK studio doing incidental music for radio dramas and documentaries that had been commissioned by the NHK drama department. By 1963, as he put it, "I was more or less known, so the NHK music department commissioned me to make electronic music." His *Projection Esemplastic* (1964) was based on what he called the *plasticity* of time and space. In his words, "I tried to compose throughout with bent sounds including portamenti and sound forms which have the shape of glissandi . . . I was strongly attracted to the fact that intervalic and timbral conditions are metamorphosed by the plasticity of time when it is changed continuously through tape speed alteration."

Many composers were also working at the Sogetsu Art Center, an alternative space in Tokyo for artistic and technical experimentation. Zyunosuke Okuyama, technician, invented a pen with a recording head such that signals could be written by hand directly onto tape. Yuasa used the pen to create a piece called *Aoi no Ue* (1961)—he explains, "Same name as Mayuzumi's piece, different music"—and Takemitsu used the pen to make a musical score for his film *Kaidan*. Following 1961, Ichiyanagi also worked at the Sogetsu Art Center. He was, in fact, influential in arranging for John Cage and David Tudor to be invited to Japan in 1962.

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Meanwhile, on May 9, 1952, at a Composers' Forum concert at Columbia University in New York City, Vladimir Ussachevsky presented five electronic studies that he'd done with his own and borrowed equipment. One outcome of the concert was a friendly review by Henry Cowell in *Musical Quarterly*, October 1952, which ended: "We wish him well." Another outcome was an invitation from Otto Luening to present his work in August 1952 at the Bennington Composers' Conference at Bennington College in Vermont. It marked the beginning of a collaboration. That summer, Luening and Ussachevsky received an invitation to present their works as part of a contemporary music concert series produced by Leopold Stokowski at the Museum of Modern Art in New York. They accepted the invitation, then started to compose the music using, among other things, a reverberation device built for them by Peter Mauzey, a young engineer. It's Luening's story:

> We transported our equipment in Ussachevsky's car to Henry Cowell's house in Woodstock, New York, where we spent two weeks. With a borrowed portable tape recorder, an oversized wooden speaker, and old carpeting to deaden sound, we went to work. Using a flute as the sound source, I developed two impressionistic, virtuoso pieces, "Fantasy in Space" and "Low Speed." The latter was an exotic composition that took the flute below its natural range, but with certain acoustic combinations and the help of Mauzey's reverberation box, the flute was made to sound like a strange new instrument . . . Ussachevsky began work on an eight-minute composition that used piano as the primary sound source . . .
>
> This primitive laboratory was brought to Ussachevsky's living room in New York City, where we completed the compositions. With more borrowed equipment we added the final touch to our works in the studio of the basement of Arturo Toscanini's Riverdale home, at the invitation of David Sarser, the Maestro's sound engineer . . .

The concert took place on October 28, 1952, and included Ussachevsky's *Sonic Contours* and Luening's *Low Speed*, *Invention*, and *Fantasy in Space*. It was the first concert of its kind in the United States—as Jay Harrison wrote in the *New York Herald Tribune*, "The result is as nothing encountered before . . ."—and it was subsequently broadcast by WNYC in New York and WGBH in Boston. Luening and Ussachevsky were also invited to do a demonstration and interview on the *Today* show on NBC television. Luening describes it:

> We were met at the studio by a member of the Musicians Local 802, who asked if I had a union card. I said, "No, but if any flutist in the union can improvise the program, I will be glad to have him take over." That settled the matter. A crew of eight engineers tried to connect Mauzey's little box, but it would not work. Five minutes before the telecast, Mauzey was finally allowed to operate his machine . . .

In April 1953, Luening's and Ussachevsky's music was presented at a festival at Radiodiffusion Française in Paris. In the summer of 1953, they did a short piece for Leopold Stokowski's CBS radio program called *Twentieth Century Concert Hall*. Also in 1953, they presented their music at a concert supported in part by the Musicians Performance Trust Fund and the Musicians Union; and an announcement from the stage that the concert probably signaled the eventual end of live music, as Luening recalled, "did not seem to detract from the audience's genuine interest." There was a commission from the Louisville Symphony Orchestra to compose a piece for tape and orchestra, a small grant from the Rockefeller Foundation to purchase a tape recorder, a brief stay at the MacDowell Colony to write a ballet for the American Mime Theater, a commission from the Los Angeles Philharmonic, and in June 1955, a grant from the Rockefeller Foundation to look into studios in the United States and Europe. Luening:

> We wrote a report for the Rockefeller Foundation on the state of experimental music in Europe and the United States, including recommendations about the best program to be followed here.
>
> Our studio in the Ussachevsky living room was moved to my apartment. We then reported to President Kirk of Columbia University that unless we could have space on campus, our whole program would be seriously jeopardized. Soon afterwards, we were provided with suitable quarters—the charming "Charles Adams" house, located on campus at the site of the former Bloomingdale Insane Asylum . . .

The Columbia University studio was born. It was soon to be transformed, however.

> In 1955, RCA demonstrated the Olson-Belar Sound Synthesizer . . . Davidson Taylor, director of the School of Arts at Columbia University, suggested that we try to obtain the synthesizer on loan. Ussachevsky

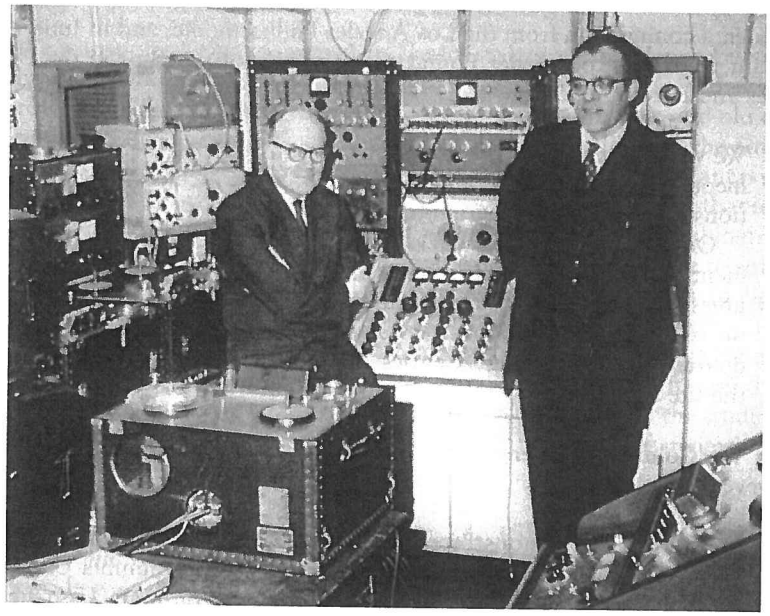
wanted very much to pursue this possibility, and I wrote to several RCA executives . . . Our report to the Rockefeller Foundation included a detailed description of the equipment and personnel needed . . . Our application was approved with the recommendation that we procure the RCA synthesizer . . .

That Milton Babbitt, on the faculty of Princeton University, had also been interested in the RCA Mark II Electronic Music Synthesizer led to the involvement of Princeton University in the grant application. In January 1959, the Columbia-Princeton Electronic Music Center, containing the RCA Mark II Electronic Music Synthesizer and several tape studios, was established.

In 1960, Mario Davidovsky arrived in New York from Argentina. He began by working with Bulent Arel. As he recalls, "I assisted him and by imitation I absorbed his techniques—so in a certain way he was my teacher, and a wonderful one, a wonderful teacher." And what was it like to work in the studio? He answers:

Life at that time was being in the studio. There was nothing else. I remember staying up to thirty-six hours at a time, taking catnaps and crossing

Otto Luening (left) and Vladimir Ussachevsky (right) in one of the tape studios at Columbia Princeton Electronic Music Center in about 1960. Photo courtesy Robert Moog.



Broadway to buy sandwiches and coffee and going back to the studio. My colleagues were doing the same thing. Every little sound was like a discovery. We were starting to decode the potential of what was sitting in front of us, using each piece of equipment and then relating it to the others. In a way, we were building an instrument, a very special sort of instrument. Technically, I was totally naive. But I was also having my own ideas.

In order for me to keep some psychological continuity while going into this new territory, I found ways of translating things that were known to me, that reflected my past tradition. I found that it was possible for me to think of a phrase made of a sequence of sounds, of timbres, dynamics, registers. I shaped gestures following the sculptural shape of a melody. I found that it was almost impossible with that technology to produce long sounds that were beautiful—they would tend to become dull. But I found that sounds of short duration and percussive-like sounds were accessible. To me, the most important ability was to articulate the music by shaping the sound. If it was a simple sound, let's say a sharp attack and a decay, I could do it with a splice at the beginning and then a long decay in the mixer. Or if I was working on a percussive sound, I would take an inch of that sound and make a tape loop—so that I heard the sound every few seconds—and then I would take that sound, go to a filter, mixer, another filter, reverb unit, and so on, so the sound would reappear in slightly different dressings, and then I would use the mixer as a way of balancing all of these elements in order to shape the timbre.

On May 9 and 10, 1961, the center presented its first two concerts. The programs included Davidovsky's *Electronic Study #1*, Halim El-Dabh's *Leiyla and the Poet*, Ussachevsky's *Creation-Prologue*, Babbitt's *Composition for Synthesizer*, Arel's *Stereo Electronic Music #1*, Luening's *Gargoyles for Violin Solo and Synthesized Sound*, and Charles Wuorinen's *Symphonia Sacra*. It was a lot of music for one year's work, and it was just the beginning. As Luening later reported, "From 1960 to 1970, more than 225 compositions by more than 60 composers from 11 countries were produced . . ." When Ussachevsky retired in 1979, Davidovsky became director. As he said, "My major goal was not so much to get involved in technical research but rather in creating music."

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Luciano Berio was in the audience at the Museum of Modern Art on October 28, 1952. As he remembers, "The sound was very new for me—I became enthusiastic and I became friends with Ussachevsky and Luening." He then established a studio in Milan. He tells it:

A few weeks later, I went back to Milano and a few months later, in 1953, I met Bruno Maderna. He had already worked on electronic music in Germany. I convinced the radio—I was occasionally writing music for the

radio, in any case—to establish a studio for electronic music. I was the one that was responsible for it because I was there more than Bruno. He was travelling and conducting a lot, but he was like my older brother there. Alfredo Lietti was also very interested. He was one of the technical chiefs at the Milano station, and I asked him if he was ready to help us. And he did.

In 1955, the Studio di Fonologia Musicale was established at the RAI (Radio Audizioni Italiane / Italian Radio Broadcasting) studios in Milan with Luciano Berio and Bruno Maderna as artistic directors, Alfredo Lietti as technical director, and Marino Zuccheri as technician.

One basis for the studio was radio sound. As Alvise Vidolin points out, "radio had come to be seen as a new stage, or rather a new medium for shows, in which the principal ingredients were voice, music, sounds, and noise." In 1954, Berio and Maderna had collaborated in composing *Ritratto di Cittá* specifically for radio broadcast. *Ritratto di Cittá*, a sound portrait of Milan during the course of a day, with text by Roberto Leydi, had been an important step in exploring the value of audio art created specifically for radio broadcast. In 1956, Berio stated a need for further exploration: "the idea of a radiophonic art and aesthetic has not yet been defined . . ." Many of the pieces composed in the Studio di Fonologia Musicale were commissioned by the radio specifically for broadcast.

There were also purely musical concerns. Compared with the rigorous musique concrète approach of the Paris studio and with the strict serialist philosophy of the startup Cologne studio, the Milan studio was not tied to any particular ideology or method. As Berio said, "Bruno and I immediately agreed that our work should *not* be directed in a systematic way, either towards recording acoustic sounds or towards a systematic serialism based on discrete pitches." At the same time, Berio's musical ideas provided an initial focus, a starting point for his own work, and a kind of *personality*, one might say, for the studio in general:

> The idea of the studio was the interaction between acoustics and musical form, the coordination of timbre and harmony. It was important for me to work with Joyce's words, to extract certain sound qualities and to transform them by speeding up or superimposing them into something else. I felt a constant need of dealing with sounds as evolutionary phenomena, not static, always changing, but always for musical reasons. For me, the experience of electronic music generated a view of form, of musical structure, different from instrumental music. And so the Studio di Fonologia was always open to exploring the interaction between the acoustical dimensions of sounds and musical forms.

The Studio di Fonologia Musicale was for a brief period in the vanguard of European studios. With its complement of nine oscillators as well as other state-of-the-art equipment, it was for its time exceptionally well equipped. Alfredo Lietti, who designed the studio, echoed Berio's and Maderna's artistic openness and cooperative spirit:

> The musician may have a clear idea of the sound he desires to obtain, but it is, naturally, a musical idea. To the technician interested instead in the physical data of the sound, it's a question of whether it can be produced electronically. It's obvious that the difficulty can be overcome only by a reciprocal effort of understanding.

Berio's first important tape piece at the Milan studio was *Thema–Omaggio a Joyce* (1958). He had been studying onomatopoeia in poetry with Umberto Eco, and among the texts they examined was the beginning of the eleventh chapter of James Joyce's *Ulysses*. Here are some brief excerpts:

> *BRONZE BY GOLD, THE HOOFIRONS, STEELYRINING IMPER-thnthn thnthnthn.*
> *Chips, picking chips off rocky thumbnail, chips. Horrid!*
> *And gold flushed more.*
> *A husky fifenote blew.*
> *Blew. Blue bloom is on the*
> *Gold pinnacled hair.*
> *A jumping rose on satiny breasts of satin, rose of Castille. . .*
>
> *Boomed crashing chords. When love absorbs. War! War!*
> *The tympanum.*
> *A sail! A veil awave upon the waves . . .*
>
> *A moonlight nightcall: far: far.*
> *I feel so sad. P. S. So lonely blooming.*
> *Listen!*
> *The spiked and winding cold seahorn. Have you the? Each and for other plash and silent roar.*
> *Pearls: when she. Liszt's rhapsodies. Hissss.*

The text, which became the basis for all of the sounds in *Thema*, was first recited on the tape by the magnificent singer Cathy Berberian. Then Berio selected elements and began to work with them. He said, "What I emphasized and developed in *Thema* is the transition between a perceivable verbal message and music . . ." Certain text elements were suggestive of musical figures. For example, "IMPER-thnthn thnthnthn" suggested a trill. "Chips, picking chips" suggested staccato. "A sail! A veil awave upon the waves" suggested glissando or portamento. Sibilant and vowel sounds were derived from the text—as in "a sail, a sail . . . a veil awave . . . hissss hisss . . . I feel so . . . bl bl bloo blooming

. . . rhapsody . . . hisss soft hisss . . . —and organized in changes from discontinuous to periodic to continuous. All of the sounds were subjected to electronic processing, primarily filtering with one-third-octave filters, and tape editing, including superimposition at different time and pitch scales and the construction of fragments into various musical articulations. For example, at one point the *bl* of "blooming" is repeated to make a stutter sound, the *ooo* is extended as a musical sound, the *sss* becomes a continuous hiss; and many of the sounds are abstracted to a point of unintelligibility only to reappear as recognizable words, reflecting the shifts in Joyce's text between onomatopoeia and semantic meaning. *Thema* is remarkable in that all of its myriad and detailed sounds are derived from the text. Indeed, the texture of *Thema*, its rhythm and its play with the sounds and meanings of words and phonemes, parallels and extends the musicality of Joyce's text. Berio said it, but Joyce might have said it as well: "I attempted to establish a new relationship between speech and music, in which a discontinuous metamorphosis of one into the other can be developed . . ." And *Thema* is all the more remarkable in light of the way it was composed. Berio describes the experience:

> At that time, techniques and procedures were quite time consuming. Everything was done by cutting and splicing tape . . . In order to create certain effects, some sounds had to be copied sixty, seventy, and eighty times, and then spliced together. Then these tapes had to be copied further at different speeds in order to achieve new sound qualities more or less related to Cathy Berberian's original delivery of the text. I was interested in constant and controlled transformation from discontinuous to continuous patterns, from periodic to nonperiodic events, from sound to noise, from perceived words to perceived musical structures, and from syllabic to a phonetic view of the text . . . I didn't surrender to the difficulties . . . It's surprising now to think that I spent several months of my life cutting tape while today I could achieve many of the same results in much less time by using a computer.

Among the pieces done by other composers in the Milan studio, Henri Pousseur's *Scambi* (1957) was distinctive. For one thing, it was based on procedures rather than a fixed structure, as Pousseur later said, "to experiment on the electronic level with the idea of open, variable form . . ." Different versions were made at different times by Pousseur, Berio, and Mark Wilkinson. For another thing, all of its sounds were made with white noise. White noise, which sounds like hiss, or steam, or waterfalls, is a wide-range smear of sound energy undifferentiated by pitches or timbre. As Michelangelo specified shape by chipping at his block of marble with a chisel, so Pousseur specified crisp, clear, and pitched sounds by chipping at his block of white noise with an electronic chisel called a *filter*. Pousseur differentiated the sounds by pitch, timbre, and reverberation and then edited the sounds into sequences on tape.

Cage did a tape realization of his graphic score *Fontana Mix* (1958). During a four-month period during the summer of 1958, with the technical assistance of Marino Zuccheri, Cage used random numbers as a guide to snipping and splicing little bits of tape from several different reels of sound material recorded and/or found in Milan and from Italian radio. And amongst the traffic sounds, dog barking, and so on, there's a fleeting moment where a radio voice says, "Qui c'é folkloristica," meaning "Here there's folklore." Considering that it showed up randomly, and considering the nature of the assemblage of sounds to which it seems to refer, that fleeting moment is certainly worth a fleeting smile. And there was the occasion for another smile. During that same period in Milan, Cage was featured on *Lascia o Raddoppia* (Nothing or Double), an Italian television quiz show. In five appearances, he presented several of his compositions. He also won the equivalent of about $6,000 for answering questions about mushrooms.

Berio's last tape work in Milan was *Visage* (1961). Within an ambience of electronically generated sounds, Cathy Berberian sang and recited mostly abstract vocal sounds suggestive of the formation of words and language. Different from *Thema*, the vocal sounds in *Visage* were used as they were recorded, without electronic manipulation and with a minimum of editing. *Visage* is, as Berio described it, "purely a radio-program work: a sound track for a 'drama' that was never written . . . based on the sound symbolism of vocal gestures and inflections with their accompanying shadow of meanings and their associative tendencies . . ."

Shortly after finishing *Visage* in 1961, Berio left Milan to live in the United States, and following his departure, the studio progressively changed. Maderna, of course, had also worked in the studio during the 1950s—his best known works of the period include *Continuo* (1958), *Invenzione su una Voce* (1960), and *Serenata III* (1961)—but because he became busier with conducting engagements in the 1960s, his work in the studio became more occasional, although it did include *Le Rire* (1962), *Tempo Libero* (1972), and a few other compositions. Other composers who worked in the studio through the 1960s and 1970s included Girolamo Arrigo, Nicoló Castiglioni, Aldo Clementi, Franco Donotoni, Pietro Grossi, Marcello Panni, and Camillo Togni.

Luigi Nono, originally introduced to electronic music by Maderna, became the studio's principal composer. Nono was there as the studio's equipment was updated in the mid-1960s, and he worked there until the studio closed at the end of the 1970s. His first composition was *Omaggio a Vedova* (1960), which was his only work to use only electronically generated sounds. He often combined live instrumental and vocal performance with electronic sounds on tape. And he often based his compositions on social and political themes. His next works were *La Fabbrica Illuminata* (1964, The Illuminated Factory), composed with factory sounds recorded at Italsider, a steel plant at Genova; *Ricordati Cosa Ti Hanno Fatto in Auschwitz* (1966, Remember What They Did to You in Auschwitz), which was derived from his incidental music

for a play by Peter Weiss and which combined high, thin electronic sounds with multiple choruses and a soprano melody, projecting the effect of terrible anguish; and *Non Consumiamo Marx* (1969, We Aren't Consuming Marx), which included sounds from political demonstrations during 1968.

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Because equipment was expensive and technical knowledge was necessary, most of the first studios were established at institutions where budgets and technicians were available. But there were, at the same time, a few composers sufficiently ingenious and stalwart to forge ahead and form personal studios. Tristram Cary's studio in London, for example, was among the first of the independents. Cary's story starts when he was demobilized from the British navy in 1946:

> We all knew about tape recorders but nobody had seen one—we had aboard the ship a very poor wire recorder—but what seemed quite clear was that tape was going to make possible editing sound in a way that was not possible before. So I spent my gratuity, the gratuity you get when you're demobilized from the service, to buy equipment. My gratuity was £50 which was equivalent I guess to $1,000 of today's money. I was able to buy a disc recorder for which I made pickups that ran behind the cutting head in the same groove, so I had echo effects. I also had a playback turntable that would do anything from 12 rpm to 200 rpm and was reversible. And in those days, Lisle Street, just behind Leicester Square in London, was full of junk electronic shops. There were war surplus supplies from Britain, Germany, America, everywhere, and a lot of this gear was brand new. So for a few shillings or a few pounds you could buy the most exquisitely made stuff, things like bomb sights, airborne cameras, all sorts of things from which you could make elaborate delay gear and that kind of thing. And I bought my first tape recorder in 1952.

Cary then wrote to several BBC producers. As he reports, "Three of them replied, two of them saw me, and one of them gave me a little job." By the end of 1955, he was working regularly for the BBC and his studio, of course, was continually growing. By 1957, he had three tape recorders, a number of turntables, and three or four oscillators, some entirely home constructed and some built with kits. He adds, "I was using recorded sound most of the time because my electronic facilities were fairly limited." But limited though his facilities may have been, through the 1950s he did the music for a lot of films, among them *The Lady Killers* (1955), *Time Without Pity* (1955), *Town on Trial* (1956), *The Flesh Is Weak* (1957), *Tread Softly Stranger* (1958), and *The Little Island* (1958), an animated film by Richard Williams. Of *The Little Island*, in particular, he remembers:

> It really put my studio and my ideas into high gear. Dick had no money, of course. Nobody had any money. He said, "Look, you're obviously good at film music, and I've got this film I'm trying to make and I've got no money so I can't commission music. But I'd like you to help me choose some library tracks." Well, I saw the line tests and I was very impressed, and I said to Dick, "You've got to have properly composed music with this." So I borrowed money on my house and we went into this thing together because, whatever kind of production you're making, you can't skimp on the music.

The Little Island won the Best Experimental Film of the Year award in Venice in 1958, it was shown at the 1958 World's Fair in Brussels, and it won the 1959 British Film Academy award for Best Cartoon of the Year. Cary continues:

> Meanwhile, at about this time I bought a cottage in the country, in Suffolk, in Fressingfield. There was no electricity when I moved in, but I had a great big hut in the garden and I made a spacious studio. I moved in properly in 1962, when there *was* electricity, but even then we were on the end of the line run, sharing the transformer with the local farmer. Whenever he started up his agricultural equipment, my voltage dropped. So I had considerable problems with voltage regulation. The Fressingfield studio, nonetheless, depending on the money, got quite good. All of it was built by me in between things, when I had a spare day or a spare hour. Very often what happened was that I came across a creative problem that became a technical problem. I wanted to create a certain sound, and I knew how I could do it, but it needed a special gadget. So I would stop being a composer for the moment and build something, with the result that the studio became as most studios in those days, very personal matters. It became a studio for me doing the things that I wanted to do.

Among those things, through the 1950s and 1960s, Cary completed many instrumental and electronic concert compositions. There was electronic ambient music for the Industrial Section of the British Pavilion at EXPO '67 in Montreal: "I decorated the whole place with sound." And there were many electronic scores for BBC radio and television, among them *Macbeth* (1959), of which he recalls, "It seemed perfectly obvious to me that the way to do the witches was with electronics." There were also Craig's *The Children of Lir* (1959), Macneice's *East of the Sun and West of the Moon* (1959), Cocteau's *La Machine Infernale* (1960), Jennifer Dawson's *The Ha-Ha* (1963), Ionesco's *The Killer* (1964), Peake's *The Rhyme of the Flying Bomb* (1964), and Ray Bradbury's *Leviathan '99* (1968). And there was *Doctor Who*, a BBC science fiction series for which Cary composed a considerable amount of incidental music. Cary recalls a visit to the *Doctor Who* studio with one of his children

who saw a Dalek, one of the show's salt-shaker-shaped villainous creatures, and said, as Cary tells it, "It's pretty primitive, Dad. I don't think it will be a great success." Cary continues:

> In those days, a million years it seems before sync devices like SMPTE code, timing was the main problem, and *The Dead Planet* (Serial B) had long tracks of atmosphere stuff (e.g. a faintly menacing alien forest with strange creatures) interspersed with sudden events that had to be in sync. A given scene could only be roughly timed at rehearsal in some hall away from the studio, and the show only moved into the studio just before the recording. Videotape was used, but the show was recorded as if it were a live transmission. So I used two or three tape machines. Red track was the main holding track with the continuous, non-sync stuff covering the general atmosphere of a scene while Green track carried short events like a menacing close-up or an exploding Dalek to be punched in at the right moment over Red.
>
> I aimed at rich sounds which were different from normal aural experience. One always had to remember that the final product would be heard on the absurd speakers used in the average TV, so things that relied for their effect on extreme bass or top, or even being loud, were out. Sometimes, in fact, I played a track through the family TV's audio to hear the effect. In long tracks, I would use loops, but such long ones that nobody would hear them as loops. At Fressingfield, I sometimes had loops going out through the window and round mike stands set among the cabbages outside. And living in four acres of space gave other opportunities to explore unusual environments, like the strange echoes produced in wells, tanks, and oil drums. They were breaking up railways at the time, and I had a blacksmith make a railway-line metallophone for me (tuning not accurate), which made a huge noise. That sound in particular was interesting both slower and faster, and also recorded at a distance. In fact, I got some fascinating results from a very long way, like 200 yards from the microphone, done in the middle of the night when the birds were asleep.

Cary did the music for several more episodes, including *Marco Polo*, *The Gunfighter*, and *The Mutants*. Of *The Mutants*, in 1972, he reflects:

> Compared to the early ones, this was hi-tech in every way. Colour gave the opportunity for special visual effects, and my studio was as good as it ever got. *Who* was often fun, but in the end it was a bit samey. *Another* space travel sound, *another* alien invasion.

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Among the ingenious there were also Louis and Bebe Barron who founded a personal studio in New York. They had begun as early as 1948 to work with taped sounds and simple electronic circuits and they then went on to do several electronic film scores, among them *Bells of Atlantis* (1953) and *Forbidden Planet* (1956). They were there in 1951 when John Cage and David Tudor launched the Project for Music for Magnetic Tape in New York. Tudor recalls:

> It was John's idea. It was John who supplied the ideas and motivation. And the project actually began because our friend Paul Williams gave us some money. He was a godsend. The spirit was to be all inclusive, so one of the first endeavors that we made was to categorize sounds. The Barrons acted as sound engineers, as a team. They worked with us for several months. Then, because the money was running out, John took the tactic that we should record all the necessary material, so the last monies were spent with the objective that we would have all the material in our hands necessary to complete the splicing. The Barrons helped to record and prepare all the material . . .

The Barrons recorded approximately 600 sounds to provide the initial material for the project. Tudor continues:

> I worked closely with John in the first year. We established a method of working. The main work was splicing tape for *Williams Mix* . . . John and I were impoverished. There was no money to throw around. I recall that at one point the money was in danger of running out, and so John and I made an assessment of what had to be done so that the funds would last until the completion of *Williams Mix*, and subsequently Paul gave us another sum of money to help continue. Then Earle came and offered to help. And spent more and more time helping.

In mid-1952, Earle Brown arrived in New York and immediately started to work with Cage. Christian Wolff and Morton Feldman also became involved with the project and composed pieces, but Brown and Cage did most of the work. Brown continues:

> I lived in the Village on Cornelia Street. John lived on Monroe Street, underneath the Williamsburg Bridge. There's no subway because it's diagonally crosstown, so I used to walk to John's loft every morning. The cutting and splicing happened at John's loft . . . John and I worked on opposite sides of a big table . . . We usually worked from ten in the morning until four or five in the afternoon and then we usually went to meet Morty and Merce Cunningham and Carolyn Brown at the Cedar Bar or one of our apartments. Fridays, John and I used to go to Suzuki's lectures at Columbia.

The cutting and splicing was for Cage's *Williams Mix*, finished in late 1952. Cage first created a library of snippets of tape, catalogued as *A* (city

sounds), *B* (country sounds), *C* (electronic sounds), *D* (manually produced sounds, including normal music), *E* (wind-produced sounds, including voice), and *F* (small sounds requiring amplification to be heard). The sounds were further classified: the letter *c* indicated control and predictability, the letter *v* designated lack of control or unpredictability; and both *c* and *v* were applied to pitch, timbre, and loudness in that order. The designation *Bvcv*, for example, would indicate a country sound of uncontrolled pitch, known timbre, and uncontrolled loudness. Cage then created a score for the piece, in effect a graphic plan, using a procedure derived from the *I Ching*, the ancient Chinese *Book of Changes*. The procedure was to toss three coins six times to generate a random number between 1 and 64 and to use the resulting random numbers to select, from corresponding listings in several charts, what type of sound from the library was to be used, where among any of eight tracks it was to be placed, the durations of the sounds and silences, and the shapes (attacks and decays) of the sounds as they were physically cut into the tape. Brown continues:

> We simultaneously cut and spliced John's *Williams Mix* and composed with his three coins by chance, using the *I Ching*. Anybody could toss the three coins and write down heads, heads, tails, do it again, tails, heads, heads, do it again, oh, three tails. . . Anybody could do it, so when anybody would come to visit, John would hand them three coins and tell them how to do it and everybody would be sitting around tossing coins. That was the composing part of it, completely by chance, and the coins referred to, first, the kind of sound, then duration, then how the attacks and decays were cut. We cut the attacks and decays into the tape with demagnetized razor blades. We put the score under a glass plate on the table, and then lay the tape on it, and cut exactly to the pattern. John used to suggest that it was like following a dressmaker's pattern . . .
>
> The pieces of tape were in regular legal size envelopes, white envelopes, bunched up. We didn't have them on reels or anything. We had them in a cardboard box in one corner of John's loft, and there were maybe 150 or 175 envelopes, each marked "A," "B," "C" . . . up to seven categories, and then we'd go over and paw through the envelopes until we came to the right one, as called for by the chance process. We'd pick up the envelope, take the piece of tape over, lay the tape on top of the glass under which was the score, and cut and splice exactly as was called for. Then we applied the pieces of recording tape onto splicing tape and then, between pieces of recording tape, we rubbed talcum powder so the splicing tape wouldn't be sticky. After we did this, and we'd gotten a minute or so finished, we used to go over to Colonel Richard Ranger's studio in New Jersey to make copies on a solid piece of tape. We didn't even have a tape machine. We couldn't hear anything. All we had were razor blades and talcum powder, no tape machine, it's true. If we'd needed to use one, we could have gone to the Barrons' studio. But John was doing it by chance. He didn't need to hear. You only need to hear when you're doing something by taste.
>
> It took so long, so bloody long, and it was boring to do all that cutting and splicing. John and I sat at opposite sides of the table and we talked about everything in the world. . . we would talk about Suzuki, we'd talk about profound things, banal things, we smoked cigarettes all the time. We would usually end up at three in the afternoon and neither one of us would have any cigarettes left, so we would smoke the butts. And nearly every day we would go across the street from John's loft and buy a big hero sandwich, and John would make terrible black coffee.
>
> We both joked a lot. I could be funny, John could be funny. We would get on each other's nerves once in a while. I'd argue with him about something, and he'd get riled up a bit. I remember one thing that we argued about was that he liked to say that any sound in the world could be in the library of the Music for Magnetic Tape project, and I would say, "John, that's impossible, you can't get the sound of a whale, ten fathoms down, into the library," and he'd say, "It could be." Philosophically, he didn't eliminate any sound, but when he said that any sound could be in the library, I said, "That's impossible. You can't get every sound in the library."

After *Williams Mix*, Cage and Brown worked together on Brown's *Octet*:

> Having finished *Williams Mix*, there were a lot of scraps of tape. We knew we were going to have a concert at the University of Illinois Arts Festival, March 1953, and I wanted to do a piece, so I tried to think quickly about how to make a piece . . . And I worked out a way to do the piece, based on density. I used a book of random sampling tables. I would get the length of a piece of tape, say fifteen inches, and then I would come up with how many pieces of tape would fit into that fifteen inches, and then I would take some pieces of tape and then I would chop them so that I had relatively equal lengths to fit into fifteen inches. Maybe four inches might have seven fragments, but never more than ten . . . So I made *Octet*, for eight mono tapes and eight loudspeakers surrounding the audience because *Williams Mix* is that way too, eight tapes for eight loudspeakers. I remember what John said about *Octet*. He said, "It sounds like a snowfall."

The March 1953 concert at the University of Illinois Arts Festival included *Williams Mix*, *Octet*, and pieces by Wolff, Stockhausen, Eimert, Boulez, Luening, and Ussachevsky. Brown remembers:

> We had eight mono Magnacorders on stage and eight loudspeakers equidistantly spaced around the auditorium. The funny thing is that peo-

ple would come into the concert hall and they would see this stack of eight Magnacorders on stage, and at that point everybody was frightened to death of electronic music, so they would look at the stage and they would sit in the back. But right behind them were loudspeakers.

The project ended in 1954 as both Cage and Brown moved on to other things. As Brown said, "I don't remember why it stopped actually. I guess I needed a job."

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In parallel with the development of the early instruments, with Duchamp's and Cage's early work, with the invention of the tape recorder and the opening of the first studios, indeed in parallel with the entire early development of electronic music, Edgard Varèse had pursued his ideas about what has been called "the liberation of sound." Varèse had met Busoni in Berlin as early as 1907 and later commented on Busoni's famous statement ("Music was born free. . .") by saying, "It was like hearing the echo of my own thought." In Cage's words:

> More clearly and actively than anyone else of his generation, he established the present nature of music. This nature . . . arises from an acceptance of all audible phenomena as material proper to music. While others were still discriminating "musical" tones from noises, Varèse moved into the field of sound itself . . .

Why was Varèse' work so significant? Prior to the twentieth century, orchestration had been inseparably linked to melody, rhythm, and chord progressions, as color had been linked with the objects depicted in painting, such as green grass, blue sky, and so on. As Hector Berlioz said, in *A Travers Chants*, "Orchestration is, in music, the exact equivalent of color in painting." In the general artistic upheaval at the beginning of the twentieth century, sound and color became increasingly independent aspects of music and painting. Arnold Schoenberg, for example, in his *Harmonielehre* (1911), proposed the idea of a *Klangfarbenmelodie*, a "sound-color melody," which based musical structure on sound. And Wassily Kandinsky wrote in 1912 that "colors are not used because they are true to nature but because they are necessary to the particular picture." Varèse put it perfectly when he said:

> The role of color or timbre would be completely changed from being incidental, anecdotal, sensual or picturesque; it would become an agent of delineation like the different colors on a map separating different areas, and an integral part of form.

In Varèse' *Intégrales* (1926), for woodwinds, brass, and percussion, the pitches that the instruments play, their loudnesses, their spacings in orchestral chords, their crescendos, attacks, and durations, were important because of the way they contributed to a composite timbre. In all of his music, Varèse' concern with timbre as a primary musical quality led him to shape sounds so unconventionally that his orchestration approached, as Milton Babbitt put it, "nonelectronic synthesis." In *Ionisation* (1931), Varèse used percussion instruments to create a repertoire of unpitched sounds. And he used a siren. As he later said, "I have always felt the need of a kind of a continuous flowing curve that instruments could not give me. That is why I used sirens in several of my works."

In 1916, Varèse said, "Our musical alphabet must be enriched . . . We also need new instruments very badly . . . In my own works I have always felt the need for new mediums of expression." In 1927, he contacted Harvey Fletcher, director of acoustic research at Bell Telephone Laboratories, to investigate the possibility of access to a laboratory, but then and afterward, Fletcher, although sympathetic, was unable to support the request. Varèse had formed a friendship with René Bertrand in Paris in 1913, and in 1932, in another attempt to find support for researching new instruments and sounds, he applied to the Guggenheim Foundation to do collaborative work with Bertrand. In February 1933, Varèse wrote the following as a clarification of his application:

> The acoustical work which I have undertaken and which I hope to continue in collaboration with René Bertrand consists of experiments which I have suggested on his invention, the Dynaphone. The Dynaphone (invented 1927–28) is a musical instrument of electrical oscillations somewhat similar to the Theremin, Givelet and Martenot electrical instruments. But its principle and operation are entirely different, the resemblance being only superficial. The technical results I look for are as follows:
>
> 1. To obtain absolutely pure fundamentals.
> 2. By means of loading the fundamentals with certain series of harmonics to obtain timbres which will produce new sounds.
> 3. To speculate on the new sounds that the combination of two or more interfering Dynaphones would give if combined in a single instrument.
> 4. To increase the range of the instrument so as to obtain high frequencies which no other instrument can give, together with adequate intensity.
>
> The practical result of our work will be a new instrument which will be adequate to the needs of the creative musician and musicologist. I have conceived a system by which the instrument may be used not only for the tempered and natural scales, but one which also allows for the accurate production of any number of frequencies and consequently is able to produce any interval or any subdivision required by the ancient or exotic modes.

Edgard Varèse in the 1950s. Photo by Roy Hyrkin. Courtesy Ann McMillan archive at Electronic Music Foundation.

By no means the last important composer to be turned down by the Guggenheim Foundation, Varèse' luck began to change many years later. In 1954, Pierre Schaeffer invited him to Paris to complete the tape parts to *Déserts*, a work combining orchestral and taped sounds. In 1957, he gained access to the Philips Laboratories in Eindhoven, Holland, where a special studio was created for him with sophisticated equipment and the support of a group of technicians and advisors. He went to Eindhoven to compose *Poème Electronique*. And he crossed paths with Iannis Xenakis.

Xenakis had arrived in Paris from Athens in November 1947, following his activities in the Greek resistance during and after the war. As he said, "I was a civil engineer—I was on my way to the States, but I stopped in Paris and I thought, 'Well, why not?'" He soon found a position with Le Corbusier, one of the most prestigious and interesting architects in France: "I got to Le Corbusier through an acquaintance and I started calculating beams and columns and floors for the Marseilles building." (The Marseilles building was *L'Unité d'Habitation*, one of Le Corbusier's best known works.) After a while, Xenakis got interested in architecture and asked Le Corbusier if he could work on an architectural project. Le Corbusier agreed and, as Xenakis recalls, "We started doing the monastery of La Turette, which I designed completely from beginning to end." Among other Le Corbusier commissions, Xenakis also worked on the Assembly Hall for Chandigarh, India.

In January 1956, Philips Corporation in Eindhoven asked Le Corbusier to design their pavilion for the 1958 Brussels World's Fair. Le Corbusier replied: "I will make you a *poème électronique*. Everything will happen inside: sound, light, color, rhythm . . ." Xenakis continues:

> They asked Le Corbusier to design something and Le Corbusier asked me to design something. At that time, I was very much interested in shapes like hyperbolic paraboloids, things like that; and so I organized them to form a shell in which we could produce sounds and images on the walls. I did the designs and I showed them to Le Corbusier and he said, "Yes, of course."

The World's Fair opened in May 1958. The Philips Pavilion also opened, and its sound-and-image show, created by Xenakis, Varèse, and Le Corbusier, was repeated several times every day. The sound consisted of Xenakis' short and gritty *Concret P.H.* (1958) followed by Varèse' *Poème Electronique*. Le Corbusier's colored lighting formed a backdrop to his projected images—pictures of animals (monkeys, shellfish, birds), religious objects and art from different cultures (Buddha, Giotto, masks, sculptures), parts of the Eiffel Tower, Laurel and Hardy stills, nuclear explosions and other war imagery, and buildings from different countries—which were shown continuously. By the end of 1958, more than two million people had visited the Philips Pavilion, heard the music, seen the projections. Varèse later described the event as:

> a spectacle of sound and light, presented during the Brussels Exposition in the pavilion designed for the Philips Corporation of Holland by Le Corbusier, who was also the author of the visual part. It consisted of moving colored lights, images projected on the walls of the pavilion, and music. The music was distributed by 425 loudspeakers; there were twenty amplifier combinations. It was recorded on a three-track magnetic tape that could be varied in intensity and quality. The loudspeakers were mounted in groups and in what is called "sound routes" to achieve various effects such as that of the music running around the pavilion, as well as coming from different directions, reverberations, etc. For the first time, I heard my music literally projected into space.

Indeed, Varèse thought of his sounds as objects of different shapes and materials with dynamic properties and tendencies, existing in and moving through a musical space. He said:

> There is an idea, the basis of an internal structure, expanded and split into different shapes or groups of sounds constantly changing in shape, direction, and speed, attracted and repulsed by various forces. The form of the work is the consequence of this interaction.

The sounds in *Poème Electronique*, many of them the result of electronic processing, are derived from percussion and melody instruments, bells, sirens, electronic tone generators, machines, and voices. There are simple sound objects, consisting of a single sound such as a percussive stroke. There are complex patterns of different sounds. There are extended rhythmic figures, articulated in percussion; smooth hyperbolic curves, contrasted with buzzing, shaking, and fluttering sounds; and staccato, pitched sounds combined in short melodic phrases. Born in 1883, Varèse was in his mid-seventies in 1958. He was a mature musician whose ideas and style had developed through the first half of the century. *Poème Electronique* was the ultimate statement of tape music as musique concrète. It marked the end of the beginning.

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