

ELECTROACOUSTIC PERFORMANCE PRACTICE



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GOOD EVENING! Thank you for coming to this lecture on electroacoustic performance practice. I have been asked to speak on this subject. The occasion is that *Mixtur*, for orchestra, four sine-wave generators, and four ring-modulators will be played this evening by the Conservatory Orchestra under the direction of Arturo Tamayo. Mesías Maiguashca—who has been my long-time collaborator—has attended to the electroacoustic installation, and I am very pleased with it.

I would like now to speak about six areas of **electroacoustic performance practice**:

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The first area is **recording technique**, which sets as goal the production of differentiated musical art products in performance practice; the second is **amplification technique**; the third is **transformation technique**; the fourth area is the **technique of pre-formed music**: *musique concrète* and electronic music; the fifth is the adoption of **electronic musical instruments**; the sixth area is the **combination of all electroacoustic possibilities** which we know of up to now.

In response to a question about my catalog of works, I have recently counted about 230 separately performable works which I have composed since 1950, and among them there are 120 electroacoustic works. And also those compositions which you might not think of, which I have been performing using electroacoustic means since 1970 at the latest—since the World's Fair in Osaka. I mean by this, for example, the *Klavierstücke*.

I begin now with the [first area]: **recording technique**. This has mostly been left only to recording supervisors, who have been trained through a specialized instruction for musical recording, which is done by admittance to record-producers' studios—whether it be for the radio or record companies or smaller private studios. From all my experiences, however, I am of the opinion that every musician—no matter which instrument he plays—must be informed about how his instrument can be recorded. There is usually not just a single solution for this, but several; however, he must in the course of time learn what the correct acoustical and technical prerequisites will be for the work that he wants to record. A bassoonist should know how and where his bassoon is best picked up by microphones. I think that in the future this practice will be just as important as the art of wielding the instrument. As a musician, you must assume responsibility for how you sound when recorded.

I would like now to explain this with regard to performance practice. What does recording technique have to do with performance practice? In response to this I will give just two examples.

In 1955 I summoned a twelve-year-old boy to come every Sunday for two and a half hours at the WDR Cologne, in order to make recordings for *Gesang der Jinglinge*. A small studio with recording-room and director's room, a sound-engineer, and myself: that was the situation. I had prepared the following: During the week before each such recording I prepared around a dozen tape-loops with melodies from sine-waves. The

intervals of these melodies were, under ordinary circumstances, hardly singable, as they were made out of various nonchromatic scales. The youth heard the tape-loops over headphones. Each loop, which ran over a post with a reel, was composed of a tape with the sine-tone melody and a somewhat longer silent tape (leader-tape). The melody was to be sung back each time by the youth during the silent tape. All of the melodies from the *Gesang der Jünglinge*—even individual intervals—were recorded in this way.

So, the youth heard a melody over headphones, sang it back, again and again—sometimes as many as twelve times—and everything that he sang was recorded on a tape recorder. In the days following a recording session I selected the best versions and copied them in the studio with multiple tape recorders, superimposing them into complex choral singing, in which the youth sang together with himself. So, in *Gesang der Jünglinge* quite singular intervals and melodies are heard, which the youth could sing in imitation.

Therefore, I employed a particular recording technique in order to produce a unique work which would never be repeated: an artwork which exists so long as its quality remains preservable, anyway. The tape was played back in four channels placed around the audience.

In this case the **recording** is part of the composition.

I will give yet another example. At the beginning of the eighties I composed *Invisible Choirs* for *Thursday from Light*. I conducted the rehearsals and recording with the choir of the WDR Cologne. For the complete work, of about fifty minutes' duration, I copied onto the sixteenth track of a sixteen-track tape all of the metric beats with impulses. On the other fifteen tracks, the choir was recorded. Through the use of pitch differences and accents, the impulses I had on the click-track clarified all the subdivisions of the measure and tempos. During the recording I listened to the click-track over headphones and conducted. For three weeks I coached the WDR Choir in sectional rehearsals, and in that way the voice-groups were separately recorded. All the voices of a section always sang. For example, all the tenors were recorded on one track, then all the tenors singing a second polyphonic layer on a second track, then all tenors on a third track; the same method applied to all the basses, all the altos, and all the sopranos. In some places I overlaid a voice group with itself as much as four times.

Through this recording technique, which always provided perfect synchronization, I realized in three weeks a rich polyphonic work. Later, in another studio over a period of six weeks, using eight loudspeakers standing in a circle around me at a distance of about two meters, I mixed

down a further eight-track version with a sixteen-track playback recorder and an eight-track copying recorder.

In the process I copied voice groups together onto some tracks, balanced—always standing—the dynamics (which took up the most amount of time) and changed the positions of the choir-groups around me, from one formal division to the next. Day by day I listened and mixed eight hours at a time a new original for performances. The result will be played back in a performance over eight—or eight pairs—of loud-speakers arrayed around the audience.

For *Invisible Choirs*, recording technique is consequently an integral component of the composition in its performance practice.

At present, what I've just described cannot be learned by a sound engineer during his period of training: it is much too short. In my opinion, a special institute needs to be added to every music conservatory. For example, a recording of *Invisible Choirs* would be a project taking about half a year. The choir, all the sound technicians undergoing training there, students of sound engineering, conducting students, and instrumentalists would take part in it and learn what the difficulties really are in producing such a musical artwork with the aid of electroacoustic recording techniques; namely, an end result which has the highest quality and would employ unlimited time for performance.

A work such as *Invisible Choirs* could never be sung by a choir *live*. In several moments as many as 180 voices are synchronized. When all the choristers are present, the WDR Choir has forty-eight members. Besides, a live performance of combined choirs could scarcely achieve a polyphonic synchronicity, exactness of intonation, and dynamic balance, such as in the recording of *Invisible Choirs*. The recording technique of our time consequently produces a quite new musical quality.

A [second area] of electroacoustics is that of **amplification technique**. This area has two aspects. On the one hand it developed historically out of musical practice, and on the other it is consciously broadened with a creative objective.

I will give you an example of how, in the case of one work, amplification technique proved significant over the course of time. In 1951 I composed *Kreuzspiel*, for oboe, bass clarinet, piano, and three percussionists. A grand piano is played without a lid, beginning in the highest and lowest octaves, moving gradually into the middle and filling all seven octaves, and then until the end of the first movement it withdraws again to the extreme registers. In the second movement, the notes move from the middle to the extreme octaves and back to the middle, and in the third movement both processes of movement are combined. The grand piano

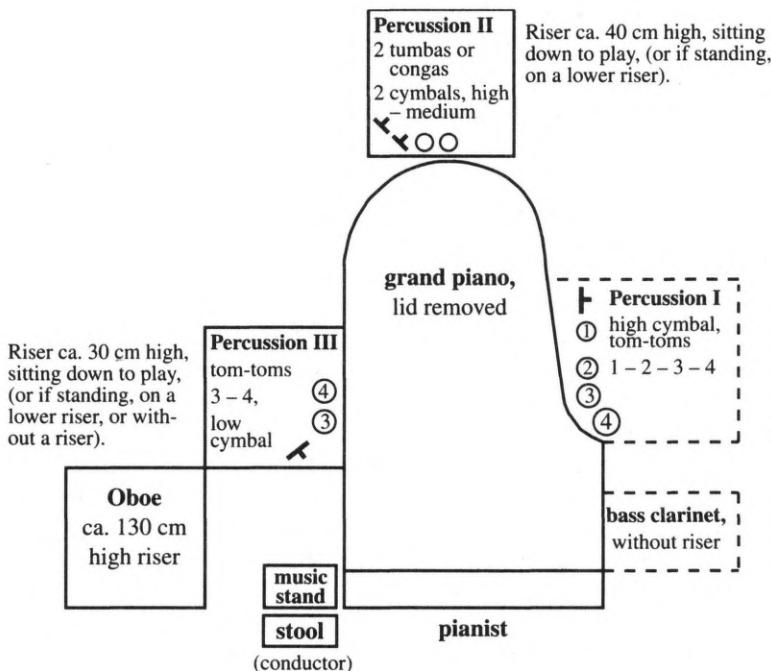
is placed with the keyboard toward the audience. Around the piano stand three percussionists. The percussionist at the back plays two tumbas, the two percussionists at the left and right of the piano play two and four tom-toms and one cymbal each. An oboist sits at the left on a riser, a bass clarinetist sits at the right at stage-level.

Already at the first rehearsals for a concert—the world premiere was in 1952 at Darmstadt—it turned out that I continually made signals to the percussionists to play softer, as the piano notes in the extreme registers and the bass clarinet could not be heard. Where *fortissimi* were written for the tom-tom strokes and *fortissimi* for piano or bass clarinet, the drums covered up everything else. For many years, in rehearsals of *Kreuzspiel* every conductor—myself included—would always continually be saying to the percussionists: “softer!” so that the *fortes* and *fortissimos* became *mezzoforte* strokes, and the other instruments had to increase the level of their softest notes, until one day I resolved to do away with the dilemma once and for all. I amplified the piano with two microphones. In several experiments I placed the microphones at first left and right under the key frame, aimed upwards from below: it lacked the high frequencies, and the tom-toms were amplified as well. Then I tried two contact microphones, attached with beeswax at the outer octaves under the key frame. This way the tom-toms were not amplified.

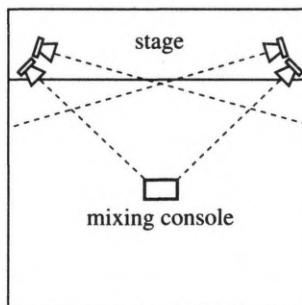
It is true there are places in *Kreuzspiel* where the pianist holds down the sostenuto pedal at a loud tom-tom stroke and the whole resonating body of the piano vibrates sympathetically. However, this drum amplification nowhere obscures the polyphony.

The bass clarinet and oboe also get one microphone each. In order to isolate the oboe sufficiently from the left percussionist, the player must sit on a riser about 1.3 meters high, and his microphone must be turned somewhat back and to the left. (See Example 1.)

Four loudspeakers must be used for the projection of the sound, and this is actually important for all amplification technique. If you wish to produce a stereo panorama, in which the sound will be heard from the place where you see the musician, there must be two loudspeakers placed on the right and two on the left at the sides of the platform, about 3.5 meters higher than the instruments. The outermost of both pairs of loudspeakers must be aimed approximately in the direction of the mixing console; the two inner loudspeakers must be adjusted so that the right one is aimed at the leftmost seat of approximately the third row in the audience, and the left one at the last seat on the right of the third row. Only in this way is it possible for the people sitting on the right to hear things in the left of the stereo panorama, and those sitting on the left to hear things from the right. This is a rule of thumb which works well. (See Example 2.)



EXAMPLE 1



EXAMPLE 2

The height required of the loudspeakers is always a problem, since either towers must be built or the speakers must be suspended—and the organizer never wants to have to do this. What you will see, for example, this evening at the performance of *Mixtur* in the conservatory auditorium is not what the score specifies. That is, we are not allowed to hang any loudspeakers in this hall. Properly, four loudspeakers for the four orchestral groups must be suspended over the orchestra, and indeed at least four meters high because of the danger of feedback and because of the angle of emission.

So, for the amplification of *Kreuzspiel* 2×2 loudspeakers are needed for stereophonic sound-projection. With panorama controls, you must then experiment until you hear the musician from where he/she sits. As the conductor of *Kreuzspiel*, you must leave the musicians to play a segment by themselves several times, and check how the amplification sounds from quite different seats both at the left and right of the hall. Panorama and sound-level corrections must also be made from the mixing console in the center of the hall, because the conductor is responsible in this piece for how it sounds in the hall.

The example of *Kreuzspiel* shows that it is not at all just about a simple amplification, but rather about the balance of sounds. Even if music is being played ever so softly on the stage, modern amplification technique makes it possible to perceive the music in a large hall as being physically nearby. For this reason also—since the 1970 World's Fair where, in the German Spherical Auditorium, fifty loudspeakers were suspended in ten rings in the sphere around the audience—I have amplified my *Klavierstücke*, using two microphones. For all piano amplification I use two microphones. One of these I position over the last metal bars in the highest octave of the grand piano at a distance of about 15 cm, aimed perpendicularly downwards, and the second is next to it, aimed obliquely downwards at the middle A, by which means the bass region is amplified.

In rehearsals of my work *Mantra*, for two pianos, in which 2×2 microphones are always used for amplification of the direct sound and for ring-modulation, I have sometimes noticed that sound-technicians place microphones in the resonance holes of the grand piano or in quite different places. Whenever I myself have been responsible for the sound projection, I have placed the microphones as I have just now described. In all performances of works with piano I mike the piano with two microphones. In the German Pavilion I used only a very little amplification for the projection over the fifty loudspeakers. This is not merely to make the piano *louder*, much more: it should make audible what in the fifties I had composed into the *Klavierstücke*. I have worked a lot with resonances—for instance, where you silently depress keys and then strike higher keys,

or the reverse. Even people in the last row of seats ought to be able to hear this. At many piano recitals which I have been to here and there, things were such that already at the ninth row the piano sounded very distant. And I actually want everyone to hear the piano as the pianist hears it.

In my workroom at the time of composition of my *Klavierstücke* there was a Grotian-Steinweg grand piano, which had an incredible resonance, especially in the two highest octaves. What I composed does not emerge from a modern Steinway grand at all—it dies away too quickly. Using amplification technique, I project the piano music into the room, high and also as wide as possible, which can help with listening right into the timbres, and with bringing all the nuances closer.

Now, in my music from this first *Kreuzspiel* example up to the works of the last few years, amplification technique has evolved enormously. This evening you will see thirty-two microphones in *Mixtur*. The strings do not each of them have a microphone. Some years ago at a BBC performance, each violinist and violist was amplified with a “necktie mike”—invisibly from the audience. For ’cellos and double-basses normal microphones on stands must be used, otherwise the lowest notes don’t sound so good. Necktie mikes are tiny and of good quality; they are noise-free. Most of the musicians in the BBC orchestra had one of these microphones, and the instrumental sound could easily be fed into the mixing console and ring-modulators.

In the last few decades a world has opened up, which has become ever more differentiated. Now every trumpeter, clarinetist, flautist, or trombonist who has worked with me knows where and how to stick on a Sennheiser microphone or fasten one with a special holder. For the flute we use a button-sized Sennheiser 10-2R microphone, upper-left on the chest. All the musicians of our ensemble are well-informed about amplification technique, and during rehearsals go about the hall while colleagues are playing, in order to hear how it sounds.

This has now evolved so far in my work, however, that the point is not only to simply project a singer or an instrumentalist into a hall by means of a sound-projector—sound-projection is a new musical profession—but I want the musicians to resound throughout the entire space, no matter where they are placed, or where they move. One such work is, for example, *Michael's Journey around the Earth*, from the year 1978, in which every musician is fitted out with a microphone. Four of the thirty-two musicians move, run about, all the while playing and dancing. They have wireless transmitters sewn into their costumes. The others are amplified by means of thirty-two cable-mikes. In the Soloist version of *Michael's Journey* one musician alternately plays trombone and euphonium, and the euphonium has a microphone attached to it, right next to

the bell; this instrument optimally is provided with a transmitter, so that the player can move freely about while changing instruments.

In almost all my small-ensemble works since 1970 the musicians with whom I have worked play by heart, while they move around and stand, sit, or recline. You will no longer see any music stands, and only in special cases chairs. I have composed specific movements and notated them in the scores. Therefore it is important that the sounds be projected into the space whatever the position of the interpreter.

In the case of *Michael's Journey around the Earth*, for trumpet and orchestra, however, this means that a musician is no longer heard from the same position where he is situated. And this is a critical point in the development of amplification technique. Ordinarily I would say—so long as we are dealing with music performed from an ordinary stage—that the sound should be heard coming from where it is being produced. This morning, for example, I took part in the rehearsal in the conservatory hall of a piece by Kaija Saariaho.¹ I went at once to the sound-projectionist, João Rafael, and said to him: “João, I hear the flute there, at the back-right, and there at the left sits the performer—move her further to the left.” He was able, with the panorama control, to correct the misdirection which had bothered me so enormously.

If, however, in a quite different spatial composition, such as *Michael's Journey*, all of the diagonals in the space are employed, in a circle with six loudspeakers, and each instrument is projected onto another diagonal with its own localization—as if you found yourself in the middle of the orchestra and the musicians were sitting round about you—then it is another matter. It's like this, actually, in *Michael's Journey* and in several other works, in which exact positions of the microphones as well as the Panorama distribution in space is stipulated. Through such sustained projections, naturally, wonderful experiences are generated, in which you can analyze the surrounding sound and hear the polyphony much better. The instruments sound from quite different directions, as if you had headphones which were not merely stereophonic but enabled a surround-perception, all around the head. Even the employment of a “Kunstkopf”² for recording does not enable a true surround-sound. I like headphones only in exceptional cases and prefer more space, variable distance of the sounds, and perceptible movement of the sounds in space in all directions.

It's a fantastic experience when sounds whiz by me at various speeds. The sound projectionist in the middle of the hall has—depending on the piece—a great responsibility as well. The traditional conductor synchronizes and balances what he hears from the podium. The sound

projectionist, on the other hand, is ultimately responsible for what the people in the hall actually hear. If, in a work with orchestra-mikes, he amplifies something too little or too much, then you will not hear what the conductor shaped from the podium. So, it is an incredibly demanding profession. The sound projectionist must on the one hand be a conductor—must have a conductor's training—in order to read the score precisely so as to be able to correct the musicians in rehearsals. However, he must also have learned his craft through long years of recording, mixing, rehearsing, and performing electroacoustic music. A mix-down such as I have described in the example of *Invisible Choirs* would be a suitable journeyman's piece.

Sound projection is therefore an entirely new field and I think that sound projectionists must be trained in a seven-year training course with regular experimental work in a music conservatory; with his own studio and a projection-hall, where he could experiment daily, do mix-downs, and above all could check what the playback ought to be, using surround-loudspeaker reproduction. Certain groups of musicians or also soloists must repeatedly play in this auditorium and be recorded and spatially projected, so that the sound-projection students can do practical work with the interpreters. This occupation can only be learned empirically. Twice as many lectures cannot establish what eight hours of daily application over many years teach.

If I could just add here: I have certainly spent more than twenty years of eight- to nine-hour days in electronic music studios, recording, and mixing studios. That makes about seven thousand days in which I have continually heard and shaped sounds. In the past year and this one alone, for four months long I mixed the opera *Monday from Light* from a twenty-four-track digital recording down to a stereo version—specifically, with a Neve-Necam mixing console. That is something special: these days you can hear each track from a twenty-four-track recording separately, adjust the dynamics and save all the computer-controlled processes. I always start with one of the main voices—mostly I build from the bass upward. When the main voices are balanced, then small dynamic alterations can be made at the very last. Even the smallest movement of a control is noted down. An entire day can be spent this way, mixing-down a segment of several minutes' duration, until everything is perfectly audible. Each operation is a detailed correction of the previous operation, without interfering with the whole. The individual tracks are corrected little by little. When you play back the result and observe from the mixing console, twenty-four or more controls vary as if in a phantom studio. You then hear and see the result of the work which you have done as sound-projectionist at the mixing console.

Something similar must then be learned for live performances, where there is no opportunity to redo things. Whatever turns out badly remains uncorrectible. Whenever a control is opened too late—as happened several times today during the rehearsal—then absolutely nothing is heard from that instrument, since the others cover it up. Sometimes only one or two decibels will determine whether an instrument is audible or not.

Being a sound-projectionist is therefore an unusually responsible, very fine occupation. You come into a hall for the first time and set up for an entire day, before the musicians begin rehearsals on the following day, and the first question arises: Where should the loudspeakers be placed? The first year, you will only know approximately what is best, and you will experiment around. After many concerts, you know a little better; but you can never foresee quite exactly what the best solution really is. So, you move the tripods, change the suspension, roam about the hall for hours, until by evening you are at last ready to play back a test-tape and have the feeling, “I now have the hall under control.”

Many halls are barely manageable. Above all when—as here in the Conservatory auditorium—suspending loudspeakers is prohibited, you can do nothing reasonable at all. Then you put the loudspeakers up on platforms, tilted upwards, so that they do not blast directly into the faces of the people in the first row. Most of the time I must work in halls which really are not suitable for the electroacoustic music of today and tomorrow.

Halls are built only for the performance of traditional music—but such music was really composed for small rooms; rooms like this lecture-hall, beautifully wood-paneled, acoustically balanced, provided with an irregular structure so that the sounds rebound everywhere and can disperse diffusely in space. Music of the past, which is performed in large halls today, is really not designed for such halls. Conductors therefore are always wanting more strings and doubling of the winds—which musically makes no sense at all. Traditional music can be performed in small halls with the original number of musicians for which it was indeed composed in the period from which the very popular masterpieces originated. Only since the end of the last century have we adapted little by little to larger halls by doubling the orchestral parts, but this has reached an end. In the larger auditoriums even an extremely enlarged orchestra cannot really be made audible to the last rows. Above all, in an amphitheater like the Philharmonie in Cologne a symphony orchestra is lost—because the hall is wrongly constructed! The high notes continue in a straight line, of course, in the direction from which they are sung or played. For the most part they carry upwards in such a steeply raked auditorium only a couple of meters horizontally, for all of the other seats it comes indirectly. And if

you sit at a height of up to forty meters away from the sound-source, a piano becomes just an insipid mumbling. If you have a subscription for symphony concerts that puts you at the front-right in this hall, then all winter long you will hear only 'cellos and contrabasses. The architect obviously had aimed at performances of classical and romantic mono-directional music, and this for about two thousand listeners. Only a highly sophisticated amplification technique can help with this.

The situation in the opera houses is even worse. I have, for example, in the last year and a half written a part of the opera *Tuesday from Light*, titled "Invasion," which will first be given concert performances in various halls. In Frankfurt at the Alte Oper it was only possible because the seating is moveable; you can put all the chairs wherever you wish. I need three left-to-right aisles and three front-to-rear aisles, each 2.2 meters wide, through which the musicians can move through the audience while playing and singing, in three *Invasions*: in the First Invasion from left to right, in the Second Invasion from right to left and forward, and in the Third Invasion from the rear forward, whereupon the musicians storm the stage. This work is performable almost nowhere, because you cannot remove any of the chairs, which are all firmly screwed down. In the theaters they say: "It's quite out of the question!" The same for the mixing console, for which no one will make space in the middle of the hall. I must write letters for months beforehand, and things go on and on, cutting and thrusting, until I am ready to give up a performance, and say: "either you remove five pairs of seats from row number such-and-such, or the concert won't take place." And then either a compromise is reached—or not. There are cases where the concert must be canceled. In theaters it is so inconceivably difficult.

Fourteen days ago I was in the Muziektheater in Amsterdam. *Tuesday from Light* should be performed there next year: a beautiful, quite new opera house with a wonderful lot of plush—large, wild, really so—each spectator has like a bathtub to sit in. Balcony-like gigantic boats loom in the space, larger than in the Cologne and Hamburg Operas. And in the first two rows of these boats the stage appears like it was on a television screen. The singers sound distant.

Sometimes the orchestra in the pit is audible, another time not. Last week at a performance in the Cologne Opera I couldn't hear it. The orchestra produced nothing but a deluge, and I also couldn't understand the singers. I sat in the twenty-second row. This hall, too, is wrongly constructed.

At the preliminary meeting regarding the performance of *Tuesday from Light* in the Muziektheater in Amsterdam I finally said: "Let's go on the stage again." We went onto the stage, and after careful inspection of the

stage area, I suggested seating the audience on the stage and constructing a platform over the orchestra pit, and not to use the auditorium at all. My suggestion was accepted. I have for this purpose drafted a seating plan for 669 places as well as all the necessary platforms.

The passageways for the "invasions" through the audience were easy to arrange there. Above all else my *Octophony*—electronic music for "Invasion-Explosion"—requires eight pairs of loudspeakers at a height of about fourteen meters and, in the high stage-area, that was accomplished without any trouble. Looking through the stage-opening into the crimson auditorium was as if into a gigantic hell-hole.

[A voice is heard in the auditorium.]

Yes?

[Question from H. Gottschewski: Would you also find it an acceptable solution to perform traditional music with amplification and sound projection through loudspeakers?]

Well, I have written much traditional music myself. I mean, where do you draw the line? Forty-one years ago, for example, I wrote *Kontra-Punkte* for ten instruments in a completely traditional manner, so far as performance practice is concerned. When I conduct this work in a large hall and, for other pieces on the program, have at my disposal electro-acoustic equipment—microphones, a good loudspeaker-distribution (at least two pairs of loudspeakers for controllable stereophony)—then *Kontra-Punkte* can be spatially projected. Each instrument is provided with one microphone, the grand piano with two. In a careful set-up you can hear before you the panorama of this ensemble, so wonderfully in fact that everything is clearly audible. I would even amplify a string quartet. However that naturally demands great experience, in order for it to turn out well.

Several years ago in the Albert Hall in London, I experienced with six thousand other listeners a performance by Ravi Shankar and his group. They used an artful amplification technique there. At the level upon which the Indian musicians sat were approximately forty small, low loudspeakers, which I really couldn't localize individually. The sound was quite broadly distributed. The tone quality was absolutely beautiful. The sound felt to me like in a small space in India, where they normally play.

Great skill is demanded of the sound-projectionist to test from all of the seats in a hall and to project a balanced sound image; to form the acoustical aura around the musicians so beautifully that you are enveloped in the sound. I would strive for that in every kind of music. Highly

professional equipment, and very much sensitivity is necessary for this (naturally things must not be coarsened, overdone). But I would in every case bring out subtleties, project them with vivid transparency, bring them into a physically perceptible proximity, and strive for the audibility of the musicians. I listen to the sound over and over in close proximity to the musicians and I try by means of the sound-projection to render this as a chamber-music experience, in the original sense. If for example my *Zyklus* for a percussionist is played, then I have since the first performances spatially projected all of the instruments. For this purpose I employ four microphones in a square around the percussion instruments and reproduce them with Panorama-controls over four pairs of loudspeakers, which were set up in the four corners of the hall for my work *Kontakte*. I try, through the amplification, to reproduce the acoustical impression which the percussionist has in the middle of the circle of sounding instruments which surrounds him. The sound from the loudspeakers is not quite so vivid as that which the percussionist hears. In *Zyklus*, some percussionists now and then produce very delicate sounds—with their fingernails on cymbals, or with fingertips on drumheads. The audience sees gestures, but hears nothing. Hence it is exactly in such places that amplification is urgently needed, by which you approach the same thing that the percussionist hears.

The thing is not only to archive music, and to create new artworks from known sound-sources through a new recording technique, but also to so amplify and spatially project music that one is physically enveloped in it like the interpreter, and the space of the auditorium is pervaded by acoustical events to such an extent that on all sides it takes on an omnidirectional character. Please don't forget that the performance practice of European art music was partly determined by the need to find shelter in closed spaces from rain, sun, cold, noise. Art music in Antiquity took place in the open air. In other cultures this is still the case today. For example, in southern India nocturnal *Katakali* performances regularly take place in the open air. Even *Nô*-theater, *Gagaku*-music can be experienced in Kyoto on open stages in the open air. In Bali I have experienced numerous performances of *Ramayana*-ballets, *Trance*-dancing and many other music-theater rites. Music can sound wonderful, when it is enveloped in nature. These days the performance of music in the open air is scarcely ever possible, because there are almost no quiet places left, where you will not be disturbed by street traffic, by engines, airplanes, noisy people.

That reminds me of an incredible story. Some years ago I made the chance acquaintance of a Mrs. Hachinikos from Greece. She arranged a performance of *Inori*, which I was to conduct in the Herodes-Atticus-Amphitheater in Athens. I wanted to give a course of lectures in Athens

about spatial music. She said, "You want to what? We had a horrible experience. Verdi's Requiem was to have been given with the Berlin Philharmonic under the direction of Karajan in the amphitheater in Epidaurus. We had spent a terrific amount of money for this—millions. The entire orchestra, the choir—more than three hundred performers—were accommodated on ships. And imagine this: Karajan comes to the podium—there were about twenty-two thousand people present, we were sold out—anyway, there ran in such a dog, it barked loudly, louder than the music. It could not be chased away. Herr Karajan furiously threw away his baton and walked out. The whole performance never took place. What *that* cost us!"

So, you've got to watch out in the case of open-air performances. Something similar happened to me in Florence in the Cloister of Santa Croce during a performance of *Sirius* in the evening under a radiant starry sky. During the performance, actually, a big dog suddenly ran through the audience, so that I had to stop the tape, switch on the lights, some men chased the dog out and we finally continued our performance. It will be urgently necessary to create quiet areas and spaces in the future.

I composed a work with the title *Starsound: Park-Music for Five Groups*. It is to be performed on a night of the full moon in the summer—July or August. Five groups of vocalists and instrumentalists are placed at wide intervals in an oval in a park, on five platforms among bushes and trees. All are amplified using microphones. Next to each platform at the left and right stand high towers for the loudspeakers. From time to time sound-runners move from group to group, singing or playing, escorted by torch-runners. A performance lasts from two-and-a-half to three hours. The audience moves about among the groups, or lies in the meadow. Ten times during a performance all the groups are synchronized by means of a percussionist, who stands on a platform in the center of the oval in the shrubbery. His instruments—tam-tam, tubular bells, large alpine bells—are also amplified over loudspeakers. For all performances of *Starsound* up to now we have had good luck with the weather—mostly cloudless under the stars with a full moon—and the audiences, sometimes eight thousand listeners, have sympathetically adjusted to the atmosphere.

As the [third area] of electroacoustic performance practice I named **transformation technique**. It has developed from the fundamental orientation out of which I started to compose and realize electronic music. I determined never to repeat the same instrumentation and told myself over and over: each work must have its own sound-world, a unique physiognomy, which cannot be identified with any other in the world.

Therefore I wanted to compose even the sounds which are unique to a particular work. The sounds are a constituent part of the form, form and material having become for me since 1951 one thing. They should never again be separated, either. It means composing for a particular form a particular material and not—as in traditional music—any number of forms using the same material.

Even if that should be the case, it is necessary at times also to **transform familiar material**. I offer just two further examples. You will hear a particular transformation this evening in the work *Mixtur* for five orchestral groups, four sine-wave generators, and four ring-modulators. At the beginning of the sixties, after twelve years of realizing electronic and *concrète* music, I began to transform instrumental sounds as well. *Mikrophonie I* for large tam-tam, two sound-excitors, two microphonists, and two filter- and control-operators was the first *live-electronic* composition.

In *Mixtur* four orchestral groups are transformed by ring-modulators: modulated in their timbres, rhythmicized, with newly formed dynamic envelopes. What's more, in *Mixtur* all the instruments which constantly play pitches with chromatic notation, also freely realize **microtonal degrees** and **glissandos**; this results from the ring-modulation.

Each pitch is freely **transposable**. If a violinist plays a sustained note and you combine this in the ring-modulator with a different frequency of a sine-wave generator, then you hear from the loudspeaker the transformed sound somewhat louder than the natural one. The natural sound can be scarcely identified any longer, or sometimes even not at all.

If you ring-modulate with a modulation frequency in the range below about 16 Hz, then you hear, in the case of sustained brass notes or bowed-string chords, a distinct **rhythmicizing**: periodic amplitude-modulation, rhythmic accelerandi and retardandi toward quite slow rhythms, even sometimes slower than 1 Hz.

The **transition from pitch to noise** in *Mixtur* is continuously audible in the case of every instrument. That is, as soon as the rhythmic modulation becomes faster than sixteen vibrations per second the tone becomes harsh and increasingly noisy. Or if a tone is modulated with a dissonance—let's say with a minor second, or a minor ninth, or a major seventh, or with an interval which approaches even nearer to the fundamental or its octave—then either the **beating** between the original pitch and the modulating one, or a more-or-less severe **noisiness** is heard.

Therefore, quite **continuous transitions** are possible, from consonance to dissonance, pitch to noise, continuing to a rhythmicized pitch.

After the composition *Mixtur*, I developed the method of ring modulation further in *Mikrophonie II* for twelve singers, Hammond organ, and four ring-modulators. In 1970 I wrote *Mantra* for two pianos, two sine-wave generators, and two ring-modulators.

Nowadays there are still other quite different methods of transformation. My latest piece, *Invasion-Explosion*, which was recently premiered at the Alte Oper in Frankfurt, uses several sound sources of specially invented percussion instruments. However, they do not look very much like percussion instruments. Andreas Boettger, for example, plays a *MIDI-Lyre*. It is not at all a normal lyre, but rather an instrument that indeed looks like a lyre with metal tongues, but each tongue is connected to a sampler by means of a touch-sensitive electronic sensor through MIDI. Behind the percussionist follows an assistant who carries an amplifier, sampler, and an approximately eighty-meter-long cable, and is connected to the percussionist by a cable. The percussionist carries two loudspeakers on his back. He moves through the scenery like a mobile loudspeaker.

[Laughter in the hall.]³

Why do you find that so funny? It is, after all, actually rather self-evident. Anyhow, in *Invasion* four of the twelve musicians each carry two loudspeakers on their backs and shoulders. Additionally, a player can also be projected with a transmitter through a mixing-console and hall-loudspeakers. Whatever I receive from the transmitter at the mixing console I can make roam in space over the octophonic loudspeaker system with the aid of a joystick, so that while moving about the player also has sounds which stream like long tails up into the air. Other sounds spin around while the player moves through the room.

So, by means of transformation relatively simple sounds become quite idiosyncratic.

A second percussionist in *Invasion*—Renee Jonker—made from a military drum a *Tambour-Miditaire*. The drum-head has sensors attached at various places and every stroke on the skin yields, through an electronic circuit, quite strange timbres which are stored in a sampler. An assistant walks along behind the player and carries the sampler, amplifier, cable. The loudspeakers are built into the drum and radiate through holes in various directions. Very interesting!

Once you have heard mobile sounds going past, then that is a totally different experience than when—as ordinarily—movements from loudspeaker to loudspeaker are realized by means of phase-shifts—as I did in *Kontakte*, *Hymnen*, *Sirius*—or are only evoked by means of amplitude shifts between loudspeakers (which of course produces pseudo-motions). The time will come when sounds can be projected to quite specific points in space, and be made so three-dimensionally audible that you could almost touch them.

The [fourth area] about which I would like to speak is that of **prefabricated music**, which may either be performed independently, or be mixed with music generated at the moment of performance. Examples of this are my *Concrète Etude* from 1952—a small piece, that still exists and that in two months you will be able to hear for the first time on a Compact Disc. Then the electronic *Study I* and *Study II* from 1953 and 1954, *Gesang der Jünglinge* from 1955–56. Then followed *Kontakte* in 1959–60, *Hymnen* in 1966–67, *Telemusik* in 1966, *Sirius* (1975–77), *Monday Greeting* (1986–88), *Monday Farewell* (1988).

In the past two years (1990–91) I have produced a seventy-four-minute piece of electronic music, called *Octophony*, which may be performed either by itself or together with instrumentalists and singers.

What is important about all of these works is this: the attitude toward making music is in the case of prefabricated music radically different. One writes as a composer and interprets as an interpreter, because of wanting to produce something that should remain valid once and for all and is not repeatable. So, you make a tape, like a sculptor or like a painter, and you must say to yourself during each second of the realization: that's the way it must be! With each copy the utmost care must be taken to ensure that no hiss emerges. You worry to high heaven out of concern for the sonic reality.

Next January I will go again for three months into the Studio for Electronic Music of the WDR in Cologne. Up to now the studio has had no money available for a twenty-four-track digital tape recorder. All the other WDR studios have such twenty-four-track machines and, nevertheless, they record only two-channel stereo with them, because neither the time nor the technicians are available for prolonged mix-downs from twenty-four-track recordings to stereo versions. It's like this in the large *Philharmonie*, in *Sendesaal 1*, in *Sendesaal 2*. There they now have the most wonderful equipment, whereas the Studio for Electronic Music, which ought to produce lasting products, has no digital recorder and also no digital mixing console with saveable mixing-setups. So, I must work with an old twenty-four-track analog machine with Telcom-gadgets.⁴ The Telcoms are fragile; you cannot reliably adjust them to each other, and you cannot know whether the playback or the recording is wrongly set. But there is no other option. I work with this equipment all the same, because I want to realize electronic music.

So, with this work I live in the constant awareness that I am realizing something NOW which will never again be made—not corrected, repaired, or made over again. Each decision must count. This is also the reason that up to now there still exists no fair copy of the score of *Gesang der Jünglinge*, or of the realization-scores of *Hymnen* or *Sirius*. They are

in fact in the form of pencil manuscripts, quite hastily sketched. But I never have the five months reserved for a version of the realization-score of *Gesang der Jünglinge* suitable for printing. The work exists.

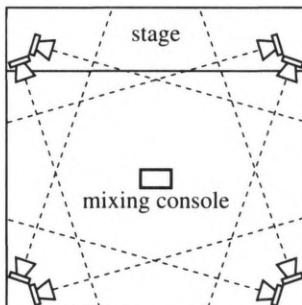
Soon there will be analytical processes with which much of what I have realized can be analyzed. The sketches and working-notes can be studied. Realization scores of electronic music are not so useful as in the performance practice of music which is to be played or sung. Nevertheless, pre-formed music is extraordinarily important in performance practice, because it contributes the highest quality and, above all else, sound-worlds which could never be created with the sound sources familiar to us. That is the be-all and end-all of prefabricated music.

A realizing musician spends much time in the studio and condenses it down into the small duration of a composition—in the case of *Gesang der Jünglinge*, for example, around two years' work into about thirteen minutes. In this work you can listen for years, and even after many repeated hearings still discover something beautiful and new, profundity, an incredible lot of sophistication. In the case of several individual sounds in *Gesang der Jünglinge*, which last only three seconds, I had to work for six weeks. Such a sound has such very fine shadings, assembled out of tiny little mosaic elements.

It simply requires a different attitude to listening, to include such a thing with musical practice because the detail is repeatable as often as you like. Historically, composition first arises from a practice of musical perception such as had never before been: namely, so that a musical work can be heard as often as desired. The increase in polyphony, in subtleties of articulation of sounds, in duration, in mystery, has become evident in the last forty years. Up until the middle of the century, whatever an educated musician could not understand after a single hearing in the concert hall was regarded as poorly composed. Today, however, this is no longer the case. Indeed, it should be evident when a large-scale musical architecture is well-made. But by the second time, you ought to hear much more already. And by the hundredth time you should still be discovering new things. That is the meaning of a condensed prefabricated music.

This also applies to all possible **combinations of prefabricated with live music**. My work *Kontakte* for electronic music, piano and percussion is the prime example. *Kontakte* can be heard in a separate version also, as electronic music without instruments, in the correct manner, in four-track sound (two-track remains ever a compromise for study); therefore four tracks, with the correct loudspeaker setup, namely with four pairs of loudspeakers in a square, with good placement, so that all of the rotations, diagonal movements, alternations, flood-sounds—that means sounds that shoot forth overhead from the rear toward the front or from

one side to the other—can be well perceived. (See Example 3.) If you are experiencing the movements for the first time, you will be diverted to a large extent from a real immersion in the fine structure of the music, then you may be fascinated by the physical effect of flying sounds. Just as you might be amazed at what all the familiar instruments produce during a performance of *Kontakte* with piano and percussion.



EXAMPLE 3

Another work in which electronic and concrete music is combined with instruments is *Hymnen with Soloists* and *Hymnen with Orchestra*.

In parts of *Light* tapes which were produced by me in the studio are combined with live music. After all, the emphatic difference—to some extent even polemical conflict—between so-called *musique concrète* and *elektronische Musik* has disappeared. *Gesang der Jünglinge* was already a combination of the two. The recordings with the boy's voice are certainly concrete sounds (the French use this expression, *musique concrète*, to mean something recorded with a microphone, which exists concretely in the world and then is transformed in the studio), and sounds which are created by me with generators are *elektronische Musik*.

The first *elektronische Musik* which I set about from an entirely puristic point of view (although I had realized concrete music a year previously) I composed with sine tones, and I required them then for myself—not for my colleagues—for several years in this electronic-synthetic form. Many pieces at the time were made with only electrically generated tones. This had a particular philosophical basis. I wanted to produce a music from tones which were not already modulated from the outset, and thus fully laden with harmonic spectra, dynamic curves, and frequency and amplitude modulations. I wanted to compose with *pure* tones, just like

Mondrian with pure colors. I hope that you know well Mondrian's paintings from the years 1932 to 1944. During this relatively short period he painted vertical and horizontal black strokes, within which were blue, yellow, and red squares and rectangles. Or the white pictures—white-on-white—by Malewitsch. These were models at the time of the first electronic studies.

Then came *Gesang der Jünglinge*, a very colorful world from electronically produced sounds, from impulses or filtered noise or sine-tone chords, plus sung notes. And these sounds are diversely layered one above the other, and synchronized. That was already a first synthesis of *musique concrète* and *elektronische Musik*, in which that former philosophical conflict simply no longer existed.

In *Hymnen*, electronic and concrete music from the years 1965 to 1967, many recorded sound events are combined with electronically generated ones.

Likewise in *Sirius* from 1975–1977: crackling fire, rustling brook, breaking ice, wind, combined with synthetic sounds generated in the studio.

Telemusik from 1966 is the example *par excellence*, where more than twenty fragments stemming from quite distinct traditions, which had been recorded on tape, were intermodulated with electronically generated sounds. That is a wonderful world. In *Telemusik* you can study what modern genetics seeks: namely, to cross living things which do not cross in nature, so that odd hybrid-types arise. In *Telemusik* you can experience such a thing clearly. I have often given examples of this—how for instance I modulated the chant of monks in a Japanese temple with Shipibo music from the Amazon, and then further imposed a rhythm of Hungarian music on the melody of the monks. In this way, symbiotic things can be generated, which have never before been heard; the original qualities are perceived as a whole, which then also can no longer be dismantled. It is like chemical combinations which cannot be reversed. Such intermodulations in music have a great deal of scope.

When I work together with my son Simon, who has a lot of experience with sampling and transformation, then we mix the most singular sounds from recorded events and synthetically generated, synthesizer-produced sound forms. In this way, original and vital sound patterns arise.

Many envelopes of sampled sound-phenomena cannot be produced synthetically, as they are too complex and just "organic." The organic qualities in *Hymnen*, *Telemusik*, *Sirius*, *Monday from Light*, and so on, come in part from sampled natural sounds, from sounds of nonmusical material, or from the present instrumental or vocal world, which musicians produce with their instruments and voices. Pre-formed music thus includes also all of the possibilities of *Intermodulation*.

The [fifth area] of electroacoustic performance practice is the adoption of **electronic musical instruments** into performance practice.

[Question: "I have another question in connection with *Mikrophonie I*. I recall an analysis in Darmstadt with your description of the sophistication of the electronics and the unusual performing equipment. How many supplementary instruments do you have? The reason I ask is because they are special instruments, which produce quite particular sounds."]

Yes, there are two trunks in the archive with the original equipment which we used at the time—mind you, some of them are loaned out at the moment to musicians, the percussionist Andreas Boettger amongst them. Also the Slagwerk Groep Den Haag has borrowed several of them from me, and not yet returned them.

In the meantime three new productions of *Mikrophonie I* have taken place; one with a group which fourteen days ago gave four concerts in Holland. Andreas Boettger and Renee Jonker have made copies of the equipment which I tried out in 1963, together with Christoph Caskel, Bernhard and Aloys Kontarsky, Johannes Fritsch, and Harold Bojé. Renee Jonker sent a telegram just two days before the performance: an old egg-timer which was being used had gotten broken, did I have another as substitute? Now, at the time, I had taken this gadget (which since 1962 had been used in *Mikrophonie I*) from my wife's kitchen. It was a plastic egg-timer with a turnplate for setting the duration of the ticking before the ringing.

[Laughter]

Yes, exactly. When you held this timer to the tam-tam and let it tick close to the microphone—which occurs in two places in *Mikrophonie I*—then it sounded like a cosmic clock in a gigantic echo-chamber. More importantly though, the housing can be scratched, scraped, rubbed over the tam-tam's surface, and thereby fantastic timbres can be produced. The case is molded from a special soft kind of plastic. The edges were something quite unique. I have never since found anything similar. At the time I bought fifty of these timers from the manufacturer's factory. I still have them in a box.

[Laughter in the hall. . . . Renewed, unintelligible question about the tam-tam.]

The history of the *Mikrophonie* tam-tam is rather bizarre. I found my large Paiste tam-tam in 1961 in Frankfurt at the Music Trade Fair and

used it in *Momente*. After that I composed *Mikrophonie I* for this tam-tam. For many years institutions have sought to buy further exemplars of this tam-tam for *Momente* or *Mikrophonie I*. However, the firm had in the meantime produced a different kind of tam-tam with much thicker material and rougher surfaces, so that *Mikrophonie I* could no longer be played properly.

Robert Paiste—there are two Paiste brothers—together with three craftsmen recently visited with me for three days in Kürten. I had invited several percussionists as well. We tried out three new tam-tams in the Kürten school. Paiste had had the blanks rolled out in a rolling-mill in Siegen. The tam-tams were much too thick. By means of my old tam-tam I showed why thinner ones must be produced. Besides, the edges should not be so steep, but rather more gently arched. These new tam-tams no longer respond to cardboard tubes and boxes, plastic dishes and lids, glasses, tea-caddies, suction-cups, egg-timer cases, massage vibrators, monochords, spaghetti-forks. It all sounded wrong. And once such a heavy tam-tam had been brought into vibration, it was scarcely possible to damp it.

After this meeting Paiste will try to produce tam-tams with thinner material, and when these are ready, we will once again test them all. Robert Paiste has announced a gift. He said to me: We are really now old enough and want to call this tam-tam the “Stockhausen-Mikrophonie Tam-tam.”

There is now again all the necessary equipment for *Mikrophonie I*. At the Freiburg Conservatory there is going on at the moment a course for percussionists as a Special Project *Mikrophonie*, directed by Andreas Boettger, with the aim of performing the work regularly. In 1964 I had 150 photos made of the items of equipment, in the order of their use in the Brussels Version. To each timbre correspond two photos, in which are seen only the hands and the piece of equipment, at the angle in which it is to be held against the tam-tam in order to produce sound by drawing or rotating the gadget. Nowadays it could all be recorded with a good video camera and be passed on to interpreters.

[Question: The Brussels Version has, er . . . (rest unintelligible)]

The Brussels Version is released on a recording and has also been published in score. To it belong the photographs I referred to. There are also other versions of *Mikrophonie I*.

After this long detour, I return to my actual subject: *Mikrophonie I* is a prime example of the adoption of electronic musical instruments in

performance. I had made at that time *two filters*, which could be manipulated according to the score. Yesterday I had a long talk about these filters with Thomas Kessler from Basel. Thomas Kessler was here a little bit ago—ah, there indeed is Thomas! He prepared *Mikrophonie I* in Basel with his students. There is the problem that we could no longer rebuild the old filters. They were so-called *Hörspiel-Verzerrer W 49* [W 49 Radio-play distorters], built in-house at the WDR in Cologne: filters with carbon strips. It is really interesting how very old-fashioned that sounds (after all, violins with catgut are used today). Such materials are glorious, aren't they? The two metal levers of the filters scrape along on the carbon strips, and spray must now and then be used. Today, If you try to substitute computerized filter simulations, the characteristic sound goes to hell. The scraping and the skips between filter-levels is lost; but they actually belong to such a sound, when it is brightened up from below to above, or vice-versa. The score is also written in such a way that both controls can be opened and closed in the span between the index-finger and the little-finger of a spread hand. The W 49 filter was quite fumblingly designed.

Yesterday Kessler said: "Even if the filter is created electronically with a computer, we should still construct them mechanically like they used to be, no matter what the electronics behind it are. It must still be the same for the hands."

It's extremely important to comprehend works, which were born to a particular historical moment, for their uniqueness. It just won't do to be continually discarding everything and making something different, but rather we should be preserving things and adding new ones. Anyway, it is my experience of music that every instrument, every item of equipment, every technique can produce something unique, which can be achieved in no other way. Since that is the case, then we can speak of an original technique, and thus deal with an original instrument. If it is imitable, then it is also not worth much.

Now I come at last for the second time to the **fifth area** of electroacoustic music, namely to the **adoption of electronic musical instruments**. The industry for performing-synthesizers in recent years has exploded. All sorts of companies in various countries produce a multiplicity of synthesizers and samplers as modern keyboard instruments, modules, and so on. For six years I have worked with several musicians, who together with me have programmed timbres for particular works. After a long tradition in which one could write in a score: flute, oboe, piano, harmonium, perhaps also even Hammond-organ (which, by the way, scarcely exist any more), the **fashioning of timbres** now belongs to composition. These timbres can scarcely even be notated in words or symbols; never mind

analyzing them. If you employ a Fairlight synthesizer and describe on several pages how you produced a timbre, this is little help to a performer. Even for a technician who has no Fairlight synthesizer or does not know how a sound was brought into being, step by step, it is not discernible from the numbers and graphics what sort of timbre that really is. You can listen to them and either say “interesting,” or “I know that one already.”

If I produce for a work, in which I mean to use a synthesizer, **work-specific original timbres**—and that sometimes can take weeks, as in the work together with my son Simon or with Michael Svoboda or Michael Obst for the timbres for *Eve's Song*, a scene from *Monday from Light*—then I record them separately, one after another, on a demonstration tape, with announcement of the numeration in English, and played on the pitch A in several octaves, so that now and forever people can hear how these timbres sounded. This is really the only possible way to “notate” new timbres. The time-structure, the pitch structure, the dynamic structure are composed, and then the acoustical record of the timbres is added.

There is still something particular to say about the **dynamic structure**, because volume levels have not been sufficiently differentiated up to this point. In all conservatories the primitive indications for loudness, such as *pianissimo*, *piano*, *mezzoforte*, *forte*, and *fortissimo* should really be replaced with more exact ones. What can actually be notated in the realm of *loudness*? The old Italian indications are so coarse, as if a child were to be taught only about the roughly seven octaves of the realm of pitches, whereas on a piano there are eighty-eight pitches at your disposal. We hear very fine gradations of volume as well: at least eighty phons, with distinctions as small as half a phon.

It would therefore be essential—and that belongs to synthesizer-technique as well—that each instrumentalist who is miked and projected in space should employ a display apparatus with vertical light-columns for amplitudes, by which can be seen what dynamic is being produced. During rehearsal he can then take note of the level when he is corrected by the sound-projectionist, or when colleague performers suggest adjustments of volume. Then in the course of time everyone learns the new technique of measuring loudness, and an incomparably more precise awareness of dynamics would develop, comparable to the development of the hearing of pitch since the Middle Ages. It's rubbish when an orchestral musician who has been corrected cries out: “Yes, *mezzoforte*! That's what I just played!” and I reply: “That might be so, but couldn't you raise your *mezzoforte* a bit more?” Another calls out: “But I have *piano*!” I call back: “Your *piano* a little bit less, please, then you will be equally loud!”

This is really an impossible situation—things really cannot go on like this! There is an appalling dilettantism at work, which we have not improved for decades. Because this primitive distinction was taken a long time ago from the Italians, it is still used today. In the New Music dynamics become ever more nebulous. Most of the corrections made in rehearsal are corrections of dynamics: “too loud,” “too soft,” “a bit more,” “a bit less.”

Of course, for loudness there is still no prefabricated scale built into the instrument, like there is for pitch. However, just as the bowed strings must find chromatic pitches (in the case of singers maybe there is not quite such precision),

[Laughter in the audience]

all musicians could learn to differentiate precisely and to produce at least forty-eight degrees of loudness.

So, we need instruments with light-columns for volume; the same goes for singers. The measuring equipment would of course be used in rehearsal, so that in the performance the dynamic balance is perfected.

The same goes for all parameters: during practice all rhythmic values should be counted in sixteenth-notes, though not necessarily during performance. Of course, each musician must have practiced separately the mechanics of all the parameters, before the general rehearsals. Then the aesthetic of the performance could be moved on to in the general rehearsal. All that is well-shaped, beautiful, harmoniously interrelated—that really should be the object of most rehearsals. Unfortunately, this is scarcely ever the case today.

So, new methods of documentation of timbres and new measuring instruments for practicing dynamics are needed.

I come now to the **sixth and last area** of electroacoustic performance practice, that of **combination of all electroacoustic possibilities**. Everything nowadays is sampleable, everything is transformable, everything is also—after sufficient work and with sufficient imagination, sufficient technique—intermodulable in novel ways.

Only after decades of work in electroacoustic music can such syntheses be expected. Timbres may no longer sound as in the preceding piece, or in any other earlier piece; in any case they must not sound the same as in the music of another composer. Creativity itself has come to the content of the music. Each time some new music is performed somewhere, there must be the feeling that the utmost attempt was made to create something unique. Please don't forget this, it is my ideal: to create something unique in perfection, in originality, and in beauty. And to do it again and again.

That is the meaning of a liberated music, which must not be “entertainment music” because then it will be used—produced with clichés like wallpaper-patterns, “Environment Music.”⁵ Art music—that is what we should undertake: that we truly invoke creativity itself again and again through that which we produce.

In order to become acquainted with a combination of many electro-acoustic possibilities, it is only necessary to study my latest composition: *Tuesday from Light*, with a duration of about two-and-a-half hours. In the *Tuesday Greeting* two choral groups at the right and left behind the audience are amplified using microphones. One soprano, who moves about and comments on the choir, sings through a wireless transmitter. She is projected, by the sound-projectionist in the middle of the hall, to where her movements from time to time take her. Everything must be clearly understood, even each whisper.

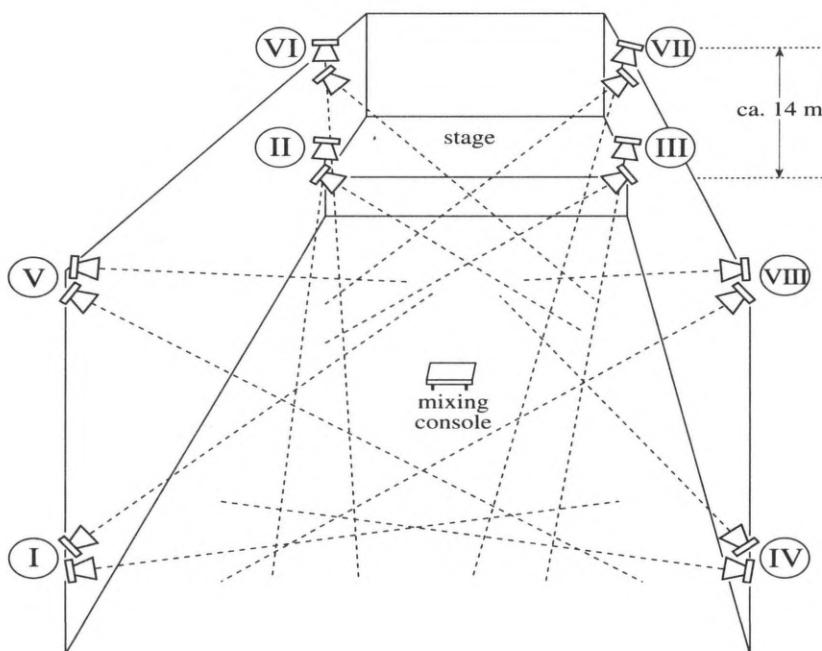
Nine trumpets and nine trombones are in fact unamplified, but stand in a long row on high platforms behind the audience, or to the right and left of the audience. Two synthesizers, each with two loudspeakers, are played close to the two choral groups.

After this comes the first act, *Jahreslauf*. On the concert platform on two levels—in a staged performance at the back of the stage—there are four instrumental groups arranged from left to right. At the world premiere in Tokyo, three *Shō*'s played in the first group. In Europe they are replaced by three harmoniums. Good harmoniums, however, are really hard to find. For this reason, in the most recent performances I used samplers as keyboard instrument. Simon, my son, sampled harmonium sounds and original *Shō* sounds. The sound is balanced, brilliant with very delicate deformations of tuning, artful flashes above in the higher reaches of the overtones, and with spectral flashbacks. Three sampler-players therefore do not play *Shō* instruments, nor harmoniums any longer, but rather a mixture of *Shō*'s and harmoniums using samplers.

In place of *Ryuteki*, which played in the second group of the original *Gagaku* orchestra, I use three piccolos, each with a wireless transmitter.

The third group consists of three soprano saxophones in place of the Japanese *Hichiriki*, each with a microphone on a stand. The players move in various ways before the microphones, producing a definite effect on the dynamics, which are very beautiful. When a saxophonist plays while moving around the microphone, fine alterations of amplitude and timbre are produced.

A *Gakuso* and a *Biwa* played in the fourth group of the *Gagaku* orchestra. In Europe I use in their places an electric harpsichord and a guitar with a microphone. In the most recent performances I have replaced the electric harpsichord with a synthesizer and sampler, whose timbres



(To each group a subwoofer is added.)

EXAMPLE 4

Imagine, for example, a left-to-right-alternating timbral layer with gong-like sounds, from which occasionally one sound shoots to the other side, another sweeps away, and then the sounds split up again.

A second sound layer turns in slow spirals from the floor—beginning at the back, left—over about twenty-one seconds, quite slowly once around in the lower square and gradually in such meanderings up to the ceiling; from the ceiling it quite slowly turns downward to the left wall; the spiral at the left wall turns toward the floor, spins around the floor, directs itself high on the right wall, and so forth.

A simultaneous third layer may be discovered, if you close your eyes. It is soft, with a delicate internal articulation; the pitch scarcely changes, sometimes with only tiny glissandi, so that the ear does not lose it. Anyone who does not have much listening experience can focus on this layer and lose track of the other two for a while. But you can of course jump back; the other two are always still there. This sound layer, for instance,

include a rich family of harpsichord sounds and transformed sounds as well. Problems of tuning, of dynamic balance, timbral changes, of transport, of hall temperature—all solve themselves this way. For the guitar, a classical guitar with a microphone was used.

Three percussionists are the synchronizers for the second, third, and fourth instrumental groups. In the *Gagaku* orchestra they played *Shoko*, *Kakko*, and *Taiko*; in a European orchestra, anvil, bongo, and bass drum. These instruments also are amplified using individual microphones. A tenor and a bass sing the Introduction, Temptations and Incitements, and the Closing Scene. They sing over wireless transmitters and move about, even in concert performances.

The sound projectionist projects all of the instruments in the sound panorama to where they are visible on the platform. Towards this end, four loudspeakers are hung over the four groups. The singers are followed in their movements using panorama controls. If the second act is to be performed afterward, then the orchestra in *Jahreslauf* is amplified somewhat over the high loudspeakers in the upper left and right of the stage as well, and also, imperceptibly, behind the audience. In this way a greater presence is achieved. In the score, all of these electroacoustic details and the dynamic regulation are set forth.

In the second act, "Invasion-Explosion," electroacoustical practice has now become very complex. All the available means come into play. New here is the electronic music in *Octophony*. A few months ago I discovered sonic spatial movements which fascinated me. Next January I shall continue this research. For decades I had wished that sound could be made to move vertically in all directions. Last year I had loudspeakers suspended and set up in a cubical array in the Studio for Electronic Music of the WDR. The studio is relatively small—not much larger than this room, but it has a flat floor. Raked halls cannot be used for this kind of music. For *Invasion* it is necessary that musicians and singers be able to move through and around the audience, while they play and sing. (See Example 4.) The eight loudspeaker pairs are placed in the four corners of the room, in one square below and another square above. In the studio the upper ones were hung five-and-a-half meters high. In the Alte Oper in Frankfurt they were hung twelve meters high. If the room is even higher and relatively dry, so that not only indirect sounds are heard, then they should be hung higher still; so, as high as the longitudinal distance amounts to.

Using special equipment, I composed over several months the **octophonic** music in eight sound layers which move simultaneously through each other. Each layer can be followed precisely, because the sound is altered slowly enough. We are therefore dealing with a completely new kind of music.

at the upper-left rear, moves in slow cycles, beginning toward the front, lower-left, climbs vertically upward, changes above on the wall along towards the right, then forward, lower-right, and diagonally through the space toward upper-left rear, and so comes back to its starting point. This trapezoidal figure repeats itself for several minutes.

On the basis of this example, you can imagine for yourself other sound-beams or sound-surfaces. Such varied sound-movements can be made simultaneously audible—in the *Octophony* from *Tuesday from Light* in up to eight layers. In order to do this, however, one needs particular spaces, a special kind of octophonic loudspeaker setup. In large auditoriums not eight, but rather eight *pairs* of loudspeakers must be used. An entire day is needed for setting up and for the octophonic tests. In the case of one performance in the Alte Oper in Frankfurt the setup was not ideal. At the back of the hall the loudspeakers could not be suspended. There were to sit another three hundred people in the balcony, even though they were right outside of the loudspeaker cube there, and could only indirectly hear the movements in front of them. Indeed, that's not impossible—actually, movements of this kind can even be heard when you are not located inside the cube—but it is better to be located within the octophonic projection.

To me, the perceptibility of spatial sound-movements **from the outside** in performances of my works *Gruppen* for three orchestras and *Carré* for four choirs and orchestras is remarkable, for instance in the case of *Gruppen* at the Vliegermolen in the Hague, and with *Carré* at the Salle Wagram in Paris. At the *Gruppen* performance I sat outside of the three orchestras on a raked gallery, and at the *Carré* performance in the balcony on the wall above the choirs and orchestras. In both cases I could acoustically follow the rotations and alternating sound movements.

In addition to the *Octophony*, in *Invasion* there are twelve (or twenty-four) interpreters: a Michael-troop with tenor, three (or thrice three) trumpeters, a mobile percussionist and a mobile synthesizer player; confronted by a Lucifer-troop with a bass, three (or thrice three) trombones, also with a mobile percussionist and mobile synthesizer player. Both percussionists carry instruments with them: a specially built *MIDI-Lyre* and a *Tambour-Miditaire*. These instruments are provided with electronic sensors, and control samplers with unfamiliar timbres. Both synthesizer players carry keyboards, which are connected to samplers. Each of the percussionists and synthesizer players has an assistant, who carries sampler, amplifier, and cable. The players carry the loudspeakers on their shoulders, backs, and in the MIDI-drum. Both of the singers are amplified by means of wireless transmitters. Twelve (or twenty-four) musicians move about through the audience in the “Invasions.”

We are dealing with a very odd mixture of transmitter technique for the singers, prefabricated music (octophonic electronic music), transformed music of the electronic percussion instruments and synthesizers, with octophonically projected and live performed music. The vocal music is untransformed, projected into the room with a special kind of panorama-technique using joysticks.

This is therefore a **synthesis**, which unites the many aspects of electroacoustic performance practice. Probably still others will come additionally in the future.

The big problem at present is **education**. We are here in a conservatory, and know that all these things to which I have referred remain unconsidered in most fields. Many musicians even have an aversion to technology, and that is not good. You know that everyone is surrounded in private life with all the gadgets of modern electronic technology, and therefore with electroacoustics. Many employ tape recorders, radios, television sets, cassette equipment. However, when someone plays the contrabass, he says: "Keep away from me with this modern stuff of microphone amplification, sound transformation, spatial projection." I think that this is a wrong-headed attitude. Whoever on the one hand in private life adopts modern technology, but in the artistic area abstains, is being schizophrenic. A musician should be interested in the extension of timbres; not only in those which are acquirable, but also in what is yet to be discovered.

There is a slow development of mechanically produced timbres and the performing techniques belonging to them which have evolved up to our time. But I believe that the traditional instrumentarium has come to an end. It will continue to be maintained in its best exemplars by soloists who represent with unlimited time the great art of the traditional and the new instrumental practice. Similar to the way in which Japanese *Gagaku* performers or *Nō* musicians timelessly continue their art—but that applies only to the best. Beyond this, everything should be done to see that music is truly renewed by means of what modern technology from time to time places at our disposal, in order to produce more differentiated, more original sound worlds—more coordinated, more coherent, more balanced, more adventuresome, more mysterious, more fanciful: all concepts which indicate what it is that technology really serves. Beauty, which is alien: *Alien Beauty*.

It is the meaning of our work, that we can ever again discover something new and are fortunate that we do not stand still, that we do not live in a museum, but constantly remain on a journey of discovery.

I wish you all a good evening. Relax for a bit.

And then Arturo Tamayo will conduct before us what *Mixtur* sounds like when played by students.

Many thanks for your attention.

—Translated by Jerome Kohl

NOTES

1. Kaija Saariaho, b. 14 Oct. 1952, Helsinki. This Finnish composer's *Lichtbogen* for nine instruments and live-electronics (1985–86) was being performed.
2. Translator's note: "artificial head," with microphones in the "ears," originally devised for transmission of binaural, as opposed to stereo, sound.
3. Translator's note: *Er läuft durch die Landschaft . . .* may equally be translated as "He runs through the countryside . . .".
4. **Telcom=TELefunken COMpander** (hiss-suppression system).
5. Translator's note: In English in the original, underlining a perceived cultural imperialism. This is the kind of music played in banks, airport terminals, shopping malls, department stores, and other public places—in America, usually called "elevator music."



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