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The Percussive Arts Society is a worldwide organization founded in 1961 and incorporated in 1969 as a not-for-profit corporation under the laws of the State of Indiana and the State of Illinois. Its purpose is educational, promoting through its activities a wide range of musical knowledge, encompassing the young percussion student, the teacher and the performer. Its mission is to facilitate communication between all areas of the percussive arts. PAS accomplishes its goals through six annual issues of *Percussive Notes*, its worldwide network of chapters, and its annual International Convention (PASIC). Annual membership begins with the month in which dues are received and applications processed. Eighty percent ($16) of dues are designated for subscription to *Percussive Notes*.

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On The Cover:

The genesis of the handsome teponazli on the back cover occurred in the late 1960s when Stuart Marrs was an undergraduate student at Indiana University. The percussion department at IU owned a homemade plywood version that sounded close to a real teponazli; however, Marrs tried to imagine how the instrument made from a solid piece of rosewood must sound.

While home on break in New Jersey, Marrs made an appointment to meet Dr. Gordon Eckholm, then director of the Mexico and Central America anthropology department of the Museum of Natural History in New York City. Dr. Eckholm allowed Marrs to measure and study numerous specimens from the Museum's collection and photocopy several pertinent articles from anthropology journals.

Marrs's next step was to find a piece of rosewood large enough to make the instrument himself—with concentration on acoustics alone. The search proved futile; art supply houses imported only small pieces for sculptors. His enthusiasm for the project waned.

The teponazli was forgotten until 1974. At that time, Marrs was timpanist for the National Symphony Orchestra of Costa Rica, and happened to accept a free-lance engagement for a production of "Guys and Dolls." He met Eric Eigen, a trumpet player whose vocation is abstract sculpture. Marrs shared with Eigen his dream of making a teponazli of rosewood. Eigen was familiar with a local relative of rosewood called "cocobola" that he felt would probably work as well, and was eager to take on the project.

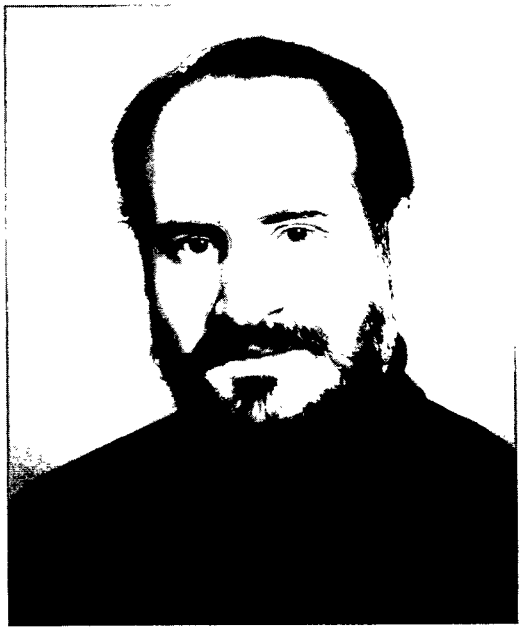
Marrs commissioned Eigen to sculpt the teponazli, giving him artistic rein and all the acoustical design information he'd gathered in New York. The result is the rich, exotic and beautiful instrument on our cover, which Eigen copied from an original specimen in a Mexico City museum. The artwork "sounds great," too, Marrs affirms.

Eric Eigen now lives in New York City. Stuart Marrs, in recent months involved in the pursuit of his doctorate at IU, has now been appointed to the faculty of the University of Maine.

An Interview With Karlheinz Stockhausen

by Michael Udow

The following interview with Mr. Karlheinz Stockhausen took place in Ann Arbor, Michigan, on March 8, 1984. Mr. Stockhausen and his chamber ensemble were in residence in Ann Arbor for the advance preparation of Luzifer's Tanz, *the third scene of his opera,* Samstag aus Licht, *which was premiered with the University of Michigan Symphony Band under the direction of H. Robert Reynolds in a production by the La Scala Opera in Milan on May 25, 1984.*



Michael W. Udow

Karlheinz Stockhausen

Photo Credit: Clive Barda/London

MICHAEL UDOW: Because of your concern for timbre and frequencies, you have amassed a very large collection of instruments. Would you please describe some of your instruments for our readers?

KARLHEINZ STOCKHAUSEN: For every work with percussion instruments I have composed since 1951, I have purchased the unusual instruments myself. Whenever percussion players have worked with me on these works, I have shown them the instruments and they have gone to the same factories and to the same dealers in order to get the right instruments.

For the very last composition (which you have helped me to realize here in Ann Arbor) for Symphony Band, *Luzifer's Dance,* which includes ten percussionists, I have first selected the instruments. I went to the people who make some of them, like the church bell factory in Karlsruhe with engineer Stumpf. Some were made by Kolberg himself, specifically those that had to be made of bronze. Several were ordered from Asia through the Asian Sound Shop in Cologne, owned by Michael Ranta. Some instruments I had already, myself.

Starting from the most critical instruments that I required for *Gruppen for Three Orchestras,* I had already traveled in 1955-56 to Lindau to the cowbell factory, and I selected for the West German radio station the right cow bells. As you know, there is a whole scale with precise pitches spread over about five octaves, and I had no money at that time. I bought these cowbells for something like, nowadays, $60. Later I couldn't get these cowbells back and some were stolen, so I needed to buy them again. I went again, and now I have three complete sets of the right cowbells.

The most crucial problem started right away when other musicians tried to find the same type of cowbells. For example, Boulez then went to the factory and bought three complete chromatic octaves of cowbells. He later mounted them in a fashion where the cowbells didn't resonate anymore because they were mounted horizontally. Caskel, who performed in the premiere later, mounted them that way, too. In *Gruppen for Three Orchestras,* rather than suspending them, Caskel fixed them with screws on horizontal stands, and the sound was dead. There was no resonance anymore. One must mount them in an extremely careful way, so the screws that go through the holes at the end of the cowbells do not touch the metal. There has to be a very special kind of rubber or fiber glass insulator which allows the cowbells to ring. In *Gruppen for Three Orchestras* I would recommend stands that allow the bells to hang vertically so the musician is standing. I have composed the piece in such a fashion that the percussion player should be standing. Then one can see the conductor *under* the cowbells, and when the player holds his hand in a normal playing position in front of his body, he can strike the lower edge of the cowbells with the cowbell clapper at an angle of about 45 degrees. It must be the clapper that was originally in the cowbell and not some other kind of metallic stick. He can achieve the best sound when the cowbell is suspended with leather straps, and he can still see the conductor with the music stand in front of him. The correct instrument racks are essential; I had blacksmiths make them at the right height for *Gruppen for Three Orchestras*. The stands are bent: they are made in steps so that the lower edges of the four cowbells hang exactly even in one horizontal line. That is absolutely necessary, and is dependent on the size of the cowbells. Sometimes you get the same pitch with different sized cowbells, so you must make special stands for special sets of cowbells and never separate them or use them for some other purpose.

I have always recommended that percussion players who play certain pieces more often or who are playing in an orchestra do not lend out these instruments because the instruments will not always be given back. The replacement of instruments is very hard because the stands are no longer right, the sizes are different – and as you know, there are frog mouth cowbells, or rectangular mouth cowbells, and they have different sizes and different tones. One can be happy if one finds the right features and if the sound is clean, which means there is no rattle. Sometimes they rattle and the musicians don't know why. There are very few fine cowbells, so you must select them among several hundred

to get a clean sound. It is like the Japanese *rin,* for example, which are made differently. Certain *rin* have overtones that are noisy and this you can neither see nor immediately hear if you don't compare them with the better kinds.

The next problem, after the cowbells, are the African log drums. I chose the original African log drums in Cologne at the *Rautenstrauch* Museum, and I got them for several performances, but then the director didn't want to rent them out again. He simply had very few available. Then I found a violin maker in Frankfurt who made another set of six with the right pitches. He imitated the original ones from Africa. The problem is that these drums were made with fresh wood and they cracked after some time because the percussionists, as is often the case, did not treat them well. They just threw them into boxes with other oriental instruments – "exotic instruments," as they say – and then they cracked because the humidity was not sufficient. Two were stolen when they were rented out to another orchestra. Then came the problem of how to replace them.

I have found several percussion players in the United States through the years who have made replicas with some other materials. One percussion player (I don't remember his name) in California made a set that sounded fairly good, I must say. He made it from hickory wood and burned out the inside, and he got a very good resonant sound. There is another percussion player in The Hague in Holland who made, last year, a set for *Gruppen for Three Orchestras,* and I heard them. They are a little bit less resonant than the original African log drums. Nevertheless, the pitch and the timbre were right. But then the specifications of the sticks must be naturally adapted to the new kind of wood and the special volume of air inside the drum. One should try to duplicate the original timbre evoked by the photographs and heard in the recording.

The Harmonia Mundi EMI recording rereleased last year is the very first performance of *Gruppen for Three Orchestras* conducted by Maderna, Boulez and myself. It is different from the one released by Deutsche Grammophon recorded seven years later in 1965. This one is from 1958, and it has the right timbre of all the instruments.

Very few percussion players have their own tom-toms and bongos. I think we should now approach a new era in percussion technique where percussion players should never travel without their own instruments. It is unthinkable that a good percussion player from an Indonesian Gamelan Orchestra, for example, or from a Japanese Nôh Orchestra or a musician from Ghana would ever use another drum that is not his own. And I think also in Western practice we should not have that disregard, as is the case of many percussion players, for the instruments they use in concert. They should always be as close to their drum or to their set of drums as a violin player is to his violin. Percussionists should never use other drums unless it is an emergency. I traveled with the "London Sinfonietta," and the percussion player who is one of the first chair players with the BBC Orchestra would phone beforehand to Florence or to Milano and then be obliged to run around in the city to rent a conga, cymbals and bongos, and also tom-toms, for example, for *Kreuzspiel,* which was part of the program that I conducted with this orchestra. These were the lousiest old drums that had been hanging around somewhere in the percussion room of a local orchestra, whose percussionists couldn't care less about their quality. I was shocked about this whole attitude of the musician towards his instruments, because I think a great deal of a drum. I played a lot of performances of my work *Ceylon* (Chrysalis Records) which uses a Ceylonese "Kandy drum," and I have a set of these "Kandy drums" at home. They are so fragile; if it is the wrong temperature and the wrong humidity, the drum does not sound anymore.

So I think the percussion player should really live with his drums, like a violin player lives with his violin, or a clarinet player with his personal clarinet, or a flute player with his flute. This is absolutely necessary. The pitches of rented instruments are usually wrong. They go sharp or flat because naturally these tom-toms are always being tuned for different pieces. The drums must be prepared ahead of time for quite a while so the pitch does not move anymore. It

is like a piano; if you tune it too much up and down, it does not hold its pitch anymore and the sound is dead. And then percussionists nowadays always use these plastic skins. I strongly recommend for certain works that I have written to use only calf skins. And they are still available, I'll tell you that.

Speaking about drums, for example, after *Gruppen for Three Orchestras,* three years later in 1961 I started *Momente,* which has a large set of different kinds of percussion instruments very dear to me, for three percussionists. We can just continue talking about drums. I went to a fair in 1960 in Frankfurt and I found one made by Karl Rimmel called a "kidney drum." It has a size of about, I would say, 3½ feet long but is kidney-shaped, and it stands on four metal legs. It is built like a tom-tom but has a switch for being half-muted or completely muted. It has several in-between steps of muting that are discontinuous. And the drum has this incredible quality that enables you to produce a 1½ octave glissando by moving from the center (the largest diameter of the drum) toward the edge (the smallest diameter of the skin). The drum has two calf skins, upper and lower. I still have several kidney drum skins at home. This drum is extraordinarily beautiful in all qualities that concern the focusing of the sound, the timbre. It sounds like one of the best timpani, if you like. With a wooden stick-on-stick rim shot while moving one stick you get this marvelous overtone glissando which goes from the highest [*e*] to the [*u*] sound and at the same time when you draw up the left stick (let's say the stick that is underneath and touching the rim), if you draw it over the whole skin from the center to the edge, you get a 1½ octave glissando. When you have a series of attacks from the center of the skin going to the edge, this same glissando is produced. There is also a continuous glissando possible with a roll, and in addition, the basic skin tension is even tuneable.

Now, *Momente* has been composed for that drum, and my works which are slightly complex in performance practice are not performed very often. The record is out, nevertheless. I ordered a few more of these drums several years ago when *Momente* had to be performed again and I had difficulty getting them from Karl Rimmel because he said nobody wanted this drum. He made one more for me. He is an ex-Hungarian who lives in Austria; he is an old man now. And I wonder if this drum will ever be made again. I happened to have always composed for special instruments throughout my life, in spite of the fact that they are not commercially available. I believe that originality is more important than an ensemble of mass-produced instruments.

MU: With regard to instrument selection in playing *Zyklus,* it seems crucial, from what you are saying, that the percussionist then selects tom-toms that have two membranes so that it is a distinct timbral source from the bongos which are a one-headed membrane.

KS: Not in my work. In my work, they are just an extension of the same scale and only because of the lack of tom-toms in the higher register, let's say, around C in the middle of the piano. It starts already at G below that middle C and upwards: there were no tom-toms available. That is why I took the bongos; I would have very much liked a whole family of tom-toms not having differences in timbre (except in a few works where I specify that it should be a bongo, or an upside-down bongo with beans like in *Kontakte:* that is something else). Generally when I write for five or six membranophones, I prefer the set. In *Gruppen for Three Orchestras,* I prefer a whole set for the twelve percussion players (four times three); I prefer a complete family of tom-toms.

MU: Would you prefer one membrane or two?

KS: Two. Usually the bongos are much too dry for what I want.

MU: You prefer more resonance?

KS: Yes, because they don't carry far enough in context, as in *Zyklus* where the membrane instruments mix with the metal instruments. I like the drums to carry a little bit longer. Even a snare drum carries longer than bongos.

MU: Speaking of resonance, when you select your own almglocken, do you strive for similar decay from the lowest to the highest pitch?

KS: That doesn't exist. That is only the case with a very special vibraphone I bought. It is

the Deagan Traveler used in *Refrain*. I bought it myself, because on all the vibraphones I found in the West German radio stations and city orchestras the lower bars resonated much longer than the higher ones. The only vibraphone I found, after checking every model (also the other Deagan models, by the way) that had an even decay was the Deagan Traveler, which I bought. It has a decay of plus or minus eight seconds, which means it differs only for plus or minus half a second. I checked this bar by bar by beating with the same beater and measuring with a stop watch. Each bar lasted eight seconds which I found absolutely marvelous and that's why I've always recommended this instrument, in particular, for *Refrain* and also for *Zyklus*. Whenever I use a vibraphone, I recommend this one. Also, the clarity of the attack compared to the golden one of Deagan is better. The Artist Model is much too soft in an ensemble context where cowbells, log drums, and tom-toms are played. The vibraphone that speaks more clearly in the attack is best.

So, now we have come to *Zyklus,* the result of the long research I made together with Christoph Caskel. In *Zyklus,* I finally found this circular idea where the percussion player plays like an organist – only a round organ. For the first time in the history of our music, the percussion player became a soloist and now has the same importance in chamber music concerts as organists, pianists, wind instrumentalists, and certain string players. This requires something from the percussionist he usually doesn't have: a source to acquire all of these instruments and a little van in order to transport them. Caskel, who started all this, was first connected with music conservatories that bought certain instruments for him and then, later, radio stations had them. But always he had to rent instruments out or to give some of them away. Half of the instruments I own myself, so he got mine; I worked hard all the time to earn money for the percussion instruments, so I didn't want to give them away. He had my tam-tam, my nipple gong, and got two log drums that he rented out from the museum. The director was so kind to give them to him for a longer time. Finally Caskel bought two, one of them with wrong pitches and the other one with the right pitches. So there were these compromises necessary sometimes, you see.

Caskel had a special rehearsal room where he taught his students. There were and still are many Americans who are working with him at the Music Conservatory in Cologne on *Zyklus* and *Kontakte*. I hope they will one day come back to the States and teach what they have learned so that finally a new tradition will begin from the place where these works were first composed, performed, and experimented, and extend to other places where they are taught now. I think this is absolutely necessary so that the next generation learns from those who have had contact for some time with the musicians who have played first performances of certain works in European music and experienced first-hand our new percussion music.

What I am trying to say is that percussion players who do not have the means have only two possibilities: either they are teaching in a school, and then the instruments must remain in the school; or the percussion players who want to make a career as solo players or chamber music players must then wait until they have their own instruments and should not loan them out anymore. They should also look for personal students as in the great traditions of Indonesian and Japanese music. Once a player has started a solo career or a chamber music career, he should have always, I would say, two younger students who then prepare the instruments for their master, whenever the concert takes place. For example, for several years I saw Robyn Schulkowsky, the American percussion player who is a very good player, setting up percussion instruments when Christoph Caskel performed *Zyklus* or *Kontakte* because she was studying with him and always wanted to help her master to set up or transport these instruments. Our concert contracts state that "transportation of the instruments must be provided by the person who organizes the concert." Someone comes and gets all these instruments, and the students, together with Caskel, set them up.

Younger pairs in Germany give concerts. For example, Andreas Boettger and Ingo

Metzmacher, a new duo, have been working with me recently to prepare *Kontakte*. They own their van, a Volkswagen bus, and when they need very special instruments, they get them from me. They also have help to set up the percussion instruments before they start playing. That is not usually the case. When percussionists arrive, they have to set up for two or three hours, and they are completely exhausted. The music becomes secondary because the percussionist is exhausted. That is wrong. We always arrive the day before, so that first we can set up the instruments. The musician goes to sleep and then he starts in the morning with a long rehearsal, but it should finish by one o'clock on the day of the concert and not go on into the afternoon. Otherwise the concert cannot be good. So it is absolutely necessary that the percussion players find a way to own the instruments and to protect the instruments – their own instruments – and transport the instruments, and have help setting them up. It is only, I feel, the teacher-student relationship that can give the right conditions for the best quality of the performance.

I would also say that no one should ever play pieces like *Zyklus* and *Kontakte* and even *Kreuzspiel* (or now the new pieces, *Musik im Bauch* for six percussionists or the composition, *Kathinka's Chant as Luzifer's Requiem,* a 36-minute long composition for six percussion players and one flute that I composed last year) without having worked with the musicians who have given the first performances of these works. So, one should study *Musik im Bauch* and *Kathinka's Chant* with a teacher who has performed them together with me. The latter requires that the percussion players make their own instruments, and I specify criteria for that. Once they've made their instruments, it takes quite awhile to study the work.

The "Kolberg Ensemble" is composed of three percussion players from the Radio Orchestra in Stuttgart and three percussion players from the Southwest German radio station in Baden-Baden. These six players now have a new repertoire. They own their own instruments, and at the radio stations they have always the same instruments, the right facilities, and the best stands you can imagine for these new instruments. They also are willing to teach others. I have just arranged a contact with an East German ensemble of percussionists and the Kolberg Ensemble.

This East German ensemble is also willing to work together with a group from The Hague, called the "Slagwerkgroep Den Haag." This is the best in Holland. I think at the moment it is even better than "Les Percussions de Strasbourg" which has had a very hard time for three or four years and now has some new players. "Les Percussions de Strasbourg" are gradually beginning to play *Musik im Bauch, Schlagtrio* and other works they have in their repertoire; they made a complete new start last year. So these two ensembles, the "Kolberg Ensemble" and the "Slagwerkgroep Den Haag," have the right instruments now, after having worked with me. I am going back to The Hague directly after my American tour, to work another week with them and take them to Milano where they will stay for three weeks to play the scene entitled *Kathinka's Chant as Lucifer's Requiem* for six percussion players and flute, as I have said before, in my new opera, *Saturday from Light.*

In the future, anybody who looks at the score will have no idea, even with lots of photographs, how the instruments sound. Even if he has a recording, he will have no idea how to obtain these sounds. They are so strange, and the method of playing these instruments is so strange, that it is essential for new musicians to visit the groups who have worked with me for a long time in order to see what kind of instruments they have. Then one can make different kinds of instruments, other varieties, but one must absolutely have had contact and long working sessions with the musicians who played these works for the first time.

For example, for several works *(Inori, Music in the Belly, Kathinka's Chant)* I searched for years to find bell plates. Bell plates are extraordinarily varied in Germany. *Inori,* my work for large orchestra and two dancers, uses them. In the very first performance, the bell plates were from the Southwest German Radio Station in Baden-Baden. They were thin bronze and not heavy at all. They had a very precise pitch, al-

though the second overtone (the upper octave) was louder than the fundamental. The fundamental was fairly weak, because they were thin, as I said. Nevertheless, they were transportable, and the chromatic scale was good. They had a noisy sound when you hit them harder, and I didn't like that so much. So I went to the church bell factory in Karlsruhe and found a man who made bell plates from duralumin, a marvelous solution. They are not heavy.

I now own two chromatic octaves of these bell plates. They are expensive, though, I must say. I have bought special stands for them. They must be fixed in a very special way that is difficult to describe now. The nylon strings must loop around two metal hooks so that the plate doesn't move sideways when you hit it and the best resonance can be obtained. I use three stands for the chromatic ninth which is required for *Inori*. When the three stands are complete, one has two octaves. If you want more, then you need more players. To dampen these plates, one needs an extraordinary technique wearing special gloves you have to make – woolen gloves – that don't make sounds themselves. You must dampen these plates in rhythm in order to play clean melodies.

Music in the Belly has been composed for these bell plates. The "Percussions de Strasbourg" never owned a set so they rented them from me. It was a very complicated process because they are in France 600 kilometers away from me, and the customs problem is difficult. Now they have their own set. The "Kolberg Ensemble" also obtained their own set because the South German Radio Station replaced the older bell plates with these duralumin sound plates. I make a distinction between bell plates, which are the old bronze, the heavy ones, and sound plates, which are the duralumin ones.

Now the "Slagwerkgroep Den Haag" found, for example, a Dutch maker of bell plates who cut them especially for this ensemble and they were pleased that they were less expensive than the ones from Karlsruhe. I came to a rehearsal, and I said, "What are these pitches? The pitches are wrong." They didn't recognize that once these bell plates were hung next to each other and played one after the other that the pitches they checked at the factory were no longer chromatically right; the tuning is a very delicate thing. These cheaper ones do not have the right overtone series and harmonically they sound wrong. The people in Karlsruhe have enormous plates of hard aluminum, and they use a special process of putting metal powder on top of them. Then they make an electro magnetic field to find out where the heart of the plate is – that means where the center is. The metal powder forms circles moving around the "center" of the plate. That is how one finds out how to cut and finely tune each plate, to get just the right pitch. The rest of the plate has to be thrown away. This is a very expensive process. So, the "Slagwerkgroep Den Haag" came to the conclusion that they had to throw away the bell plates they had just obtained. And now they will use mine for La Scala. They have already ordered the right ones from the "Karlsruher Glockengiesserei."

MU: For my own curiosity, how is the one that I built for *Luzifer's Dance*?

KS: It's good; it's extraordinarily heavy. And Larry Kaptain who is playing it should play it with a large beater. But he also needs to play the snare drum rim shots, the tom-toms, and the gong. So I told him, whenever there is a time in the solo which he has to play, he should use a heavy beater (wooden center covered with felt) for the gong so that the gong speaks better, and to strike the gong only on the nipple: that's where it speaks the best. On the other hand, he should have an even heavier beater for the bell plate. Then the fundamental of this very precious bell plate that you made comes out very beautifully. The beater used is dictated by the speed of the other instruments, but that's a long story. That's why I think he would have been much better off with a duralumin bell plate, because it is much easier to hang, handle, and transport. At the same time, it has a very beautiful quality, and the pitch that he gets now you can easily get with a duralumin bell plate.

MU: This is interesting, because actually what I purchased for the raw material is hard aluminum.

KS: That is not steel?

MU: No, it is very dense aluminum.

KS: It is heavy, like brass...Mine are very light.
MU: It is this type of distinction* that can become confusing.
KS: Yes, that is why it is important that one sees the original instruments and physically plays them.
MU: Yes, that would be terrific.
KS: For example, Boulez had ordered some bell plates after he had learned about *Inori* and heard the recording. He ordered them for *Pli selon Pli* where they are required. The BBC bought a whole set of bell plates (not the sound plates) made of bronze. And it turned out he wanted to make a recording for CBS in the BBC building. I spoke to the percussionist and asked how the work was going. He said that Boulez had to rewrite the entire part because of these new bell plates. They were so heavy and therefore so difficult to play that it took two people to play the part, and it is only one octave. It also took four people to mute them because they were so difficult to mute. You need both hands and the knees and special gloves to mute them right after the attack, because Boulez has written clear melodies, not "let vibrate" all the time. Boulez came to the rehearsal and saw the mechanical process that was required to mute and play the bell plates. He was shocked. So, what he had to do was rewrite all the rhythms and cut out all the fast rhythms for the bell plates, because once they were bought, it dictated a different music, you see. Now the rhythms are much slower in these parts.

But I think once the music is written, one should find the kind of bell plates that are necessary. It is true that with my bell plates, Boulez would lose most of the fundamentals, because the fundamentals do not really come out – only the higher octave comes out clearly. One hears the lower pitches only when one is close. This means that the pitches that were originally written sound more loudly one octave higher. When there is time enough to take a very soft beater with a wooden center inside, the fundamental will come out more strongly. But then, immediately, the second partial (which means the octave) or the third partial (the octave plus a fifth) predominate. This is a real problem we cannot overcome. I think we have to accept that the lower octave we call the octave from contra C, two octaves below middle C, is only obtainable with the very heavy bell plates, but then you have to have very slow music and very special beaters and, again, it's very hard to mute these bell plates. Now I have written many works that include the sound plates chromatically.

These new works also include instruments I found while living in Japan. I bought many *rin* in shops that sell instruments for Buddhist temple ceremonies. Finding specific pitches is not so easy. You have to have many *rin* in order to find the right pitch. It also requires special experience to know in which tessitura the pitches can be found. I have used the *rin* with defined pitches in *Inori* and in other works for the last fourteen years. I own three chromatic sets; each *rin* has a special cushion. Suzanne Stephens has played in all performances of *Inori* to date with the Japanese *rin*. One needs a special technique to mute them. The *rin* must be played from above with different sticks covered with soft leather (thicker or thinner, depending on which pitch you hit). The chromatic scale of *Inori* starts at middle C, and then ascends 14 pitches. Now, for example, in *Festival* (1980) I have used four *rin*, and in *Luzifer's Dance*, three pitches of the *rin*, and there are other works where I have used the instrument. It is best to have a friend in Japan or, maybe, one has a chance to go there oneself, and go in these shops in Osaka without talking too much about their use for music. Don't go to souvenir shops; one pays ten times as much as they really cost. Go in with a tuning fork and select the right pitches. They are very cheap, and I have bought most of these, like the middle C, which is the biggest one (17 to 18 centimeters in diameter), for $8 or $9, but that was a few years ago. When you buy them in a shop in Cologne or from Kolberg, they cost ten times as much. The middle man makes a considerable profit on this. It is preferable to have a Japanese friend select them (and then one has to buy many in order to select the right

*It is, in fact, the translation that is at fault. Duralumin is not "hard aluminum, but rather, an aluminum alloy with copper, etc., remarkable for its strength and hardness combined with lightness." (*Concise Oxford Dictionary, 1982*)

pitches) or go to the shop yourself. It might be even better to go to the factory where they are made; then it would not be hard at all to find a chromatic scale. Nowadays, in order to find the right pitches, one can write to Michael Ranta in Cologne, and he selects among many in order to find the exact pitches required. Then he recommends putting a certain amount of water into certain ones in order to have the precise pitch. I think, though, that it is better to have more to choose from and then choose the right ones. This will come, I am sure, and some day they will be made as musical instruments with precise pitches.

Then there is the problem of gongs. The gongs with right pitches are now fairly common in Germany. Just before I came here, you needed the two gongs E-flat and C for my new piece. I went to Michael Ranta again, and he had just prepared three chromatic octaves of the same Thai-gongs for the Radio Orchestra in Stuttgart. I know that Boulez personally owns two chromatic octaves of gongs. He has written for chromatic scales of Thai-gongs. They are these black gongs with the nipple, the bronze gongs. The resonance of the same pitch sometimes is shorter or longer depending on the quality of the gong. I found one E-flat even more precise in pitch than the one I bought for you, but its decay was much shorter. The gongs differ very much in length of resonance, and it is clear that the longer its resonance, the better it is (there are no conflicting frequencies in the material).

This is a whole new trend; all percussion instruments, even the "noisiest" ones that traditionally, in all instrumentation books, have been considered as being undefinable in pitch, have pitches. Since *Kreuzspiel,* 1951, even cymbals have been notated by me with predominant pitches. If you strike them mezzo forte with a hard stick, like a plastic stick, then you get a very predominant pitch. Naturally if you strike the cymbal on the cup, you get another pitch. A cymbal sounds best, for the pitches, when struck exactly halfway between the edge and the bell of the cymbal. Then you get a fairly clear pitch. It was clear when I came here that you had chosen the right two pitches for the cymbals. Those pitches are clearly noticeable B and a B-flat, as required. Every cymbal has its pitch. Naturally if you choose among many Paiste cymbals (even though cymbal manufacturers are not concerned about pitched cymbals) you can find the correct pitch. Paiste does employ a church organist every now and then to determine the pitches of their instruments because more and more percussion players order pitched cymbals, gongs and tam-tams for symphony orchestras.

The original Chinese so-called Peking cymbals, for example, have clear pitches. There is no question that a cymbal should fit into the orchestra as any other instrument with the pitch and the right overtone scale. We should get used to the fact that even tam-tams, such as the three Chau Luo tam-tams I selected for you for my new piece, have very clear pitches and do not immediately explode like bad tam-tams which are so thin that even when you beat them mezzo piano with a heavier beater, they "whish" with a noise rather than give a sound which builds up with the dynamics. I think a tam-tam should start crashing (making the colored noise) only when you hit it very hard so that then the predominant vibration becomes completely irregular, because all the particles of the metal are vibrating against each other, and that causes "noise" which means aleatoric vibration. Every good tam-tam has a predominant clear pitch when you hit it at the edge of the inner center with a good beater, the size and weight of which is very dependent on the size of the tam-tam. That is why the choice of Sato beaters for tam-tams from the Orient is always dependent on the diameter of the tam-tam. The larger the tam-tam, the larger and heavier the beater.

One should know that tam-tams and cymbals, as much as gongs, can have defined pitches, and all composers should write the pitches and should know what they want. Sometimes you hear in the most defined harmonic field of an orchestra that the percussion is playing gongs or tam-tams which completely destroy the harmony. The composer is not aware of this because he just says "tam-tam" or "gong" (small or medium or large), but he is not aware of the fact that a gong in a good orchestra in Bali could

never have any other pitch because it fits in the harmonic spectrum, and it is exactly in harmony with the orchestra.

In different pieces one should use different tam-tams, different gongs, and different drums. Drums should be as perfectly tuned as violins. Cymbals, tam-tams, and gongs should be chosen exactly according to the harmony of the pieces in which they are used. They are harmonic instruments as all others are; there is no percussion instrument, not even guiro or maracas, or Indian bells, that does not have a predominant pitch. We might compare, for example, a half dozen small Indian bells like those I use for *Zyklus, Kontakte,* or *Inori* in particular; you can hear the different pitches. It depends on the selection – the size, the cluster, and the number – of the Indian bells to find the predominant pitch you want. It is easy to select the pitches according to a harmonic field. It is absolutely necessary that the composer specify more precisely the predominant pitch of a given metallic instrument and also of a so-called noise instrument. Every noise instrument, as you know, has a noise band and not just white noise. Every so-called noise instrument has a predominant medium pitch of that band of noise. It is necessary that percussionists get used to the defined pitches of all their instruments. Then a new culture will start where the western percussionists will be really on the level of the great traditions of percussionists in Japan in the Nôh music, Kabuki music, and Gagaku music where percussion instruments are used. Their instruments cannot be a quarter tone off – it is unthinkable. The same is true of Javanese and Balinese and Indian music. We should have the same concept of harmony and of the melodic quality of percussion instruments.

Now we come to my last composition which uses instruments that are not known yet – for example, what we call "Schalenglocken" (bowl bells). They come from the Karlsruhe church bell factory in as many octaves as you like. They are big bowls of bronze, and they are struck with very hard beaters. It is better to strike them with a typical *Keisu* (*Dobači*) beater, which is wood with soft leather around it. They come also in different thicknesses, depending on the pitch. The Karlsruhe factory now makes beautiful, quite heavy antique cymbals. Some people call them "crotales," but I think crotales is the wrong term. Originally crotale meant a wooden rattle in the Hebrew, Egyptian and in the Greek tradition. The bronze discs referred to as crotales were originally played with two hands and hit together as tiny little cymbals.

MU: Like the Turkish type?

KS: Exactly. These so-called crotales were originally made of wood. The adaptation of the word for metal "antique cymbals" has come later. You know, antique cymbals have been used by the French Impressionists. Debussy and Ravel were the first people that really used them in the modern orchestra, and they said "antique cymbals," from "cymbale" which means "cymbal" and "antique" which means "ancient." They used the very tiny small diameter cymbals with a defined pitch which they hit together as they sometimes do in marching music, where they strike the large cymbals together in order to make this rather complex double cymbal sound. The antique cymbals come in many varieties. Avedis Zildjian in America is the one who first started making them chromatically. I bought a whole set of two chromatic octaves, and I used two sets in *Kontakte.* I have used chromatic antique cymbals I have owned since 1961 in several more works. I found many different methods to suspend them. First, I put them on two wooden plates on metal stands, and the wooden plates had screws in a chromatic order, arranged like a piano keyboard.

MU: So it physically looked like a keyboard instrument?

KS: Yes, but the screws had these fiber glass pipes, and they were screwed into the wood. If a metal screw touches the antique cymbal, the instrument doesn't sound anymore. If the fiber glass pipe is too thick and touches the antique cymbal too tightly, it sounds dead as well. If an antique cymbal is screwed on from the top, and the metal screw touches the cup, it is again dead. I have heard the antique cymbal sets of Les Percussions de Strasbourg. For *Musik im Bauch,* three chromatic sets are required. The three chromatic sets sounded dead. The players even turned the antique cymbals over and hit

them on the rim, but this way the antique cymbals were muted by the rubber below and the fiber glass pipe through the hole: the antique cymbals didn't sound anymore. Lots of percussionists use antique cymbals and are not aware that the cymbal sounds "dead," which means it still sounds, but the spectrum cannot develop and it no longer has resonance. If an antique cymbal falls once on a stone floor, it becomes dead, but you cannot see any crack. So it is made of very sensitive material. Many percussionists do not know if an antique cymbal is alive or dead. Thus they still use the dead ones. This has been the case even in my work with Les Percussions de Strasbourg. I asked: "Don't you hear that?" They said, "What do you mean?" I said, "Well, listen to it. Even the pitch is no longer the right pitch." And they were not aware of it.

MU: And there was no decay?

KS: Yes, there was almost no decay anymore. I said: "You have to get a new one, as it must have fallen, or sometimes they die after a certain time when you beat them too hard with too hard beaters. They are very, very delicate instruments."

What I am trying to say now is this: for my new composition, *Lucifer's Dance*, I bought two sets of all the percussion instruments. I own a duplicate set of all the instruments I selected for The University of Michigan. Because I was afraid that you couldn't find the right instruments, I bought them for myself and I could have rented them to you. You see, I hate writing for material that is not the best. I found out that the Glockengiesserei in Karlsruhe could make the new type of antique cymbals. They are only a little more expensive than the ones Kolberg makes. They sound much better. I bought several of them. Then I had the one with the low D fabricated (one octave plus major second above middle C). One can go down to the middle C with antique cymbals now.

MU: Would that be about 16 inches, roughly?

KS: The D for *Lucifer's Dance* is 8 inches in diameter, so you are probably right. Which means there is no end to "antique cymbals" (what Mr. Kolberg calls "crotales"). The heavy bronze antique cymbals can now have four complete octaves chromatically, and they sound very beautiful. There are special resonance boxes made for these lower ones, so that you have a volume of air resonating; it keeps the antique cymbals resonating. The large antique cymbals need somewhat different beaters, as you know. I have seen a full chromatic set bought by the Amsterdam Percussion Ensemble. Do you know this Dutch group?

MU: The Nieuwe Slagwerk Ensemble?

KS: Yes. They bought them for an opera. So there are these new antique cymbals every percussionist should know about, and maybe if you come to Europe, I can show you all these instruments.

It is important to know the difference between the different makers. For example, this church bell factory has a totally different process in making these instruments than the others. There is a long tradition of making the same pitch of church bells in different qualities. It depends on the mixture of the metal, the form, etc. There are so many secrets about this. Through the years, I have also purchased several tam-tams. The large one has become very famous through *Mikrophonie I*. The size is 155 centimeters in diameter, 5 feet 2 inches. And this tam-tam was for a while the only one available of that size. One has to specially order it from Paiste. Now I bought these Chinese tam-tams for *Lucifer's Dance* that I like very much.

The use of the material and the fabrication have a whole long tradition, longer than the tradition of the piano, as you know. This dictates the kind of quality we should look for: we should not replace the original instruments with replicas just because of commercial availability. I hope this is a time of transition – that percussionists will become more aware of their instruments, much more cultured in knowing the history of percussion instruments, and aware of new possibilities. Then a new tradition can start.

To recap what we have said this morning: I recommend if anybody wants to play one of my pieces that includes percussion instruments, they should not play it in public until they have worked with the players who have worked on these pieces with me. I am still alive, and I hope I can still live a little longer and train players. Now I will go back to Europe and train a new

team of players for *Kontakte* again because Caskel is practically no longer performing in public. He is only teaching. He does not have enough time to rehearse. And Kontarsky, who has played so many of the performances of *Kontakte*, is very ill now. So I need to train young musicians. I have become very involved in this, because I see there is no meaning in continuing to compose new works for percussion if there is not a solid tradition of young musicians who have studied these works with me and with the players who have played these works for the first time and for hundreds of performances thereafter. So, finally, the quality of performances of percussionists must reach the quality of performances with other instruments like piano or wind instruments. Percussionists should come to Europe and study and work with these musicians. Or European musicians who have worked with me, and whom I recommend, should then come, for example, to a symposium for two or three weeks at a certain place in the United States. People could apply, send in tapes, and a jury could decide who is accepted. Then, let's say, five or six of the best teams who play *Kontakte* should come together and work with these musicians. Allow more than half a dozen top percussion players who have applied to play *Zyklus* to come and work *Zyklus*. Then I am perfectly willing to come and show them the new technique.

And there is something more to say: The duos should then also bring their sound projectionist with them, which is a new profession altogether. Almost all my works of the last thirty years need amplification. It is always misunderstood. People think amplification means to make the music louder. That is only partly true. It means to bring the music closer in order to listen into the inner world of sound, in particular of very soft sounds. So, in certain piano pieces (like the *Piano Piece No. VII*), I put two or three microphones in the piano, especially in larger halls, so that the people who hear it have the feeling that their ears are as close to the piano as the pianist; one should hear the overtones, because a lot of overtone playing is required in the *Seventh Piano Piece*. And in *Zyklus*, for example, so many sounds are produced by the player that only the player can hear. In the hall one hears only the attacks of many sounds; and one does not hear the full spectrum and all the sympathetic sounds. So *Zyklus* is always played, when I supervise the sound projection, with four microphones at the four corners of the setup. Playback occcurs over four times two speakers placed in the four corners of the hall, so that the public has the same experience as the player in the center of his instruments. Then a whole world opens up. And the player can also play pianissimo in certain passages so that very beautiful timbres come out that the public never has heard before.

In *Kontakte* it is exactly the same. The percussionist always has four microphones at the four corners, and the pianist has four microphones: one for the almglocken at the back, one across the piano taking the highest two octaves of the piano as well as the Indian bells (suspended at the right side) and the woodblock. A third one is close to the cymbal, between cymbal and hi-hat. And a fourth one is placed higher at the edge of the open lid of the piano in order to catch all the lower sounds of the piano. Then one can catch the sprectrum of the cluster sounds and of the soft piano sounds, and one gets the overtones. Then there must be one more microphone between the gong and the tam-tam in the center of the stage, with the microphone stand behind the two instruments, a little bit closer to the gong. In this way the instruments can be always balanced with the electronic music, so the tape can be played strong enough. The *Kontakte* tape must be played strong so that the public is inside the sounds and yet every sound of the instruments must be audible. We have played *Kontakte* with microphones even in halls of 400-500 people. It sounds marvelous. With amplification, the percussion players discover that their choice of beaters will change drastically once they hear all the subtle sounds on the tape.

When duos prepare themselves for such a symposium as I have suggested, they should order the two-track tape (15 inches/second) of *Kontakte* from Universal Edition and then listen to every section many, many times and try different beaters. Sometimes an indication in the score for "hard rubber" or "wooden beater"

is not enough. It depends on the instrument you have, the kind of wood in the beater, and the kind of rubber or felt covering it. So what one needs to do is listen to the tape and try out the beaters with the instruments simultaneously until one finds that particular timbre I have chosen together with the percussion players when I made the recording with Christoph Caskel and David Tudor (Wergo Records), and with Christoph Caskel and Aloys Kontarsky (Harmonia Mundi or Vox Candide). The recording with Caskel-Tudor was made in 1960 (from the world premiere). The recording with Kontarsky and Caskel was made in 1968. I don't know if the Vox Candide record is still available, but there is a new one, released about half a year ago on Harmonia Mundi, EMI (this is the international distributor). It is part of a series which is called "Contemporary Music in Germany." This record with Kontarsky and Caskel, supervised by me, and mixed down by me, is in a boxed set of four records of the years 1960-70 (box no. 5). In the series, I think, there are ten boxes of the German music after the last war, and the one from 1960-70 contains *Kontakte* in a recording from 1968. This is the record I recommend for orientation.

The only one of *Zyklus* I recommend is a very early recording of 1959 with Caskel (Wergo). It is relatively dry, but at least it is right. Whereas, in the others I have heard, there are a lot of mistakes in playing, of interpreting the score, and also mistakes in the choice of the instruments. I am perfectly willing to make another recording with a percussion player if I see that he is very serious about this and has prepared himself enough. And one should find a good record company. There is a Japanese girl who played *Zyklus* on record, and I was really shocked by the quality. I feel very bad if someone has made a recording of one of my works of percussion music without contacting me or a player whom I recommend.

It is so difficult to define this music. It is like electronic music; you can write a score as long and precise as you like, but there is so much variety in the instruments that we have not yet fixed a tradition of this new percussion age which is only thirty years old. How old is the piano tradition?! There should be close contact between the composer, the first interpreters, and the next generation of interpreters. Nobody should decide everything on his own and make up his own mind, because it's too dangerous. It is too complicated.

MU: There are certain assumptions about the "Augenblick" principle. Would you comment on that, please?

KS: Percussionists played *Zyklus* for competition in Darmstadt and Aix en Provence. (This was my idea, by the way.) I insisted for several years: "Finally the percussion players must become as important as the pianists." And I asked Dr. Steinecke, former head of the *Darmstädter Ferienkurse*, to be the founder of a new percussion competition and to get the money for prizes for percussionists. I said that I was going to write a solo piece for percussion players that requires the same high level of skill, technique, and musicality as the traditional solo literature. He was very pleased about this. I worked with Caskel and he played *Zyklus* in the final concert, but Hädler from Hamburg won the first prize in Darmstadt. Since then many percussion competitions have taken place.

I have never encountered a percussion player who played *Zyklus* directly from the score, but everybody has made himself a version, which means buying the score and then making a copy of the score and cutting out the little mobile elements, gluing these mobile elements on top of the fixed line that is always in the middle of each page, and then working for several months on his own version and moving these mobile elements in order to achieve a performance version. I have described this very carefully in a long article with more than 80 examples of *Zyklus*. It has been published in one of my volumes, *Texte*. The second volume contains a complete analysis of the work and a description of the criteria for making a version. It would not be difficult to translate that into English. It is very important. You see, it is not so easy to make a version. Once a version is chosen by a player, he should rehearse this like a piece that has been through-composed, which is completely determined. It is still his own version; he might make changes if he likes, between

performances in order to ameliorate more and more the context and to achieve something I have recommended, for example, to obtain very polyphonic structuring of as much superimposition as possible.

I have recommended building a tree of cymbals rather than using one single cymbal (three to four cymbals mounted on top of each other at one stem and connected with small chains). When you strike one cymbal, a process starts that lasts a half minute or even longer. You then start another instrument ringing so that you get very long resonances superimposing. You can build up a whole polyphonic piece out of this solo piece based on a linear method of playing. Sometimes I have seen percussion players striking an instrument with a knee while at the same time beating two other instruments to get a complex chord of pitches. That is necessary in *Zyklus*. I wanted that so that it had an equal vertical distribution of the elements within a given time.

Players should know about the process of working. They should put the percussion instruments in a circle and then, for example, hang a light bulb above them. With an electronic rheostat device, they should let the light bulb give the pulse and start working with MM = 30, which is a beat every two seconds. Then slowly, slowly speed it up, to about MM = 40. There are 17 pages. Each page has 30 units, that total 8½ minutes if MM = 60 (one second per unit). It takes about 12 minutes if you choose MM = 40. That is a good timing. I think a good duration for *Zyklus* is around 13 minutes. Only a few players can dare go to 15 minutes without becoming boring. If you have very long resonating types of instruments, you can go up to 15 minutes and make something very mysterious and beautiful. Otherwise around 12 minutes would be right – let's say 13 or 11 – the shortest can be 10½. Once I heard a performance with a duration of 8½ minutes, but it was a complete fake because most of the predetermined elements in the fixed time layer were wrong, and couldn't be heard.

So there are many methods now which have been developed in order to learn *Zyklus*. For example, using a light metronome the musicians can see from any direction sometimes causes problems. Mircea Ardeleanu has made a cassette recording of his own voice counting the time units for every page. This works quite well. He counted at certain places also upbeats, subdivisions, etc. Many players have about six music stands around them so whenever they are at a different place they can see the music. But the best way is to play a version from memory.

There are a lot of ingenious inventions now about the stands for the beaters, as well as duplicating the same instruments in opposite locations, like the *tambour de basque* for these rattling bell sounds.

MU: Or guiros, perhaps?

KS: Yes, or as you recommended, which I find very good, the hi-hat twice, once for the open hi-hat and another for the closed hi-hat sound. So you see: communicate as much as possible, please, and let these young players come to Europe to work. I have known several Americans who lived in Cologne for several years, and they still are working on *Zyklus*. They will not perform it in public because they say they are not yet ready. They have understood the complexity of it. It is like the pianist who works with a master. The more he works with the master, the longer it takes before he plays the *Hammerklavier Sonata* by Beethoven. The more you know, the more professional you become and the more you understand what is required in order to play this new literature for the public. The public has no idea how it should be done. The musician should have the responsibility and guarantee the highest quality of music. Otherwise it will be disappointing.

MU: You have talked about polyphonic structures in trying to produce vertical structures with the knee and two hands, which brings me to another point: I found, after hearing several rehearsals of your new work for the University of Michigan Symphony Band, the percussion instruments being combined in a complex vertical structure. Then that vertical structure shifts and becomes polyrhythmic 7's 5's. Can you speak to that? What interests you compositionally – today?

KS: Well, I am interested at the very beginning

of a new work in creating my own sounds. And creating my own sounds means mixing, and mixing with the traditional instruments means superimposition of different instruments, which results in complex sounds that cannot be analyzed anymore. So what I really want is that, when a percussion player makes his own version of *Zyklus*, he creates sound complexes that are his own, the result of the superimposition of several instruments, and you cannot analyze how he made them. This is, I think, the most creative process in percussion nowadays. The players can produce their own complex sounds by combining different instruments. If the composition is what we call mobile structure, like *Zyklus*, there is the chance that the percussion player can decide himself which elements to superimpose, and by this create fantastically mysterious sound complexes. Nobody knows then how they are produced because they are a mixture of several percussion instruments.

Then sometimes the player may reveal what this mystery is all about in a certain sound complex, because he horizontalizes it. You hear the same instruments played one after another, and then they become again verticalized, and it's a marvelous "revelation" for the listener because he understands: "Aha! This is what it was!" This whole work with different "diagonals of timbre" is what I call the complex sound mixture. "Timbre melodies" horizontalize complex sounds in which components form the timbre melody. The continuum between complex sound and timbre melody, with all the degrees in between, has fascinated me since the very beginning of my work. My percussion music is part of this whole research in the new structured timbre composition. A most complex timbre we do not know, that has never been heard before, can become a musical revelation as it is horizontalized and we hear its components one after another. That is a beautiful experience, and I will go on in this research.

On the other hand, as long as I compose, one can be sure that, for every composition, I will choose new instruments or instrumental varieties in order to create a maximum of uniqueness of every given composition and not repeat the same sound world twice. That is why percussion instruments are so important in our time and will always be, I think. If you could see what percussionists do in my composition *Kathinka's Chant*, which was premiered in 1983 at the Donaueschingen Festival: each percussionist uses, for example, several whistles for the entire 36 minutes. And the whistles have to be unusual whistles. They should not sound like whistles known as sport whistles, police whistles, or children's whistles, etc. One must find new types of whistles. The whistle must be held by the teeth. Thus, a special kind of whistle is required, otherwise it falls out of the mouth. The percussionists must make all sorts of glissandi and mixtures of vocal and whistle sounds while they are playing the sound plates and their self-invented instruments, and that creates such a mysterious atmosphere that you think you are hearing music from another planet. It does not sound at all like percussion. There is hardly any moment when you think "percussion." It sounds very new, very mysterious.

Every gesture of the hand, of the foot, of the leg, how they run, how they move, how they stand, etc., has been rehearsed with me, and there is now a new tradition of musical theatre. Just for the theatrical aspect of pieces like *Musik im Bauch* I have worked for many days with the performers. After the music is clear, the movements are rehearsed. Then the players work on their own and then I come back. A performance becomes a ritual in itself. It is futuristic musical theatre with special instruments, special costumes and special gestures. Not one gesture should occur that you see in real life. Everything is artful.

MU: It seems, thinking back to *Zyklus* where the visual element of the circle is so intrinsic to the composition –

KS: Oh, yes!

MU: – that this is an extension of that care.

KS: Yes, and even in *Kontakte* you can find early traces of this research. When, for example, the pianist comes to the middle of the stage to the tam-tam, the gesture should be like a performer in a Nôh play, who does everything very carefully and consciously. The beginning gesture of *Kontakte* should look like turning the wheel of the world on when the music starts. Every step

should be calculated so that the pianist returns to the piano at just the right time, not too late. The same is true when the percussionist and pianist both come to the middle of the stage. They should know exactly how they look. I prepare a very special lighting for *Kontakte* every time, with three spotlights on the pianist, two from above and from his back so he can read the music as well and one on the floor against his profile and the inside of the piano lid. I use two spotlights with a red-golden color for the tam-tam and the gong in the middle of the stage. And for the percussion player four spotlights are used: two from above and two from the floor towards his figure. Visual elements in any work are extremely important!

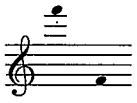
MU: Karlheinz, I appreciate your taking the time to discuss your work so that our readers will become more accurately informed of your focused and keen interest in percussion over the past 35 years, and I certainly look forward to hearing *Samstag aus Licht* at La Scala, May 25th. I know that your compositional demands placed on the University of Michigan percussion students will serve them well in the years ahead. For this and your generous time, I am most grateful.

KS: You are quite welcome – and please tell your readers that there are about 90 different records of my music...those that have been produced with my participation are as useful for study purposes as my scores.

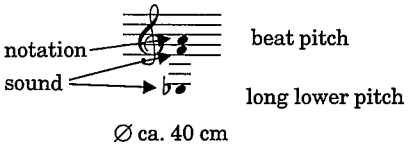
The following preface pages from many of Mr. Stockhausen's most important works indicate his focused interest in the quality of percussion sounds as articulated in the preceding interview.
— MWU

LUZIFER'S TANZ
(Lucifer's Dance)

Each percussionist has 1 antique cymbal, beaters with heavy plastic heads

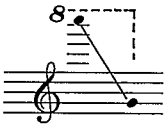
sound and notation 

PERCUSSIONIST 1
1 *keisu* (temple bell) (also called *Dobaci* or *Ching-Tsching)* with special beater

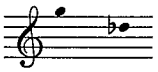


Ø ca. 40 cm

PERCUSSIONIST 2
1 glockenspiel

sound and notation 

PERCUSSIONIST 3
2 alarm bells (*tocsins*) (cast bronze bells) clapper, played from the inside original

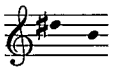
sound and notation 

PERCUSSIONIST 4
3 *rin* (Japanese temple instrument: brass colored metal cups on colored cushions) wooden beater and sometimes beaters with heavy plastic heads

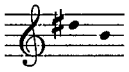
sound and notation 

Ø ca. 12,5 13,5 15,5 cm

PERCUSSIONIST 5
2 tubular bells

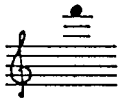
sound and notation 

PERCUSSIONIST 6
2 Javanese gongs
Khwang-wong: Thai Gamelan (gold-colored bronze gongs with nipple, hung) special beaters

sound and notation 

LUZIFER'S TANZ
(Lucifer's Dance)

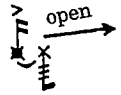
PERCUSSIONIST 7

1 antique cymbal — sound and notation 

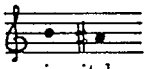
1 hi-hat

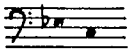
 = strike open hi-hat and let ring

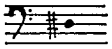
notation  = simultaneously short tread with foot and strike with stick (let ring)



= strike and tread, then roll while gradually opening the hi-hat.

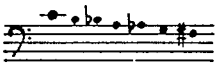
2 cymbals — sound and notation 
main pitches

2 Thai gongs (nipple gongs) — sound and notation 

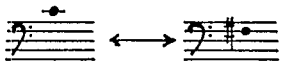
1 Chinese opera gong, *fu-in luo* — sound and notation 

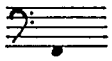
Each stroke produces a glissando which ends on D#: 

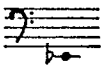
1 bell plate (bronze) or sound plate (duralumin) — sound and notation 

1 snare drum (with snares on) — sound and notation 

Tuned to  for the stroke at the rim.
The pitches within the tritone C-F# are approximately intended:



1 tom-tom — sound and notation 

1 bass drum with pedal — sound and notation 

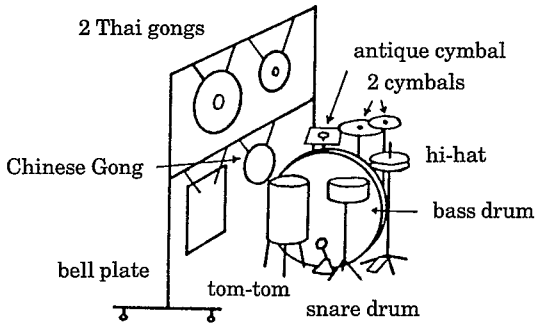
 = rim shot on snare drum or tom-tom

 = let ring

 = Immediately after the stroke, lift the stick high up over the head and hold it there until the next stroke. Depending on the instrument being struck, lift the right, left or both sticks.

For the Solo beginning at bar 613 and its return, sticks must be selected which sound good both on the gongs and bell plate, and on the drums (possibly sticks with two different heads on the two ends).

Setup (as seen by player)

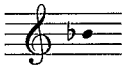


PERCUSSIONIST 8

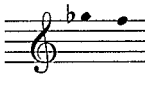
1 vibraphone bar (mounted onto a resonance box)

2 *cinelli* (also called *Tsching-ba:* heavy small cymbals "from Peking") with glockenspiel beaters

sound and notation



sound and notation



∅ 17 cm 18,5 cm

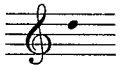
PERCUSSIONIST 9

1 antique cymbal (*crotale*) (special cast for the low pitch, mounted onto a resonance box)

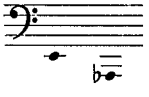
2 tam-tams (cast bronze)

Chau-Luo with *Sato* tam-tam beaters (for tam-tams 60-80 cm and 85-135 cm) and tubular bell beaters

sound and notation



sound and notation



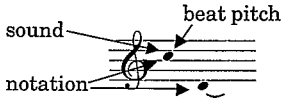
∅ ca, 70 cm 90 cm

PERCUSSIONIST 10

1 bowl bell (bronze – lower bronze support stands on small wooden table); *keisu* beater, or other

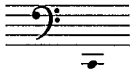
1 tam-tam (cast bronze)

Chau-Luo with *Sato* tam-tam beater (for tam-tam 60-80 cm) and tubular bell beater



long lower pitch
∅ ca. 35 cm

sound and notation



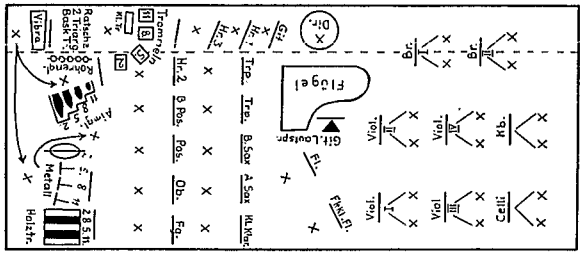
∅ ca. 80 cm

The pitches of the percussion instruments be tuned to an average value of A = 442 Hz.

GRUPPEN FÜR DREI ORCHESTER
(Groups for Three Orchestras)
The seating arrangement at the first performance

At the later performances in Donaueschingen and Vienna the seating arrangements had to be changed because of unfavourable acoustics of the hall: the strings to the right of the conductor, the winds and percussion to the left.

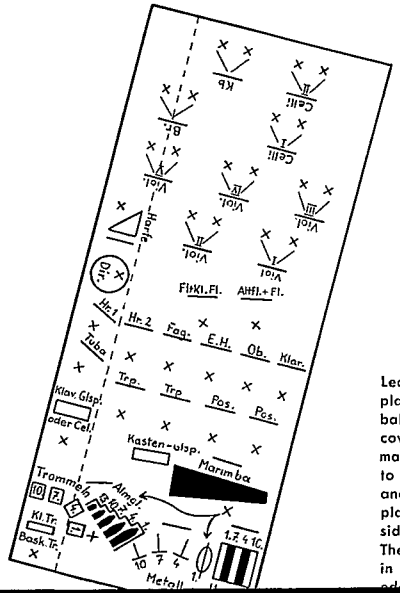
Orchestra II (centre) 36 players



Leave a path for the vibraphon-player to the cowbells, tam-tam and cymbals.

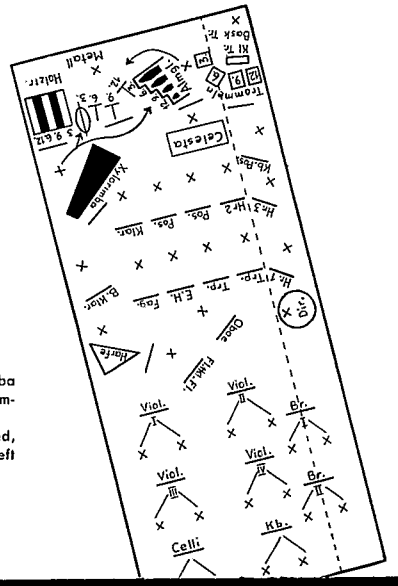
Compared to the photograph below the seating arrangement is slightly altered.

Orchestra I (left) 37 players



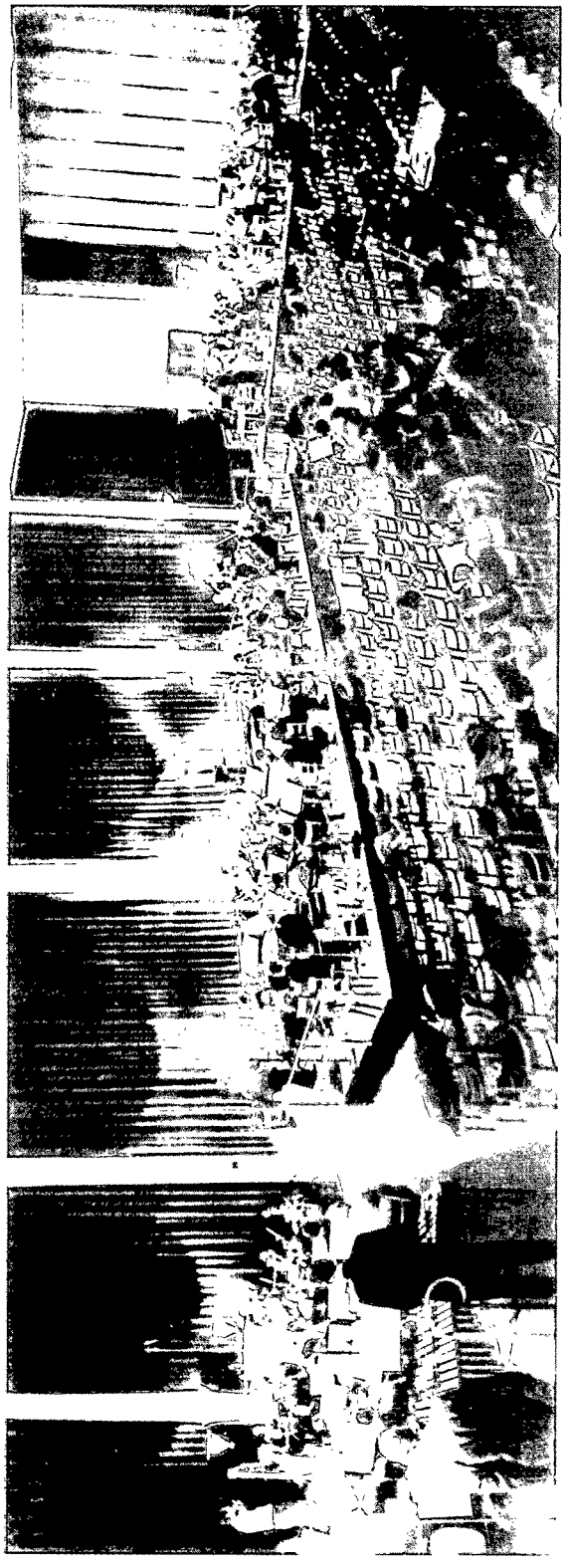
Leave a path for the marimba player to the cowbells, cymbals and tam-tam (place the cowbells obliquely, so that the marimbaphone player is able to see the conductor when he and a second percussionist play the cowbells from both sides simultaneously).
The harp may be placed, as in Orchestra III, at the front

Orchestra III (right) 36 players



Leave a path for the marimba player to the cowbells, tam-tam and cymbals.
The harp may also be placed, as in Orchestra I, to the left of the conductor.

—— = desk



Rehearsal for the first performance in the Rheinsaal of the exhibition halls in Cologne-Deutz, on March 24th, 1958 at 8:00 p.m. The Cologne Radio Orchestra plays under the direction of Karlheinz Stockhausen (Orchestra I, left), Bruno Maderna (Orchestra II, centre) and Pierre Boulez (Orchestra III, right).

GRUPPEN FÜR DREI ORCHESTER
(Groups for Three Orchestras)

Instrumentation of the orchestras:

I

- 1 flute (also piccolo)
- 1 alto flute
- 1 oboe
- 1 english horn
- 1 clarinet
- 1 bassoon
- 2 horns (higher, lower)
- 2 trumpets
- 2 trombones (2nd with bass valve)
- 1 bass tuba

4 percussionists
- 1 marimbaphone, 5 octaves
- 1 glockenspiel
- 5 cowbells (1,4,7,10,13)
- 4 metal-instruments: 1 tam-tam, 3 cymbals (1,4,7,10)
- 2 wood drums (pitches 1,7/4,10)
- 4 drums (1,4,7,10)
- 1 snare drum
- 1 tambour de basque

- 1 keyboard glockenspiel (or celesta)
- 1 harp
- 10 violins
- 2 violas
- 4 cellos
- 2 basses

Ii

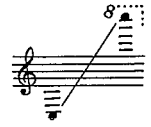
- 2 flutes (1st also piccolo)
- 1 oboe
- 1 piccolo clarinet
- 1 alto saxophone (also clarinet)
- 1 baritone saxophone
- 1 bassoon
- 3 horns (1st and 3rd higher, 2nd lower)

4 percussionists
- 1 vibraphone
- 14 tubular bells
- 4 cowbells (2,5,8,11)
- 4 metal-instruments: 1 tam-tam, 3 cymbals (2,5,8,11)
- 2 wood drums (pitches 2,8/5,11)
- 4 drums (2,5,8,11)
- 1 snare drum
- 1 tambour de basque
- 1 ratchet
- 2 triangles (higher, lower)

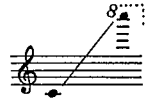
- 1 piano (with cover: small or large peg)
- 1 electric guitar

Percussion instruments

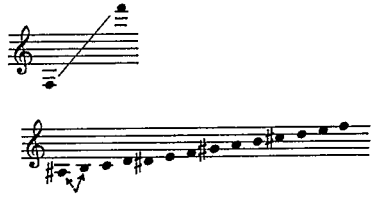
1 player
- 1 marimbaphone, 5 octaves — sound:
- 1 glockenspiel, — sound:



1 player — 1 xylorimba, 4 octaves — sound:

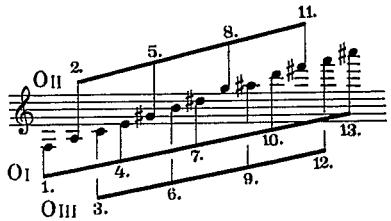


1 player
- 1 vibraphone — sound:
- 14 tubular bells — sound:



9 percussionists play:

13 Almglocken (cowbells), pitches approximately:



Each cowbell actually produces several tones; the dominating tone should have the indicated pitch.

The bells are to be hung (without clappers) on leather thongs from the stands, so that they swing freely. Otherwise the sound will be lost. Hit with a slanting motion on the outermost edge, or, in the case of "froschmaulschellen", on the curved part (pick out the best spot for resonance). The following kinds of sticks are divided into two categories, "hart" and "weich" ("hard" and "soft"): leather mallets, heavy iron clappers, vibraphone mallets, mallets with wooden balls, felt etc. Within each category the sticks should be varied according to the conductor's indications.

12 "metal-instruments": 3 tam-tams and 9 cymbals (from the largest to the smallest) should be arranged in a scale from 1—12, from low to high (in the dominat-

2 trumpets
1 trombone
1 bass trombone

4 violas
2 cellos
2 basses

III

1 flute (also piccolo)
1 oboe
1 english horn
1 clarinet
1 bass clarinet
1 bassoon
3 horns (1st and 3rd higher, 2nd lower)
2 trumpets
2 trombones (both with bass valve)
1 contrabass trombone (or tuba)

4 percussionists
1 xylorimba
4 cowbells (3,6,9,12)
4 metal-instruments: 1 tam-tam, 3 cymbals (3,6,9,12)
2 wood drums (pitches 3,9/6,12)
4 drums (3,6,9,12)
1 snare drum
1 tambour de basque

1 celesta (5 octaves)
1 harp

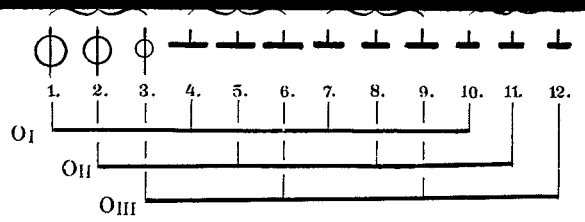
8 violins
4 violas
2 cellos
2 basses

The scale of tempos

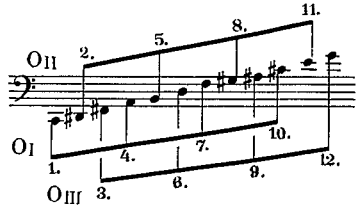
should denote 12 steps (to be sensed as equally large) between ♩ = 60 and ♩ = 120. The metronome values are rounded off:

♩ = 60
♩ = 63,5
♩ = 67
♩ = 71
♩ = 75,5
♩ = 80
♩ = 85
♩ = 90
♩ = 95
♩ = 101
♩ = 107
♩ = 113,5
♩ = 120

and 3 cymbals. tamtams, large cymbals, medium cymbals, small cymbals. The following kinds of sticks are divided into two categories, "hard" and "soft": felt mallets (heavy, light), leather mallets, rubber, wooden sticks, metal rods etc. Within each category the sticks should be varied according to the conductor's indications.



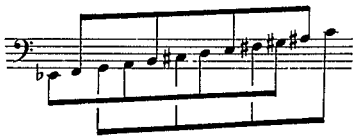
12 drums: tomtoms and/or tumbas and bongos (in the high register) with the following pitches:



"hard" and "soft" mallets (wooden sticks, felt, etc.), wire brushes.

3 side drums with snares (shallow jazz-drums, very bright sound). Disengage the snares when not in use.

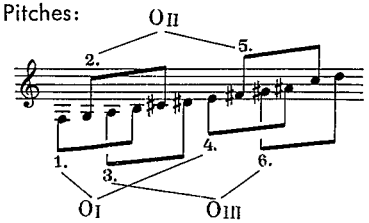
or:



6 wooden drums: African slotted drums, each with two pitches.

The wooden drums were hired from an (ethnographical) museum for the first performance. For subsequent performances new ones were made by a violin maker in accordance with the pitch requirements of the score. The drums should be struck on the thin portion of the wood alongside the slots (the two sides give different pitches). In fast groups of notes other parts of the drums may be struck to provide variation in pitch and timbre. Beaters in the categories "hart" (wood, hard rubber, leather) and "weich" (felt, soft rubber, wool) should be varied as indicated above for metal instruments.

Pitches:



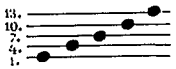
3 tambours de basque (with bells or little tin cymbals in the rim), 2 triangles (1 high, 1 low), 1 ratchet.

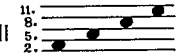
GRUPPEN FÜR DREI ORCHESTER
(Groups for Three Orchestras)

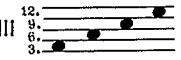
or 4 octaves with xylophone for the highest octave

the two lowest (a♯ , b) may be hung, as tubes or plates, together with the glockenspiel.

Notation:

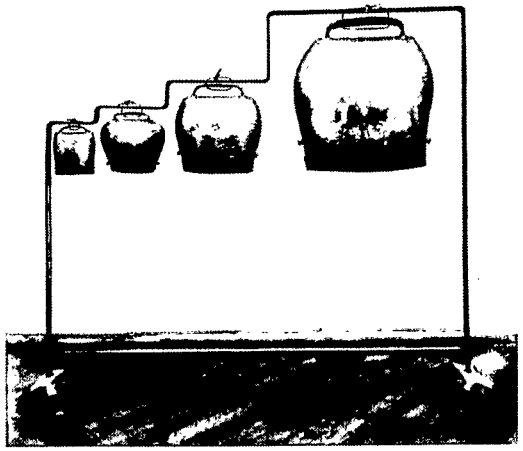
Orchestra I 

Orchestra II 

Orchestra III 

Sticks and mallets:

In the score "hart" and "weich" ("hard" and "soft") are used to denote the mallets for all percussion instruments. As mallets of the same name can give different results in sound (due to the way the material has been prepared), a more exact prescription was dispensed with. Within the categories "hard" and "soft" the most varied sorts of mallets should be used, according to the instructions of the conductor.



4 cowbells, suspended. This stand must be high enough, so that the lower edges of the bells can be hit while the player is standing.

Platforms:

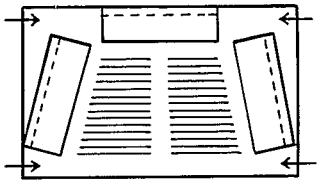
For the first performance, three platforms were constructed in the Rheinsaal, which has no built-in platform.

Orchestras I and III: 12 m. × 5 m. × 0.50 m.

Orchestra II: 12 m. × 5 m. × 0.40 m.

But the sizes 13 m. × 6 m. × 1 m. for each orchestra would be better.

The rear section of each platform (shown in the diagram by a broken line) was 1 m. wide and 25 cms. higher than the rest of the platform, so that for 4 m. of floor the height was 0.50 m. and 0.40 m. respectively, and for 1 m. the height was 0.75 m. and 0.65 m., respectively. For later performances a built-in platform of 0.80 m.—1.0 m. in height had to be used for Orchestra II. Platforms I and III had to be changed in shape and proportion, according to the size of the hall. If possible, the work should be performed in a rather rectangular hall with a level floor, without built-in seats or built-in platform (see photograph). The size of the Rheinsaal is 36 m. × 19.5 m.

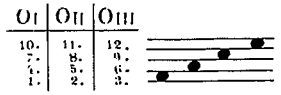


The rim of the platforms had a narrow moulding about 2 cms. high.

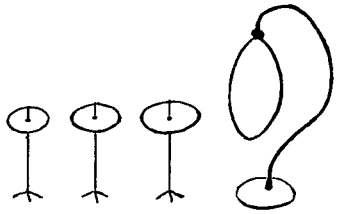
All three platforms had railings to the right, left and rear. The three conductors need small podiums. If the rear section of the platform is not raised, small podiums are needed for the harps and guitar.

The standing lamps which may be seen on the photograph are movable, and may be placed by the musicians and screwed into the wooden floor.

Notation:

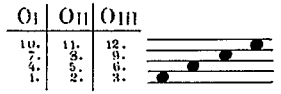


The tam-tams are written in the first space (1, 2, 3)

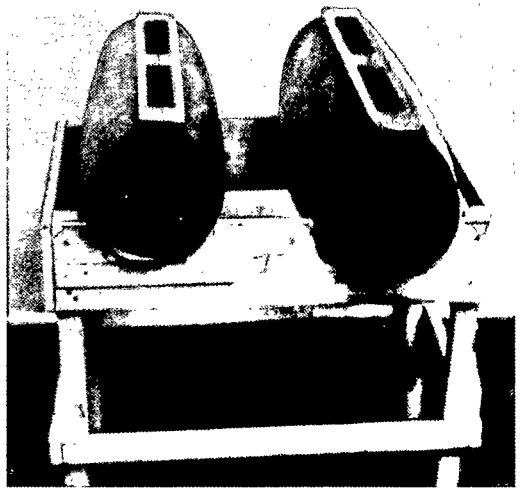


In each orchestra 1 suspended tam-tam, 3 cymbals on stands.

Notation:

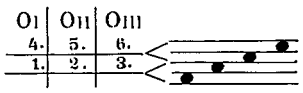


The snare drum is always written on a single line



2 wooden drums on their stand.

Notation:



Tape recording:

A 4-track magnetophone was used for the tape recording. Each orchestra was recorded onto one track, using several microphones. The 4th track recorded a mixture of all three orchestras through one microphone in the centre of the hall. The one-channel broadcast version was made from this 4-track recording.

Rehearsals for the first performance:

3 hours, all percussionists:

division of instruments, positioning, reading of the parts, change of position, choice of sticks, stick technique.

Divided rehearsals, arranged so that each player had 6 rehearsals of 2 hours (the 3 conductors working simultaneously in different rooms). Division of rehearsal time (woodwinds, brass, strings, percussion, keyboard instruments, harp, guitar) according to the individual plan of each conductor, extended over whole days.

in addition:

1 special rehearsal of 1½ hours for strings of Orchestra I
2 special rehearsals of 1 hour each, all brasses
1 rehearsal of 2 hours, all percussionists

2 rehearsals of 5 hours each, all three orchestras on the platforms in the concert hall itself

warm-up rehearsal of 1 hour (preceded by tuning of the drums)

6 rehearsals of 2 hours each, conductors alone, were interspersed among the preceding.

Programme of the first performance:

Karlheinz Stockhausen: Groups for Three Orchestras

Pierre Boulez: 3rd Piano Sonata, the composer at the piano

— Interval —

Karlheinz Stockhausen talks about his composition

Repeat: Groups for Three Orchestras

REFRAIN FOR THREE INSTRUMENTALISTS

The recording of REFRAIN for this VOX record was made on July 11, 1968 in the Südwest Tonstudio Jansen, Liederkranzhalle, Stuttgart-Botnang, Lortzingstrasse, with Aloys Kontarsky (Piano and Wood Blocks), Christoph Caskel (Vibraphone and Cow Bells), and Karlheinz Stockhausen (Celesta and Cymbales Antiques). *Set-up and microphone placement:* 9:30 a.m.—ca. 4:30 p.m., with a one hour break. *Recording:* 5 p.m.—ca. 9 p.m. *Editing:* ca. 10:15 p.m.-12:15 a.m. *Instruments:* Steinway grand piano 403951 from Matthaes Co., Stuttgart. Schiedmayer celesta 68383 borrowed from the Süddeutscher Rundfunk, Stuttgart. Deagan Traveller vibraphone, owner: Stockhausen.

6 *microphones:* 1 for the piano, on a stand to the right of the piano, bent over the edge, near the wood blocks, in front of the player's mouth.

2 for the vibraphone: one on a stand above the lowest octave of the vibraphone and near the cow bells; the other near the player's mouth when he assumes the normal stooped playing position.

2 for the celesta: one behind the celesta, fairly low, near the wooden resonators for the lowest tones; the other near the player's mouth, above the instrument.

1 stereo microphone, centered in front of the three instruments, fairly high (live hall), in order to blend together the individual presences of the separate instruments into one acoustical space.

Interpretation

Several instructions of the score were not observed.

1) The instruction that *mezzo-forte*—with the exception of the *sffz* chords—should be the maximum loudness of the piano and vibraphone (in order that a balance between them and the celesta might be possible) was *not* observed. All 3 instruments used their *whole* dynamic range for the interpretation of the given degrees of loudness, naturally always keeping the overall ensemble sound in mind; synchronous attacks with the same dynamic indications were, according to register, balanced out among the instruments, especially in mixtures containing celesta tones in the low register.

   With the playback on records in mind, a few tones and passages were played somewhat louder than usual (the levels of the microphones were not readjusted): the strongest accents sound extremely sharp and loud while playing in the hall, and the softest tones, especially the ends of tones dying away, which one just barely still hears and which are so important for the measuring of durations in REFRAIN, easily perish in the recording process; nevertheless, the tape recording has an unusually large dynamic range (it would have been impossible to record the whole dynamic range unaltered). A limiter or a compressor for compensations in dynamics was not available for this recording.

   As a result of the raising of the dynamic levels of piano and vibraphone, several sounds last much longer than usual.

2) All groups of "small notes" that are to be played "as fast as possible" were played out very clearly and, according to their internal registral distribution, rhythmically differentiated (especially by the celesta, where tones in the octave were held longer than those of higher ones).

3) Corresponding to the lengthening of sounds and the durations of the groups of "small notes," the durations of all pauses and fermatas were *doubled:*

ca 1/2 sec.	*ca* 2 sec.	
ca 1 sec.	*ca* 4 sec.	*ca* 8 sec.

This doubling was not observed in the last system. This system was interpreted according to the graphic representation of the vertical relationships, and the instruction of the score to play "independently from one another" was followed only in the short periods between synchronous attacks.

4) The instruction to shout all the syllables shortly, was interpreted in such a manner that the duration of each shout was at least long enough to let it emerge out of the usually sharp instrumental attacks. Almost every syllable—certainly every syllable with a double vowel—was shouted in the form of a fast interval—low-high (low shout—Kopfstimme) and ff-mf dim. or f-p dim., with a glissando, downwards from the high tone, similar to the shouts of the Nô percussionists; in the case of double vowels, the first was low, the second high.

I hope that this recording will correct the common misconception that REFRAIN is gentle mood-music. From the beginning on, whenever I assisted in rehearsals or played myself, REFRAIN always had a complete scale of expressive qualities, from brilliant hardness to whispering delicacy.

We play REFRAIN in public performances just as we did for this recording. The disregard for the *mezzo-forte* limit for piano and vibraphone (a better balance of the three instruments may be achieved by amplifying the lower register of the celesta) and the proportional lengthening of pauses and fermatas are alterations which I recommend as supplementary to the instructions of the score.

About the music

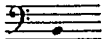
A quiet, static sound continuum is "disturbed" six times by a varied refrain; the refrain is recognizable by its trills, clusters, a short melody, bass-tones; the intervals between the appearances of the refrains are variable from version to version. The final structure of each refrain depends upon the context into which the musicians place it, and in reverse, each refrain influences the music that follows it.

REFRAIN was composed for the Berliner Festwochen 1959 and is dedicated to my friend ERNST BRÜCHER. The premiere took place on October 2, 1959 in Berlin.

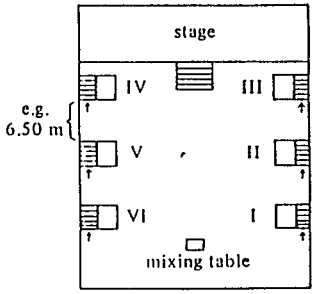
KATHINKA'S CHANT AS LUCIFER'S REQUIEM

(Saturday from Light)

Performers - Instruments

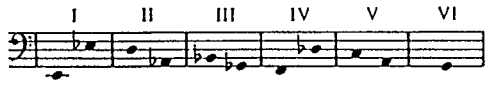
KATHINKA is a flutist dressed as a black cat. She (he) plays a flute with B-foot, and is amplified over loudspeakers by microphone with transmitter or several microphones with cables.
Further, KATHINKA needs a sound plate having the pitch  which she takes to percussionist III at the beginning of section (13).
A staircase must lead from the middle front edge of the stage into the auditorium.

6 percussionists dressed in black, with silver faces and hands, stand on 6 podia (ca. 2 m x 1.5 m, and 1.6 m in height) at the right and left of the public. The podia have access stairs at the rear.



SOUND PLATES

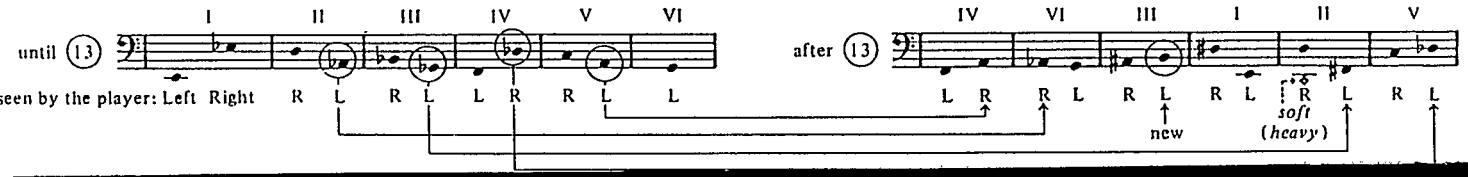
Percussionists I–V each have 2 sound plates, percussionist VI has 1 sound plate. The sound plates should be silvery (for example Duralumin). They hang at the left and right of each player's face (in the case of Player VI, at the right, seen from the public).

Pitches of the sound plates 

Percussion I:	The 2 sound plates have	two open eyes painted in black upon them.
Percussion II:	The 2 sound plates have	two ears.
Percussion III:	The 2 sound plates have	two nose halves.
Percussion IV:	The 2 sound plates have	an open mouth with tongue extended and a pharynx with gums and soft palate.
Percussion V:	The 2 sound plates have	two hands with fingers spread.
Percussion VI:	The 1 sound plate has	a brain.

In section (13), KATHINKA leaves her flute, for example floating in the air (hung horizontally on threads), and brings another sound plate  (with the drawing ⬡) to III, and exchanges his sound plate  with the plate  . Then she carries the sound plate  from III to II and exchanges it with his  , which she hangs at the left of VI (as seen from the public). She subsequently takes the sound plate  from V, exchanges it with the  of IV, and brings this one to V. Then she runs back to the stage.

Thus, after the *EXCHANGE OF THE SENSES*, the sound plates are distributed as follows:



Besides the sound plates, each percussionist has at least 5 "magical instruments" which are strapped onto the body: on the head, on the chest, on the forearm, on the belly, on a thigh, etc. Each instrument should have several different sound possibilities.
These instruments sound through striking, or rubbing or rattling or shaking, through releasing mechanical or electrical processes, etc., and should produce sounds, sound-noises, noises. They are called "magical instruments" because they should have a very strange, mysterious, "magical" effect, as in fairy tales, where mysterious sounds enchant beings, open mountains or doors, make elves dance, etc.
The percussionists must therefore find, invent, build these instruments, or have them built.

Concerning this, only a few suggestions should be made:

There are toys for small children – chimes enclosed in celluloid cylinders – which produce enchanting sounds when shaken lightly. Such an instrument could be suspended on threads inside a small drum which is worn on the head and held on by a chin strap.
When the drum is struck, the instrument resonates and the sound can be extended by shaking the head.

Or, by rubbing a wooden handle on a grooved surface (as in the case of a *guero*), strange, mysterious sounds can be produced. Such a rubbed instrument can be strapped to the forearm.

Or, an unusual striking mechanism of an old grandfather's clock could be built into a case which is then strapped onto the body. Hitting it, or pushing a lever could make it strike once. This stroke can also be an *arpeggiated* complex chord, having many pitches (a sound which announces the "ghostly hour").

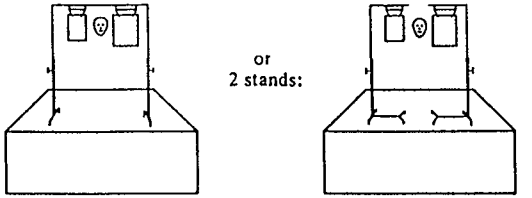
And so on.

Thus, the 6 percussionists must have 6 x 5 = 30 or more different "magical instruments". They should all be black or silver.

Any humorous effect which might be caused by these instruments or by the way they are played must always be rendered eerie by the automaton-like bearing and movements of the players.
The numbers in ellipses in the *FORM SCHEME*, and in the score, indicate the number of entrances for the "magical instruments" of each individual player. Each player must learn these numbers and the beats of the sound plates by heart.

2 spotlights for each percussionist should light only his figure and his instruments, plates, but not the podium or stands (see *Lighting*).

The stands and hooks for hanging the sound plates must be built to expedite this exchange.
Each percussionist has a black stand of adjustable height for 2 sound plates:



The sound plates are invisibly struck from behind with hard beaters. After the exchange of the plates, only percussionist II should strike the D-plate with a heavy soft beater which strongly draws out the lower octave.
Prior to the appearance of each percussionist, a black cloth hangs between his sound plates, so that his presence is not noticed. Only when the percussionist is illuminated (see ⁘ in the *FORM SCHEME*), does he inconspicuously release the cloth, which then falls down revealing his face.

WHISTLES

During the entire performance each percussionist has a whistle in his mouth. The mouthpiece of this whistle should be such that it can easily be held by the teeth and lips. It is also possible to mount several whistles next to each other in front of the mouth. The player blows a whistle simultaneously with each beat of a sound plate, for as long as his breath lasts.
Easily recognizable whistle tones, such as those produced with referee whistles, police whistles, siren whistles, common children's whistles such as trill whistles or cuckoo whistles, or other banal bird imitations should not be used.
Instead, the whistles should produce variable sounds (depending on the intensity of blowing: from a single pitch through intervals reaching complex chords) or noises (as for example *Munyo* rubber whistles). They should be blown in various ways (constant or rhythmized, with or without glissandi, with or without flutter-tongue, with peculiar attacks and endings, etc.): according to the 24 exercises!
With these whistles, the players should have mysterious nocturnal conversations: in duos, trios, etc., according to the combinations of players given in the form plan.

INORI

Large Instrumentation

INORI can be performed by a **large orchestra** (89 musicians) or by a **small orchestra** (33 musicians).

In both cases, **the same score** is used. Special indications in the score mark the small instrumentation.

The **orchestral parts** of the two versions are **different.**

In the following explanations, first the **large** orchestra will be described, and then the small orchestra.

Instruments

4 flutes (1st and 2nd also play piccolo, 3rd also plays alto flute)

4 oboes

4 clarinets (2nd also plays E-flat clarinet)

4 bassoons (4th also plays contrabassoon)

4 horns I

4 horns II

4 trumpets

3 trombones (3 tenor trombones with F attachment, 3rd also plays bass trombone)

1 tuba (with *sousaphone bell*)

Each trumpet and 1st and 2nd trombone need **3 mutes:**
straight mute, *cup mute*, *wawa mute* (or *plunger* ad lib.);

the bass trombone needs *straight mute* and *cup mute*.

Special mutes must be obtained for trombones which have extra large bores.
Horns need the normal mutes and small metal mutes.

Instructions Concerning the Instruments

HORNS I, II

The best player of *horns I* (high horns) should be Hn. I / 1, the second best should be Hn. I/3.
Hn. II/1 must be very good and a good **leader**, Hn. II/4 should be the second best of the low horns.
The pitches of the low horns must be constantly checked, because some horn players simply play an octave too high. The very low, fast passages are also playable!
The individual parts for the horns are notated a fifth higher, even in 𝄢 ; thus all horns sound a fifth lower than notated in the parts.

In places where *"gestopft"* (*stopped*) is indicated for longer stretches, a small metal mute which produces the same timbre may be used (see bars 471 - 596).

TRUMPETS

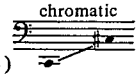
In the trumpet section, Tp. 1 should be the best, Tp. 3 the second best.

Notation for the *wawa* mutes by means of circles over the notes:

vowel timbre [a] [ɑ] [ɔ] [o] [u]

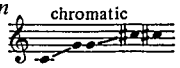
4 percussionists:

1.) 14 *"sound plates"* C - C♯



1 *slap stick* (see bar 893)

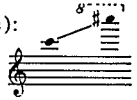
2.) 16 *rin*



(G and upper C♯ each 2x)

3.) *vibraphone* and

antique cymbals (2 chromatic octaves plus high C and C♯ ; high C♯ must be specially made):



Notated 2 octaves lower with *2 oct.*

4.) wreath of *Indian bells* (approx. 100 small bells strung on a ring of wire) and

vibraphone (bars 442 - 849). (It is possible to play everything on 1 vibraphone, but a second vibraphone simplifies the performance.)

For control of independent tempi, the 3rd and 4th players need a *silent metronome with a flashing light*, placed on a music stand so that they can both see it.

1 grand piano (with 3 pedals) without lid
14 violins I
12 violins II
10 violas
8 violoncelli
8 double basses (all with 5 strings)

The **performance material** consists of

89 individual orchestra parts, numbered 1 - 89,
1 (or 2) *Prayer Part (s)*,
2 scores for conductor and sound projectionist.

If the closed position ● is too soft in *pp*, the fingers should be spread open slightly.

○——● and ●——○ gradual transition,

——>○—— open quickly with an accent and close again.

TROMBONES

The 3rd trombonist should actually change between tenor trombone with F attachment and bass trombone. However, until now musicians have been unwilling to do this, and the entire part of the 3rd trombone has been played on a bass trombone. Then, of course, sections which have high G become heavy and too loud. Thus, it would be better to find a trombonist who can change instruments.

The trombones should play ***ff*** as "*dolce* ***ff***", i. e. not brassy; the conductor will indicate any exceptions.

For the *wawa* mutes, the same notation is used as for the trumpets.

TUBA

The **sousaphone attachment** (called a *recording bell* or also *front bell*) which is screwed onto the bore of a normal tuba is not found everywhere and is not willingly used everywhere. The symphony orchestra of the *Südwestfunk*, Baden-Baden, has one. This sousaphone bell should, especially at bar 157 and bars 820-830, aid in producing a **shattered, brassy** sound similar to that of a loud bass trombone. In loud sections it should project the sound directly into the hall.

With an E - flat tuba without a sousaphone bell, the tuba player of the *BBC Symphony Orchestra* was able to arrive at almost the same brassy effect.

A tuba player at *NOS-Radio Hilversum* played a C tuba (Kaiser tuba).
He could produce a brassy sound during these sections, without a sousaphone attachment, but bars 820 - 823 sounded too muffled, and, especially in the high range, this tuba was too loud.
Thus, if possible, this large tuba should not be used, and the desired sousaphone bell should be obtained.
A sousaphone should **not** be used.

Tubas with *recording bell* can be ordered from the manufacturers *Alexander* in Mainz.
(4 F tubas with *recording bell* exist in the *Staatskapelle Bühl*.)

Sousaphone bells inserted into the normal tuba bell change the intonation of the instrument, and this is difficult to rectify; those which are screwed on should therefore be used.

INORI

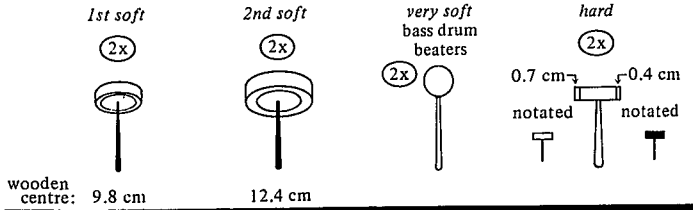
SOUND PLATES

The prescribed *sound plates* are sometimes called *plate bells*; they should not sound like church bells. Originally, chromatically tuned *Thailand gongs* were planned. It became clear however, that with neither the original gongs nor reproductions (manufacturer *Paiste*) was the necessary playability and the desired sound possible. A set of sound plates (chromatically tuned thin bronze plates) belonging to the *Südwestfunk Symphony Orchestra* was therefore used. With these plates, the 2nd overtone (i. e. the octave above the pitches notated in the score) sounds louder than the fundamental.

Since it is not possible to rent this set of sound plates, a new set of sound plates made of hard aluminium, with stands, was made especially for INORI at the *Karlsruhe Bell Foundry*, commissioned by the firm *Grabmann*, Uerdingerstr. 692, 4150 Krefeld Bockum. The fundamental of these plates sounds louder than that of the *Südwestfunk* plates, especially when a relatively heavy beater is used and when the dynamics are soft. However, even with the aluminium plates the upper octave dominates soon after the attack.

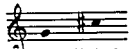
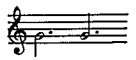
At the same foundry, it is of course possible to have *plate bells* of bronze made, whose fundamental clearly dominates and whose audible, sustained pitch corresponds to the notated pitch. However, these *plate bells* are so heavy that they require clumsy and much larger stands, cause very high transport costs and are also difficult to damp. For such a set of *plate bells*, 3 players would have to be used (1 player, 2 dampers).

As beaters, special beaters must be used, each having a round wooden centre and glued - on felt rim; for "*weich*" (*soft*) higher pitches, 2 smaller beaters with thinner felt rims, and for *soft* lower pitches, 2 larger ones with thicker felt rims. At certain places in the score, the smaller type is specified for low pitches too. For "*hart*" (*hard*), 2 identical wooden hammers are used, each having a felt covering of different thickness at each end. Sometimes, strokes are more particularly specified. For example "lightly strike with wooden handle" for an especially *hard* section, which should be the continuation of the vibraphone (bars 677 - 679); or "*tremolo* with a very soft beater, so that the pitch continues to ring" (bars 191 ff.) and "continue soft vibration with inaudible beats (with a soft beater)" (bar 413 ff.), for both of which *very soft* bass drum felt beaters are necessary.



RIN

The *rin* are brass - coloured metal bowls which are used in Japan in Buddhist temple ceremonies. They have a very long resonating, exceedingly rich, harmonious spectrum. They are played with felt - covered wooden beaters. These *rin* may be purchased in special shops in Japan, together with their cushions and beaters. Their diameters vary between approx. 6.5 and 15 cm. Since it is not possible to order *rin* according to specific pitch, many *rin* must be tried out in order to select a fairly exact chromatic scale.

The pitches  must be available twice. The pitches of each pair should deviate very slightly from each other, so that beats result when both ring simultaneously.
In the score, the two *rin* are differentiated by having note stems upwards and downwards: 

= *rin* beater covered with felt,

= beater reversed and wooden handle struck against the edge.

It is best to hire a musician who has often played the *rin* part of INORI, and who owns the instrument (perhaps via the Stockhausen-Verlag).

INDIAN BELLS

A *wreath of Indian bells* may either be purchased in India (bell wreaths like those which Indian dancers wear around the ankles and arms, diameter of individual bell approx. 1.5 cm.) or loaned from the Stockhausen-Verlag.

The wreath of bells is laid on a soft base (plastic cushion on a horizontally positioned music stand, or a high stool with plastic seat), and for continuous durations, shaken back and forth quickly and irregularly. A periodic shaking should on no account be heard. An accent or *staccato* during the shaking is made with a stroke of the other hand against the bundle.

LIGHT METRONOME

Percussionists 3 and 4 need a silent metronome with a flashing light to control the tempi in bars 450 - 453 (♩ = 92) and bars 641 - 668 (♩ = 76) which are independent of the conductor. Despite their independent tempi, the players must follow the conductor's downbeats and begin bars 647, 648, and 649 synchronously with him.

To avoid noise when damping, the player should wear **woolen gloves**.

The set of *sound plates* with beaters can be loaned from the Stockhausen-Verlag.

Photo: *JAPANESE RIN*

An explanation of the special seating arrangement of the instruments has already been given in the *General Introduction*.
A result of this arrangement is that the **first** player of each string group (Vln. I/1, Vln. II/1, Vla. 1, Vc. 1) can **see all the musicians** of his group **seated in front of him** and thus can check all the bowings which are crucial to the **choreography of the bowings**.

(These reasons must definitely be explained to the musicians, and at the end of a performance when the applause begins, the principal of each group should be asked to stand up first to be acknowledged before the entire orchestra does so!)

Another unusual result of the seating arrangement is that the last desks of each group sit nearest to the conductor. These musicians must be good leaders; therefore, the musicians within each group should be arranged so that the best are at the back, the second best next to the conductor, the third best as second desk from the back, the fourth best sit as penultimate, etc.
Vln. I/1 and 2 are the best, Vln. I/13 is the third best, Vln. I/3 and 4 are the 4th and 5th best, Vln. I/5 is the 6th best, Vln. 11 is the 7th best, Vln. 7 the 8th best, Vln. 9 the 9th, and those who sit next to these may be freely distributed.
The 11th of Vln. II should be the 2nd best, the 9th Vla. should be the second best, the 7th Vc. should be the second best.

The bowings should not be changed. They are the result of a carefully planned choreography of the movements and a great deal of practical experimentation with orchestral musicians in many rehearsals. This also applies to places where, to individual musicians, the bowings seem to be indicated against all custom. The players do not at first understand that within each string group the bowing of the entire group should result in a **uniform** picture, even though the individual players have different notes, note groups and rests to play.

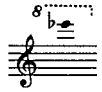
When several upbows follow one another separated by rests, the bow should not be lowered, but rather held motionlessly in the air, and after the rest, moved up further until a downbow comes (for example bars 1 - 17, Vln. I 9 - 14, Vln. II 7 - 12, Vla. 7 - 10, or bars 138 - 139, Vln. I, II and Vla., etc.).

Flautando means *sulla tastiera* (translator's note: **near** the fingerboard).

SPIEL FÜR ORCHESTER
Spiel for Orchestra

PERCUSSION INSTRUMENTS:

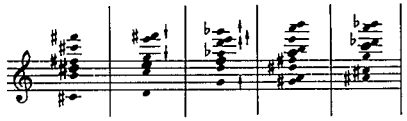
Percussion 1

1st movement: 1) small INDIAN BELL  with a lead clapper inside: FOTO 1 * 
tied up tightly, struck with a metal rod (triangle beater); main pitch e. g. long brilliant sound.

2) TRIANGLE, fairly high

2nd movement: 5 "CINELLI" (small thick cymbals, ca. 15–27 cm. in diameter) on a special stand with a horizontal iron arc on which there are 5 metal spikes with thimble-shaped rubber supports: FOTO 2

Main pitches in the sound of the "Cinelli" selected by Stockhausen at the Paiste firm (thick notes = dominant pitch):



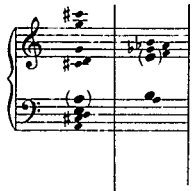
↑ = slightly higher
↓ = slightly lower
one should choose similar "Cinelli" (equal distance between the dominating pitches would be better still).

For the quiet notes use a knitting needle,
for the loud ones use a beater with a wooden head.

Instrumenten-Firma Paiste
(2373) Schacht-Audorf, Postfach 26, West Germany

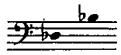
Percussion 2

1st movement: 1 higher / 1 lower } CYMBAL on stands — pitches e. g. ca.



diameter: 72 cm | 56 cm

cf. percussion 3, 2nd movement. Thick notes dominate in a soft attack *mp* at the edge, bracketed ones in a loud attack with soft leather over thick wooden beater.

2 TOM-TOMS — pitches 

hard felt beaters (for cymbals too)

2nd movement: the same 2 CYMBALS as in the 1st movement

4 beaters from soft to hard e. g.
1. soft felt
2. hard rubber
3. wood with leather
4. very hard plastic (glksp./xylophone beater).

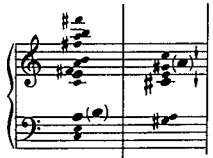
Percussion 3

1st movement: 1 WOODBLOCK — pitch  ; preferably a Japanese woodblock: FOTO 3
(diameter 23.5 cm, height 12.5 cm;
beater with wooden head)

2 TEMPLE BLOCKS — pitches 

2nd movement: 1 higher / 1 lower } CYMBAL on stands, 4 beaters soft to hard, see percussion 2

pitches e. g. ca.



diameter 63 cm | 51 cm

* Fotos: see page XIX

SPIEL FÜR ORCHESTER
Spiel for Orchestra

Percussion 4

1st movement: HIHAT

The two plates should be carefully arranged in such a way that after the attack they rattle against each other for at least 5 seconds. Method of playing in the 1st movement:  = tread briefly,  = allow to rattle,  = tread and keep closed

2nd movement: HIHAT

4 beaters from soft to hard e. g.
1. soft felt
2. hard vibes beater with twine
3. beater with plastic head
4. metal rod

Percussion 5

1st movement: 1 AFRICAN POD RATTLE

Dried seed pods in 4 rows of 10 each, attached to a cloth and suspended with twine, struck with a drumstick against the cloth (sounds like loud maracas – but broader in spectrum –, or like a plastic box with grains of shot): FOTO 4

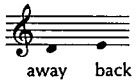
1 SIDE DRUM with snares, very high and bright; very thin sticks.

2nd movement: 1 LARGE SIZZLE CYMBAL

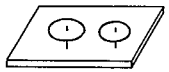
on a stand (resonating for as long as possible)
4 beaters from soft to hard (like percussion 2).

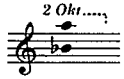
Percussion 6

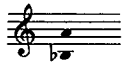
1st movement: 1 "RATCHET", but less sharp than the normal ones: a trellis of wooden rods, along which one scrapes with a thin stick (pencil); e. g. along the back rest of a wooden chair with a trellissed back:

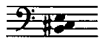
scraping to and fro. Pitches such as 

2 CYMBALES ANTIQUES
mounted on 2 spikes in a small wooden board
with metal beater



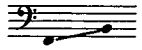
pitches 

notated 

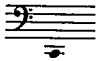
2nd movement: 3 TOM-TOMS pitches 
4 beaters from soft to hard

Percussion 7

1st movement: 2 TAMTAMS, suspended

1 PEDAL KETTLEDRUM pitches 
drum beaters (also for tamtams)

2nd movement: the same PEDAL KETTLEDRUM

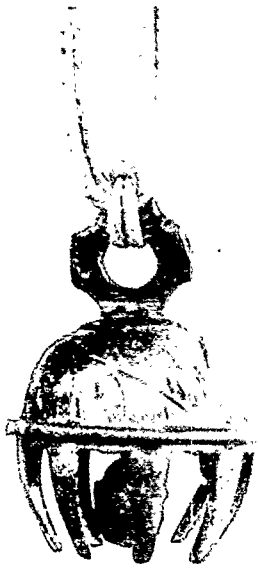
1 BASS DRUM pitch  or 

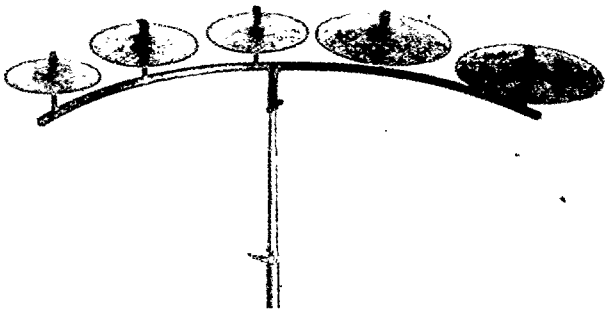
4 beaters from soft to hard

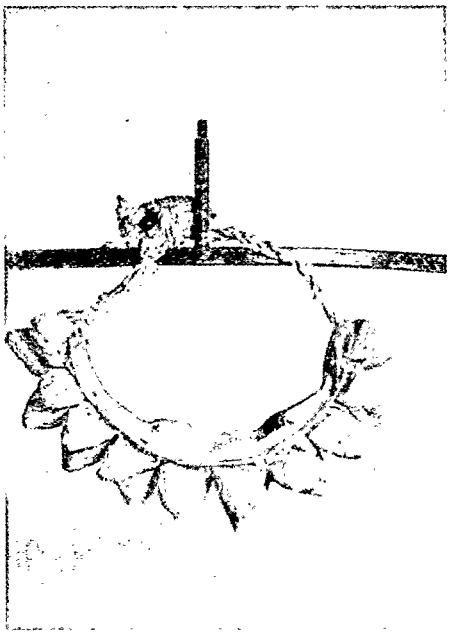
All beaters should be tried out and agreed upon with the conductor.

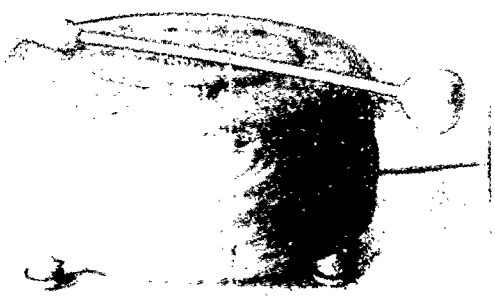
FOTOS/PHOTOS

SPIEL FÜR ORCHESTER
Spiel for Orchestra





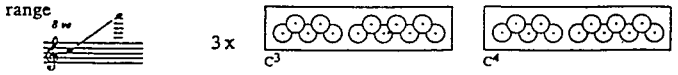




MUSIK IM BAUCH
(Music in the Belly)

INSTRUMENTS

1. 3 sets of ANTIQUE CYMBALS, mounted chromatically by means of screws on boards:

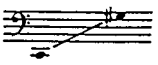


or 2 sets of antique cymbals and 1 glockenspiel (always let ring).

2. 1 GLOCKENSPIEL without pedal, on a 35 cm high table; behind the table a cushion on the floor on which to kneel.

3. 3 SWITCHES, which will be whipped in the air (with whistling glissandi). The pitches of the 3 switches should be somewhat different.

4. KLANGPLATTEN [1] (similar to plate bells) hung chromatically:

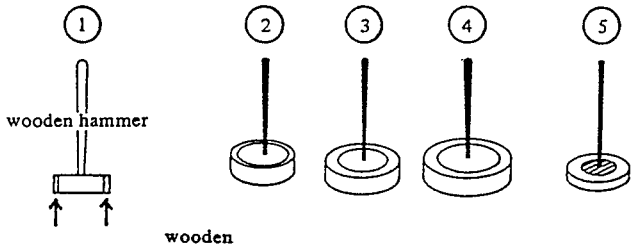


(long fundamentals !), struck with felt-tipped wooden hammers (and possibly a felt beater with an iron core).

Manufacturer: M. Grabmann, Uerdinger Str. 692, (415) Krefeld-Bockum, West Germany — or may be rented from: Stockhausen-Verlag, 5067 Kuerten, West Germany

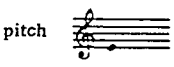
If it is impossible to obtain sound plates or plate bells, tuned gongs may be used.

4-5 variously hard beaters should be used, for instance:



	1 hard	1 soft	wooden			
felt:	0.4 cm	0.7 cm	center: 9.8 cm felt rim: 0.9 cm	9.8 cm 1.5 cm	12.4 cm 1.5 cm	iron center: 8.2 cm felt rim: 2.7 cm

5. 1 SPINNING TOP on a stand, which must be very loud (overtone chord, not a melody), or 1 TUBULAR BELL (which rings for a long time).

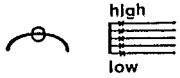


6. 1 MARIMBA, range  , perhaps 

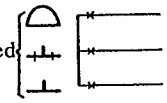
Translator's note: " klangplatten " (literally, " sound plates ") are panels made of a metal alloy which, when struck, sound like low bells with very strong penetrating low fundamentals and long resonance. They differ from " plattenglocken " ("plate bells") in that these are made of bronze and sound distinctly like low church bells.

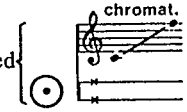
TRANS

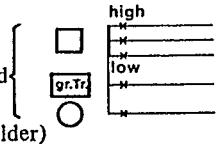
INSTRUMENTS

Group I 4 flutes
1 bass clarinet (Boehm-System with the low C to achieve a fuller and louder sound)
1 celesta (electrically amplified)
1 percussionist: 5 cinelli[1] (see below), notated 

Indian bell wreath
(about 100 strung on a wire circle), notated 
(measures 100 - 196)

Group II 4 oboes
1 trombone with F valve attachment
1 percussionist: 1 vibraphone
1 cowbell[2]
1 "sizzle cymbal"[3]
1 cymbal[4]
} notated 

Group III 4 B-flat clarinets
1 bassoon
1 contrabassoon
1 percussionist: tubular bells
2 gongs with raised centers
} notated 

Group IV 4 B-flat trumpets with cup mute
1 tuba
1 percussionist: 3 tom-toms[6]
1 bass drum
1 tam-tam[7]
} notated 

1 "infantry drum" (hung over the shoulder)

Bassclarinet, bassoon and contrabassoon, trombone and tuba have leading roles and require excellent players.

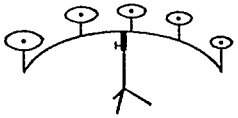
Strings: 22 violins[8)]
8 violas
6 violoncelli
4 double basses

1 electric organ[9)]

EXPLANATIONS OF THE INSTRUMENTS

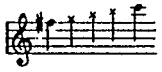
1) Cinelli are small cymbals (ca. 15 - 27 cm in diameter) mounted on a special stand consisting of an iron arc on which five metal spikes with rubber grips are mounted.

side view:



the stand should be sufficiently high, and adjustable so that one is able to strike the cinelli (from above) when standing.

five pitches at approximately equal intervals:
glisteningly bright sound with long resonance.



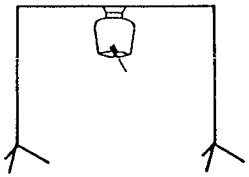
4 hard India rubber and/or hardwood beaters

rubber and/or felt beaters

Cinelli and stand are available from the firm PAISTE (Luginbühl bei Luzern, Switzerland, and D-2373 Schacht-Audorf, Postfach 26, West Germany).

2) cowbell 50 cm high, without clapper, hung on a high gong or tam-tam stand.

side view:



the stand should be sufficiently high so that one is able to strike the cowbell against the lower edge when standing.

heavy iron clapper (taken from the bell)

for less loud, yet hard attacks, hardwood or hard vibraphone beater

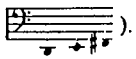
thick felt beaters

3) "sizzle cymbal" – a large cymbal (ca. 70 cm in diameter) into which holes have been bored; in these holes are loose metal rivets that rattle as soon as the cymbal is struck. On the normal kind of stand.

4) A large cymbal (ca. 75 cm in diameter) on a stand. This cymbal should not be too thick, so that it "hisses" when struck hard.

"Sizzle cymbal" and large cymbal also obtainable from the firm PAISTE.

5) The gongs with raised centers should sound as low as possible and have different pitches (Thai, Javanese or similar gongs).

6) The pitches of the tom-toms should be tuned approximately in intervals of major seconds and be fairly low (e.g. ).

7) Tam-tam at least 80 cm in diameter. The sound should have a high noise content, i. e. it should not sound like a gong (relatively thin metal). Obtainable from PAISTE.

8) The violins and the violas need arm rests on which to support their left arms during the whole performance (because of the continually sustained long notes). These arm rests should be adjustable in height, padded with foam rubber on the small upper resting surface, and completely unobtrusive.

9) The electric organ must go down to  . Big Hammond organs go down to  with an 8' stop, and the 16' stop gives the lower octave. One should try to obtain an organ on which this lowest octave is not added on, but which sounds as a fundamental without upper octave doublings.

PERFORMANCE MATERIAL

a) Individual parts for

21 wind instruments
1 celesta
4 percussionists

These instrumentalists have music stands.

b) Individual parts for

22 violins, numbered: Violin 1 to Violin 22
8 violas, numbered: Viola 1 to Viola 8
6 violoncelli, numbered: Cello 1 to Cello 6
4 double basses, numbered: Double Bass 1 to Double Bass 4

For each string player, all the notes to be played are printed on one small sheet of cardboard. In the case of the violins and violas, this sheet is fastened upright on the scroll with a paper clip and rubber band; in the case of the celli and double basses, it is attached to the instrument on the bridge. The reverse side of the cardboard should be of the same dark brown colour as the instrument.

1 electric organ

c) 1 extra page each for the trumpet solo, viola solo, and cello solo.

On The Tonal Evaluation of Xylophones

Ingolf Bork and Jürgen Meyer
Physikalisch-Technische Bundesanstalt
Braunschweig, Federal Republic of Germany

Translated by Thomas D. Rossing

Translator's Summary

The physical parameters that determine the pitch and timbre of xylophone (marimba) bars are discussed. From studying synthesized xylophone sounds, it is concluded that the pitch is determined almost entirely by the fundamental, as long as the second partial is tuned (to the double octave) within ± 15 cents. The third partial can influence the pitch slightly, but this partial mainly contributes to the timbre or tone quality. By investigating these synthesized xylophone sounds in various musical contexts, it is determined that the best tuning of the third partial is midway between a major and minor third above the triple octave. Tuning it midway between a major third and a fourth above the triple octave, which gives a brighter timbre, is also acceptable.

Introduction

Acoustical investigations of percussion instruments presently are described in the literature only in a few isolated cases. Furthermore, these papers do not concern themselves particularly with individual instrument groups but consider the percussion instruments more as an extension of results obtained with other instruments in order to demonstrate a particular measurement process. A number of sound spectra of percussion instruments are found in E. Meyer and G. Buchmann,[1] and among them are two examples of xylophone sounds. I. G. Bassett[2] describes a procedure for a three-dimensional

representation of sounds; among his examples is one for a xylophone. T. D. Rossing[3] discusses the vibrational forms of bars and includes a comparison of a xylophone, a marimba, a vibraphone and chimes. Included in the comparison are individual values of the frequency relationship and the behavior of the sound. The only systematic investigations are found in the work of J. Berghauser and A. Spelda[4] who have measured the entire tonal range in chromatic sequence for a xylophone throughout the dynamic range available.

From all these works it is nevertheless impossible to obtain any kind of a quality characteristic for instrument groups which could be used by an instrument builder as a starting point for improvements. It is therefore not surprising that these instruments which have so far been developed only empirically do not exhibit the level of sound quality which could be expected from today's understanding of the manufacturing processes and knowledge about materials. The present work is therefore designed to illustrate for the group of xylophone instruments those acoustical parameters which characterize the sound. On this basis, subjective hearing tests will be used to investigate the importance of individually measurable characteristics of instruments and their relevance to sound quality. Thus, the task is to establish a quantitative basis for changing the acoustical properties so that the sound quality can be optimized within the framework of contemporary building techniques.

The Tone of the Xylophone

The group of xylophone instruments belongs to the family of bar instruments and includes, in addition to the actual xylophone, also the marimbaphone and the so-called sounding bars used in music pedagogy. While vibrating metal plates are used in glockenspiels and vibraphones, the vibrating bars of xylophone instruments are made of wood of high density and bending stiffness (mostly rosewood) or glass fiber reinforced plastic. These bars are positioned on two small supports approximately one-fifth the bar length from the ends, so that the ends are free to move. Excitation of vibrations is caused by a mallet impulse which occurs approximately in the middle of the bar. With this type of excitation the individual resonances of the bars are excited in a manner independent of each other. In contrast to non-percussive instruments with continuing excitation, no harmonic spectrum is therefore forced.

Inasmuch as the cross dimension of the vibrating bars is small in comparison to the wavelength at their characteristic frequency, the sound radiation of the bar alone is relatively poor, especially for the lower notes. In contrast to the original xylophone of the previous century, in today's instruments a resonator, tuned to the fundamental of the bar, is usually found directly below the bar to amplify the sound radiation.

Especially in larger instruments with a chromatic tonal range of three or more octaves, these resonators are tubular. Generally, these tubes are closed at their lower ends so that they function as quarter-wavelength resonators.* Tubes with both ends open (half-wavelength resonators) are only rarely used. In the so-called sounding bars, each individual rod is usually connected to a box resonator, physically considered to be a Helmholtz resonator. In this case the bar vibrates above a relatively small opening found in the cover plate of the box. In other instruments, three or four bars are mounted above the same trough resonator in such a way that they serve as its cover. In instruments of this kind (for example, the so-called bass xylophones) four resonators suffice for a diatonic tonal range of approximately two octaves.

The tonal picture of the xylophone instruments is in large measure determined by its time structure. Due to the impulsive nature of

*Translator's note on resonators: A pipe open at both ends has its first resonance when its acoustical length (physical length plus 1.2 times the diameter) is ½ the wavelength of sound; successive resonances occur when the length equals approximately 2, 3, 4...half wavelengths. The resonance frequencies form a complete harmonic series. A pipe that is closed at one end, on the other hand, has its first resonance when the acoustical length is ¼ the wavelength of sound, and successive resonances occur when the length equals 3/4, 5/4, 7/4...times the wavelength. Thus a closed-tube resonator supports only the odd-numbered harmonics [see chapter 4 in T. D. Rossing, *The Science of Sound* (Addison-Wesley, 1982)].

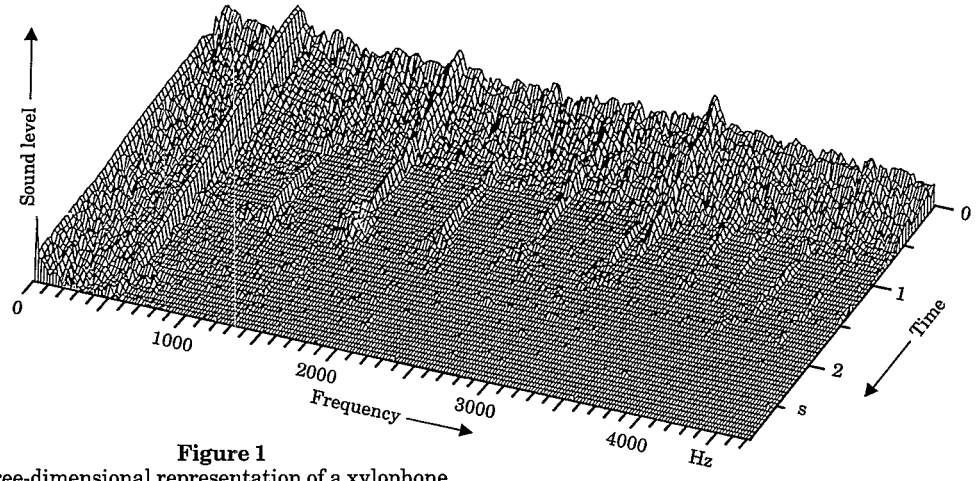


Figure 1
Three-dimensional representation of a xylophone sound (after I. G. Bassett[2]).

the excitation, the decay immediately follows the attack. A complete representation of the tonal picture is therefore only possible by using time as a third dimension in addition to frequency and intensity. Figure 1 is a representation of a xylophone sound which was obtained with the aid of a computer analysis.[2] In this illustration, the sound pressure is represented vertically on a logarithmic scale (although the original work does not give any indication of the scale).

Three partial tones stand out from the attack noise. The fundamental lies at approximately 530 Hz which appears to be a C_5.** The two strongest overtones lie at approximately three times and six times the frequency of the fundamental. Somewhere in between, several weaker partial components can be recognized as rising above the background after the decay of the initial attack sound. While the two stronger overtones can be recognized as the vibrational modes of the bar, the weaker partials lying in between can be deduced to be associated with the characteristic vibrations of the resonators, inasmuch as the possibility of distortion during the recording is unlikely. The complete series of these apparently harmonic components points toward a tube resonator open on both ends. The figure indicates clearly that the higher bar modes decay more rapidly, so that the sound impression is increasingly determined by the fundamental alone as time increases.

If one wants to describe such a sound by characteristic numbers, then three acoustic parameters should be noted for the individual partials: frequency, the maximum value of the amplitude, and the slope of the decay curve (preferably given, by analogy to room acoustics, as the time required to reduce the sound intensity by 60 dB). Naturally, for the individual parameters the relationship of the overtones to the fundamental plays an important role for the sound impression.

The characteristic frequencies of the vibrating bars depend upon their shape as well as characteristics of the material. The fundamental is tuned accurately by removing material from the underside of the bar. In a similar way the first overtone can be tuned on the basis of empirical experience. In American xylophones the first overtone is most frequently found in the neighborhood of three times the fundamental frequency, whereas in marimbaphones it is found approximately at four times the fundamental frequency.[3] In European instruments,

**In this translation, notes are designated by standard American notations, in which A_4 occurs at 440 Hz.

however, the tendency is to tune the first overtone to the double octave in xylophones as well.

The decay time depends not only on the characteristic of the bar material but also on its shape. An important influence is exercised by the resonator. Since the resonator extracts more energy from the vibrating bar than it would radiate to the free air, the decay time is shortened. The accuracy with which the fundamental frequency of the bar matches the characteristic frequency of the resonator determines how strong this effect is. As a result of this, the decay times of adjacent tones vary considerably in a xylophone, causing the overall quality of the instrument to suffer. As a point of reference, it can be assumed that the decay times of the fundamental in the lowest octave lie between 2 s and 3 s; in the next higher octave between 0.8 s and 1.8 s; and in the second octave above that between 0.2 s and 0.8 s. Decay times of the first overtone have orders of magnitude approximately one-half those of the fundamental, and those of the second overtone are about one-seventh of the fundamental.

The intensities of the individual partials depend in large measure on the hardness of the mallet used and on the strike position. The higher components become more pronounced with a harder mallet. The fundamental, on the other hand, demands a greater mallet mass in order to be excited, and it is more pronounced with a softer mallet. Striking the bar in the middle is advantageous for the fundamental inasmuch as the fundamental exhibits a vibration maximum there. The same applies to the third partial, while the second partial exhibits a node at the rod center and thus cannot be excited at that position. A relatively small departure from the center is sufficient, however, to excite this partial weakly. The spectrum of the bar is therefore not exclusively a characteristic of the instrument; within limits it can be influenced by the player. The intensity of the fundamental depends particularly on the quality of the resonators and on the nature of the acoustical coupling between the resonator and the bar. In the midrange, one can assume that the fundamental is approximately 30 dB greater than the higher partial, as long as an excessively hard mallet is not used. In the lower range this difference becomes slightly smaller, so that in the region of C_3 a fourth partial also becomes audible. In contrast to that, above C_5 even the third partial loses its importance.

The initial tone development of the xylophone sounds is not apparent in Figure 1. In Figure 2, therefore, oscillograms of the first three partials of a xylophone sound are shown with greater time resolution. The tone in question is one with a fundamental frequency of 220 Hz and overtones of 880 Hz and 2505 Hz, respectively. The overtones are amplified in the pictures so that the time envelope is clearly recognized. It becomes very evident that the third partial has completely decayed before the fundamental has reached its maximum amplitude. The reason for that is to be found in the relatively slow buildup of sound in the resonators. It follows, therefore, that one initially hears the overtones and only subsequently notices the fundamental. In extreme cases, this effect can lead to the situation that pitch recognition is influenced by the inharmonic position of the third partial, since the pitch at the time of the excitation is determined separately from the later pitch determined by the fundamental.

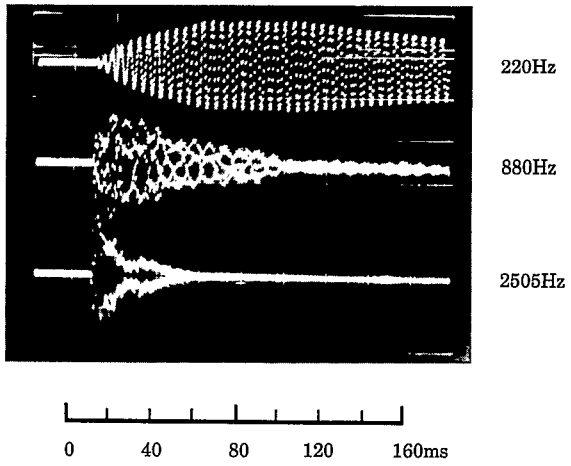


Figure 2
Oscillograms of the first three partials of a xylophone sound. The individual partials have been amplified for clarity.

Recognition of xylophone pitch is made more difficult by the fact that no complete harmonic spectrum is present. Only a few partials appear; these are widely separated in frequency and, in addition, are inaccurately tuned to a harmonic position or are totally inharmonic. Since a careful tuning of overtones is not technically possible, the question naturally arises how the overtones should be tuned in order to build instruments with optimal sound characteristics. In this regard, one must consider that the typical sound characteristics of percussion instruments are determined by the inharmonic components. Results of a psychoacoustical investigation are reported in the following section in order to clearly identify the demands of an instrument which are characterized by a uniquely recognizable pitch and a sound characteristic appropriate to any musical context.

Investigations Relative to Pitch Impressions

Because of the low number of partials, the subjective pitch of a xylophone tone is in large part determined by the frequency of the fundamental. Nevertheless, one cannot offhand exclude the possibility that overtones have a certain influence on the pitch sensation, particularly since they would exceed the fundamental in intensity at the time of impact. Thus one could expect the second partial to make pitch recognition easier, insofar as it is properly tuned to the double octave to stabilize the pitch. If such an effect is present at all, it will certainly be more effective when the second partial is tuned to the double octave than when it is tuned to the twelfth according to the American example. In this case, the danger exists that the ear orients itself to the fifth at the beginning of the tone and thus reaches two separate pitch sensations for the fundamental and the overtone.

First of all, one should investigate whether the pitch of a xylophone sound is more accurately recognized when a second partial, perfectly tuned to the double octave, is present rather than when it is missing. If such an effect (which would also have a positive influence on the quality of the instrument) were to be found, an additional question of practical importance for the instrument manufacturer would be raised: how accurately must the second partial be tuned in order to fulfill that task, or, in other words, how far can the second partial deviate from the ideal value before pitch recognition becomes uncertain?

The question arises further as to which way the ear will react to the deviation from the exact tuning. One can imagine that occasionally a not-too-sharply recognizable pitch may have some advantages. For example, if the tuning in the orchestra shifts to a lower pitch, or, as is more likely, during increasing temperature a rising pitch occurs, then the xylophone will not be able to follow this tuning change; thus the tuning of the xylophone will be sensed as incorrect. In this situation, it is clearly thinkable that a certain deviation of the second partial from the harmonic position, with its particular uncertainty in pitch recognition, would make it easier for the ear to hear the desired pitch correctly.

In order to investigate these questions, xylophone sounds were reproduced on a synthesizer. They consisted of three partials whose frequencies, peak amplitudes, and decay times were independently controllable. As a typical example, the sound of C_4 with a fundamental of 262 Hz was synthesized. Its second partial, with a level of -30 dB relative to the fundamental, was tuned to the double octave, and the third partial, with a level of -40 dB, had a frequency of 2840 Hz. The third partial thus lies 25 cents* below 11 times the fundamental frequency or 28 cents above the pitch of F_7, and is therefore to be considered as totally inharmonic.

In order to compare a pitch of such a xylophone sound with that of a harmonic sound which has a complete partial spectrum, a reference tone with a sawtooth waveform was generated. The time sequence of the sawtooth signal was adjusted to the xylophone sound by varying the low-pass cutoff frequency in the synthesizer so that during the decay process the lower spectral components dominated increasingly.

Audio tapes for hearing tests were prepared from this starting material. They were constructed according to a pattern already previ-

*One cent is 1/100 of a semitone.

ously used.[5] Figure 3 shows the time sequence. A pair of sounds to be compared are played for the test subjects three times in brief intervals, and the subject has to decide for which of the two sounds (A or B) the pitch is higher. After a brief pause, the next three pairs follow. In each one, the second sound B′ has been altered. In this fashion, up to fourteen versions of sound B are combined with the same sound A. Only very qualified listeners with special musical experience were considered as suitable test subjects. For the investigations reported here, tonmeister and music students in the Music Academy in Detmold, as well as several colleagues from acoustical laboratories, made themselves available. Altogether, 34 persons were tested.

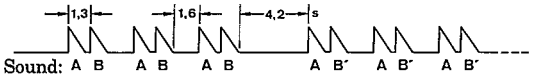


Figure 3
Time sequence of the test program: A: sound with constant quality; B, B′: sounds with changing quality.

In the first test series a C_4 xylophone sound, which consisted only of the fundamental and the third partial and did not include the double octave, was combined with a sawtooth signal, the fundamental frequency of which was varied from 50 cents above that of the xylophone to 30 cents below. The test results were evaluated by determining for each subject the limit above which the sawtooth sound was clearly higher in pitch as well as the limit below which the sawtooth sound was clearly felt as lower than the xylophone sound. The average between these two limits is then the frequency deviation for which pitch equality exists. These individual averages were then averaged over all test subjects.

As a result, one obtains for the first test series an average value of -2.42 cents (i.e., the fundamental frequency of the sawtooth sound should be minimally lower than the xylophone sound in order for the average listener to sense pitch equality). It should be noted, however, that the individual scatter for the test subjects is so large that a standard deviation of 5.4 results. This means that the individual values for pitch equality for 68% of the test subjects lie within a region of $\pm$ 5.4 cents about the listed average value of -2.25 cents. If one recognizes that only very few musically-trained listeners identify intervals of less than 4 cents correctly, it follows that for practical purposes the pitch of a xylophone can be equated with a sawtooth sound of equal frequency.

For the second series, the xylophone sound included a second partial tuned exactly to the double octave but with no other changes from the first series. The average value for the pitch equality for all test subjects is now -2.46 cents with a standard deviation of 5.8 cents. According to this, the double octave does not change the pitch of the xylophone sound, as was clearly expected. In order to clear up the question of whether the presence of the double octave makes pitch recognition easier, the width of the uncertainty region for the individual subjects is shown in Figure 4. The vertical axis indicates the number of test subjects for whom the uncertainty region is smaller or equal to the value indicated on the horizontal axis.

A comparison of the lower parts of the two curves for test series 1 and 2 shows that for some particularly discriminating subjects the uncertainty region for the sound with the double octave is slightly narrower than for the sound without the double octave. In contrast to that, the upper portion of the curve indicates that for many listeners the uncertainty with the double octave is slightly larger. This means, practically, that the certainty of pitch recognition as a whole is not influenced by the presence of the double octave.

The last noted result is based on the supposition that the second partial is tuned to exactly four times the fundamental frequency. What influence a faulty tuning of this partial has on the pitch impression was investigated in the third series of tests. For this, the test sounds consisted of a sawtooth signal that was always unaltered and a xylophone sound whose second partial was varied from -20 to $+50$ cents from an exact double octave. The results confirm the relatively subordinate role of the second partial in pitch determination. A third of the test sub-

jects (truly experienced) were unable to determine clearly a deviation of the second partial by 50 cents (i.e., the pitch sensation for them was not influenced by the fact that this partial was too high by half of a semitone). As can be seen from Figure 4, the width of the uncertainty region for this detuning is approximately three times the values in test series one and two. One half of the test subjects first noted deviations of more than ±17.5 cents, and only approximately 20% of the subjects could detect ±10 cents deviation clearly. In this, the pitch impression is, within the uncertainty, again equal to that of the sawtooth sound. The exact value lies at 0.9 cents.

The pitch impression corresponds to that of the sawtooth sound outside the uncertainty region also, as long as the fundamental pitches

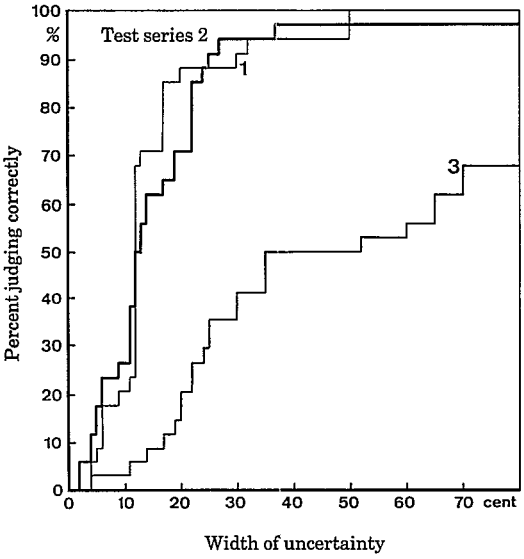


Figure 4
Widths of the regions in which pitch difference between the sounds of a xylophone and a sawtooth wave could not be determined. Test series 1: Xylophone sound with first and third partials, sawtooth with variable frequency. Test series 2: Xylophone sound with an additional double octave, otherwise as in series no. 1. Test series 3: Xylophone and sawtooth sounds with the same fundamental frequency, variable frequency of second partial in the xylophone sound.

are the same. At this point the question still remains as to whether a detuning of the fundamental in comparison to the sawtooth sound can be compensated by a detuning of a second partial in the opposite direction. In a fourth test series, therefore, the xylophone sound and the sawtooth signal were detuned by ±30 cents relative to each other, and in addition the second partial was varied up to 150 cents. The evaluation of this test showed that most subjects were no longer able to sense a consistent pitch as soon as a deviation of the second partial from the harmonic position became noticeable to them. Several comments (for example, "the tone moves up" or "two pitches: one higher, one lower") indicate that the fundamental and the second partial are evaluated separately, and therefore a different pitch is sensed initially rather than toward the end of the sound.

From this one can draw the conclusion that the xylophone sound with a widely spread overtone spectrum cannot be considered as a uniform sound with uniform pitch, but instead as a superposition of individual spectral components with differential time structure. The effect becomes clearer the slower the fundamental reaches its maximum value (i.e., the smaller the damping of the coupled resonator is). When the fundamental and the double octave are tuned exactly to each other, the third partial can influence the pitch sensation even though it decays very rapidly. Thus in comparing two bars with exactly equal fundamental frequency, one senses that bar as higher in pitch whose third partial is higher, even though this occurs at totally inharmonic positions. In addition, one feels the recognition of a tone sequence influenced when the frequency motion of the higher partials does not correspond to the motion of the fundamental in parallel. More important to the pitch sensation than the interval of the third partial to the fundamental is therefore the *regularity* of this interval for neighboring tones of the scale.

Investigations Relative to the Sound Character

The third partial gives the xylophone a sound characteristic of percussion instruments. This

is a result of its frequency position which the ear cannot bring directly into a harmonic relationship with a fundamental. Evidently the tuning of this partial cannot be left to chance, in spite of its inharmonic position, since constructing the bars of an inhomogeneous material makes unsystematic jumps in frequency position of the third partial unavoidable. The question thus arises which tuning would be sensed as optimal for this partial. The sound requirements will therefore be related to the fact that the typical characteristics of the instruments should be clearly indicated as well as that the voicing of the instrument in various musical harmonic contexts should be sensed as correct and as specific as possible.

For wooden bars, the technically realizable range for the frequency of the third partial is limited by the fact that the tuning of the fundamental and the second partial should not be affected (or at least affected as little as possible), and that by the general tuning method (shaving the lower side of the bar) only a lowering and not a raising of the third partial frequency can be obtained. In practice, therefore, only the region between eight and eleven times the fundamental frequency (that is, between the triple octave and a scant fourth above that) is available; from a production standpoint, the center of this region is most desirable.

From glockenspiels of cast bells (in contrast to orchestral instruments of the same name) it is known that wrongly pitched sounds occasionally are noticed in the harmonic arrangement of a polytonal musical piece which would be much less apparent in single note playing, if at all. For this, the minor third overtones (in rarer cases also those of the major third), which do not fit into the structure of the relevant chord, are important. This experience should be considered for the tuning of the third partial of a xylophone. However, one can certainly assume that the musical listener senses the harmonic content of the melody even though it is not played.

For this reason the short melodic phrase used for the listening test exhibits clear harmonic relationships even though it was played in a single tone line computed by a closing cadence. In addition, a weighted relationship between major and minor character should exist, and the rhythmic structure should correspond to a typical xylophone passage. Figure 5 shows a test example which encompasses a tonal range of F_4 to $E\flat_5$. The example is given as a note picture with references to the relevant chords.

This test melody was reproduced on the synthesizer in six different sound versions; in each case only the frequency of the third partial tone was varied in the following intervals above the triple octave:

A. major second
B. major second plus 50 cents
C. minor third
D. minor third plus 50 cents
E. major third
F. major third plus 50 cents

For version A the third partial falls exactly on the ninth harmonic of the fundamental; for version E it falls exactly on the tenth harmonic. All other versions indicate in the physical sense an inharmonic position of the third partial. However, it is entirely possible that in a given musical context the minor third (version C) can also be sensed as consonant. So, for example, in the case of the tone C_5 in the first measure above, one imagines a minor triad with a minor third.

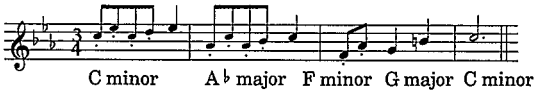


Figure 5
Test melody for judging the tuning of the third partial.

In order to enhance the influence of the third partial and to make the decision easier for the test listener, the synthetic xylophone spectrum was built up in such a way that the double octave and the third partial were only 25 dB below the fundamental in intensity. The actual test program compared 30 pairs in which every version was combined with every other version, and also the sequence was interchanged once. The question asked of the test subject was which of the two test melodies in each pair would you prefer without specifically speaking of sound character or pitch recognition. Again, approxi-

mately 30 persons participated in the test and in some cases measurements repeated several days apart confirmed the certainty of the test subjects.

Inasmuch as each of the six different versions occurs ten times on test tape, one can assume for the evaluation of the questionnaires that a version clearly preferred above all others should be listed as better ten times; however, in the event that a test subject cannot specify differences, then each version (in the statistical average) should receive five positive decisions. In order to obtain the highest possible significance, in the evaluation of results for each test person, only the number of positive decisions which exceeded the value of five (that is, over the rate probability) was counted. In this fashion, the results for a particular subject who noticed no difference, for example, or as a matter of principle always chose the first version within a pair, was not counted at all in the overall evaluation, while the result for a test subject who chose a particular version above all other consequences enters the total results with an evaluation number of five. When one now sums the evaluation numbers obtained in this fashion for all test subjects, one obtains the final results represented in Figure 6.

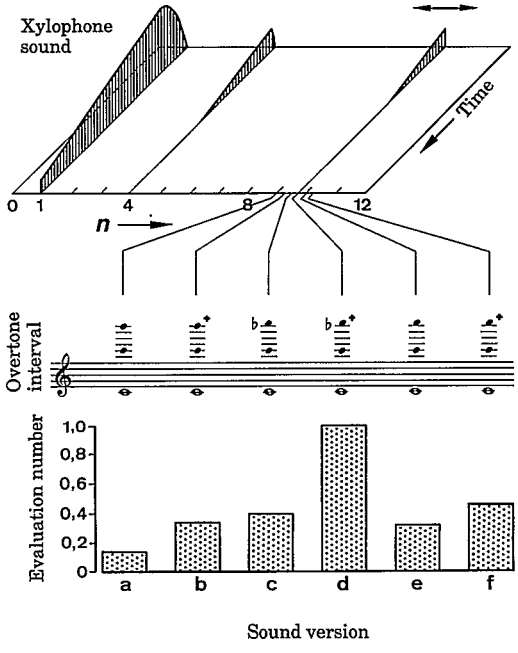


Figure 6
Subjective evaluation of the different preferences of the third partial. ***n*** is the harmonic number. + indicates a raising of the indicated note by 50 cents.

At the top of this figure, the time and frequency dependent structure of the xylophone tone is represented schematically, supplemented by a note picture showing the overtone composition of the individual versions. The lower part of the picture contains the evaluation number determined for all the test subjects, normalized to the value 1.0 for the best version. As can be seen, version D representing the interval between the minor and major third above the triple octave is preferred over all other versions. This most likely depends on the choice of this particular melody example, in which the major or minor character (that is, the major and minor third) is constantly changing. Thus, for example, in the measure before the last, the tone G_4 would be strengthened by the major third in its dominant function. The following tone B_4, however, would with its accompanying major third, $D\sharp_7$, destroy this harmonic function. It would rather require a minor third which, however, would be unfavorably influenced by the G_4. One can see from these examples that for neither of the two thirds is a harmonically satisfying result to be expected. The somehow indifferent compromise of the interval in version D, on the other hand, leads to an equally inharmonic sound impression for all notes, and thus produces the most balanced tone picture. One can also think that some listeners may adjust subjectively, hearing these intervals in the direction of the minor or major third according to the harmonic content within the melody, thus sensing the corresponding interval even though objectively it is not present.

In the qualitatively ranked sequence, version F falls in second place. Here also the third partial avoids the harmonic position, and it has the highest frequency position among all possible versions. As appears from supplementary comments by a number of subjects, it was preferred independent of its harmonic characteristic partly because

it was the best example of an expectedly bright tone quality. This also explains why version A receives so little positive evaluation; the tone color was much too dark and was too different from the expected xylophone sounds. Furthermore, the harmonic effect of a major second (or a ninth above the double octave partial) could be confusing, inasmuch as this interval, in its isolated position without the remaining stronger consonant overtones, could cause one to question the pitch evoked by the fundamental rather than supporting it.

Concluding Remarks

The extensive listening tests have indicated that the voicing of instruments of the xylophone group is not solely influenced by the fundamental but also by the frequency position of the first two overtones. From this, qualitative requirements relative to the voicing of these overtones can be derived that can form the basis for further developments about the technical possibility of voicing of individual partials. Particularly in view of the fact that instruments with vibrating wood bars also find application in many areas of music education, these results have particular significance, since ear training in the early years is essential for the development of a well-developed pitch recognition ability. Specifically, the following results can be summarized:

1. The pitch impression of a xylophone sound is independent of the sound level of a second partial accurately pitched to the double octave. Also, the pitch does not depend on the position of the strike as long as it lies in the central region of the bar.

2. Because of the difference in the time decays, it is not possible to compensate for a mistuned fundamental in xylophone sound with an oppositely mistuned second partial.

3. The tuning of the second partial to four times the frequency of the fundamental should occur with an accuracy of ± 15 cents. If this limit is exceeded, the danger exists that the sound is split into two separate tones with different pitches.

4. The third partial can influence the pitch sensation when two bars with equal frequency of the second partial are compared.

5. Different tunings of the third partial along the tone scale can influence the interval recognition of a tone sequence with properly tuned fundamentals.

6. For aesthetic reasons the third partial should be tuned to the average between the minor and major third above the triple octave. Tuning midway between a major third and fourth above the triple octave is also defensible; in this case a brighter timbre is achieved.

7. Tuning of the third partial to one of the interval positions mentioned in point 6 should occur with an accuracy of ± 20 cents.

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Footnotes

[1] E. Meyer and G. Buchmann, "Die Klangspektren der Musikinstrumente." Sitzungsber. der Preusz. Akad. der Wiss., Phys.–Math. Kl. 22, 735 (1931).

[2] I. G. Bassett, "Perceptual Characteristics of Percussion Instrument Sound." Report on the Second Workshop on Phys. and Neuropsychol. Foundations of Music, Ossiach 1977.

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(Translated by Uwe J. Hansen and Thomas D. Rossing from *Das Musikinstrument* 31 (8), 1076-81 (1982).)

Charles Ives's Life Pulse Prelude for Percusssion Orchestra: *A Realization for Modern Performance from Sketches for his* Universe Symphony

Composer Larry Austin, Professor of Music at North Texas State Universty, co-directs the Center for Experimental Music and Intermedia in Denton. His innovative works, well known and widely performed, are cited extensively in major music references, published by Peer-Southern, MJQ Music and the American Composers Alliance, and recorded on Columbia, Advance, Source, Irida, and Folkways. His research interests focus both on Ives's Universe Symphony *and the development of computer-assisted compositional algorithms.*

For the past ten years, Larry Austin has been involved in a project to realize, for modern performance, the Universe Symphony, *Charles Ives's last, most ambitious, yet uncompleted work. The* Life Pulse Prelude *is an orchestral layer of the* Universe Symphony *which, according to Ives's memos, can be performed alone (Kirkpatrick 1972). Austin's recently completed realization of the prelude received its world premiere performance on April 12, 1984, during the North American Festival of New Music held at the State University of New York, Buffalo, with a 20-member percussion orchestra conducted by Jan Williams. Score, parts, and the 16-track cue-tape for the Austin realization are available from Peer-Southern Organization, New York. The* Life Pulse Prelude *score is presently being prepared for publication.*

Critic Herman Trotter wrote in Musical America *(September, 1984) about the first performance of Charles Ives's* Life Pulse Prelude: *"At its peak, this huge crescendo-diminuendo generated an immense din and was very impressive as a musical and historical event. How close it was to what Ives would have produced had he seen it through is anybody's guess...As an isolated and repeated listening experience, I'm not sure how long Austin's realization would hold the interest, but its implications about the other two layers of the* Universe Symphony *are intriguing, and it is a fascinating extrapolation of sketches left as a legacy by one of our musical geniuses."*

Background

The *Life Pulse Prelude* of the *Universe Symphony* was very important for Charles Ives. It was the first material sketched for the *Universe Symphony* between 1911 and 1915; sketches resumed in 1927 and 1928 and from time to time were taken up again until three years before his death in 1954 (Cowell 1955). Of the 36 extant pages definitely part of the *Universe Symphony*, nine were devoted to material for the *Life Pulse Prelude*: twenty percussion parts – one evidently a piccolo – all in different meters and tempi, coming into phase every eight seconds. At those points, a "low, deep, hanging bell" is struck, Ives's "B.U." (basic unit), as he called it. Then, one by one, the other percussion instruments enter to create the complex meter/tempo ratio of 1:2:3:4:5:6:7:8:9:10:11:12:13:14:17:19:22:23:29:31. In the nine sketch pages devoted specifically to the *Life Pulse Prelude*, Ives actually notated half of one of the planned ten cycles of music, which, in the latter half, he specifies in exact palindromic reverse. Thus, one complete cycle was realized by Ives, himself. The other nine cycles are described in structural but not notational detail. With this and the structural outline provided by Ives, I have attempted to realize the entire *Life Pulse Prelude* with credible sensitivity to Ives's intent. What follows is a detailed explication of my interpretation of the *Life Pulse Prelude* sketches, the method of their realization for modern performance, and observations on what I term "the *Life Pulse Prelude* effect."

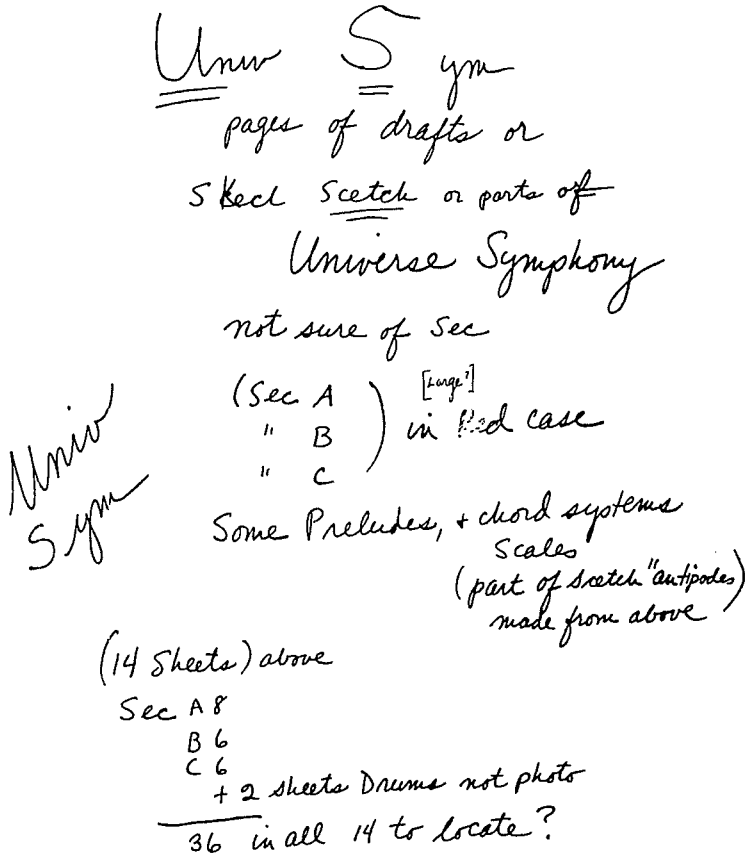
The Life Pulse Prelude Sketches

Since 1974, my work transcribing and studying Charles Ives's sketches for his *Universe Symphony* has resulted in the composition of three original works: *First Fantasy on Ives' Universe Symphony: the Earth*, for two brass quintets, narrator, and tape; *Second Fantasy: the Heavens*, for chamber ensemble and tape; and *Phantasmagoria: Fantasies on Ives' Universe Symphony*, for orchestra, narrator, digital synthesizer and tape. Now, with the realization of the *Life Pulse Prelude* for percussion orchestra, I am completing the first of what may well eventuate in a full-blown realization of the entire *Universe Symphony*, certainly Ives's most ambitious, experimental, and, I maintain, his most compelling work. I continue to be inspired not only by Ives's exciting material and advanced concepts found in the sketches but also by his open invitation to other composers to expand and even to carry out his stunning aspirations for the work.

In this article I elucidate the myriad details, often in seeming conflict, about instrumentation, tempo, and formal continuity in the *Universe Symphony*, especially as they pertain to the *Life Pulse Prelude*. These aspects have been important to me to sort out, since they bear directly on my work as a composer of fantasies on Ives's *Universe Symphony* material and on the first full realization of one of three macrolayers of the *Universe Symphony*, the *Life Pulse Prelude*. I believe strongly that the following conclusions can be well supported: 1) the instrumentation for the *Universe Symphony* is comprised of eleven orchestras (sometimes called "groups") of relatively small size and made up of like instruments; 2) the continuity for the work in three uninterrupted sections called "Past (A), Present (B), and Future (C)," is sustained by the ten "life pulse" percussion orchestra cycles, lasting a total of either 24 or 27 minutes; and 3) the tempo for the entire work is uniform and can be played at either ♩= 60 MM or ♩= 53.3 MM.

Through the present article, I adopt the ordering collated by John Kirkpatrick, long the curator of the Yale University collection of Ives manuscripts. This order was adopted by the editors of the complete facsimile edition and transcription of the *Universe Symphony* to be published by the Charles Ives Society and Peer-Southern Organization with commentaries on the sketches by Lou Harrison, John Kirkpatrick, John Mauceri, David Porter, and myself. Each sketch page especially relevant to the *Life Pulse Prelude* will be reproduced here, and references to same in the course of the text will be discussed.

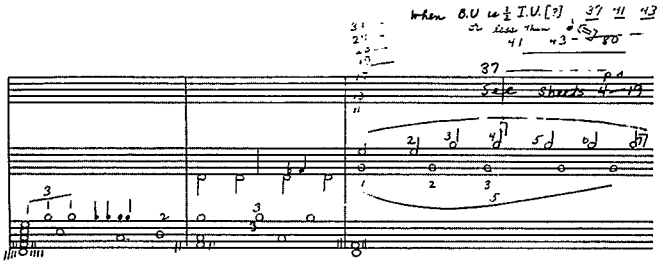
Cover Page
(Kirkpatrick ms. no. 1819)

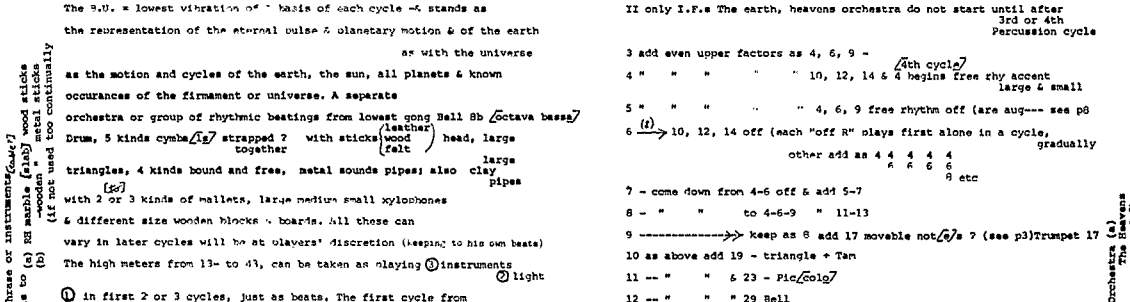


The cover page for the *Universe Symphony* collection of sketches was created by Ives in an effort to collate and catalogue his manuscripts. It gives us important information for interpreting the sketches. "Pages of drafts or Scetches [sic] or parts" suggests that Ives thought of these pages of manuscripts as being in different states of completion: 1) "draft" – emerging ideas expressed in music or annotations; 2) "Scetch" [sic] – the testing of an idea in music notation, often with different shadings and effects; or 3) "part" – completed music. It's puzzling that he wrote that he was "not sure of sec," except to guess that the reference is to the missing "pages of drafts or scetch [sic] or parts." "Sec A 8" is the total extant pages Ives numbered 1 to 10, the composed music for the Earth and Heavens orchestras, with 3 and 8 missing or simply not numbered. "B 6" refers to six unnumbered manuscript pages that include the fragmented elements of section B. "C 6" refers to the final group of six unnumbered pages, marked "III" or "C" or having some reference to identify them as being in the final section. "+ 2 sheets drums not

photo" is curious, since there are actually nine extant pages which pertain directly to the percussion orchestra music. Perhaps, Ives hadn't located them when this cover page was written. "36 to locate" (to collate) is right, if one excludes what I believe are specious pages in the complete *Universe Symphony* collection of 44 collated by Kirkpatrick and includes that elusive "p. 8" of section A, missing, but so often referred to in the sketches. In summary, there are 36 pages definitely part of the *Universe Symphony*, nine of which are sketch pages for the *Life Pulse Prelude*.

First Life Pulse Prelude Page
(Kirkpatrick ms. no. 1820)





The first *Life Pulse Prelude* page represents a musical scenario of the "life pulse prelude," an initial sketch that gives valuable information about instrumentation and musical events.

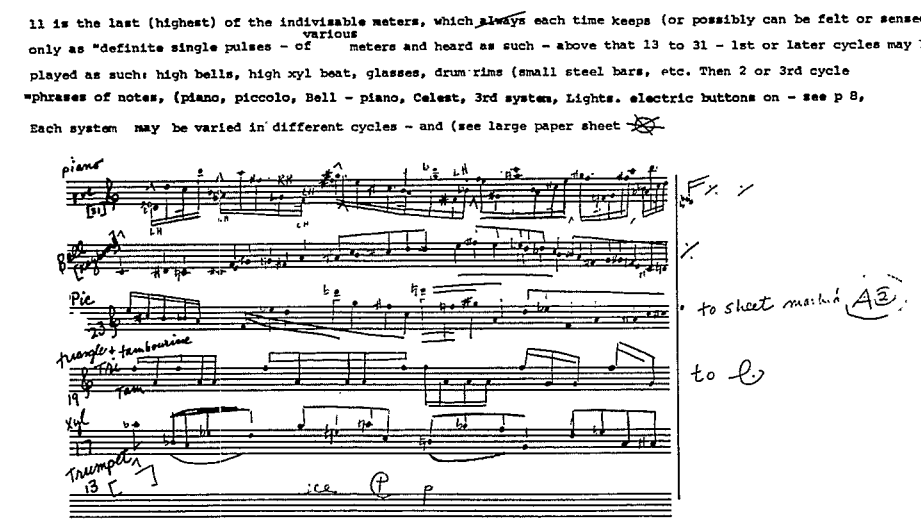
Form – "B.U." seems, on this page, logically to refer to a kind of "basic unit," a generative, cyclic time-span against which nineteen other meters form a complex of cross-rhythmic pulses,

creating what Ives referred to as "durational counterpoint" (Cowell 1955). "II only I.F.s [indivisible factors] The earth, heavens orchestra do not start until after 3rd or 4th percussion cycle" is an important reference to the order of the music to be played, substantiated on the fourth *Life Pulse Prelude* page, on *Universe Symphony* collection page 20, and, as a kind of poetic contradiction, curiously disputed on the 44th and final sketch page. "21 in the 2nd or 3rd Day" could refer to the 2nd or 3rd section, in turn a reference to the creation motif of the *Universe Symphony*. This first *Life Pulse Prelude* page, finally, seems more a formative scenario for the whole *Universe Symphony* than the definitive structural format: on the fourth *Life Pulse Prelude* page, as will be seen, the form is clearly defined.

Instrumentation – "A separate orchestra ..." of percussion including a piccolo obviates any question about Ives's conception in this work of what he meant as an "orchestra": for the *Universe Symphony*, it was most often a grouping of similar or related instruments.

Improvisation – "All these can vary in later cycles will be at players' discretion (keeping to his own beats)"...indicates here, as later, that Ives intended portions of the *Life Pulse Prelude* to be "free," improvised, in this case elaborating with syncopations and varied rhythmic figurations in accord with the players' assigned meter. Five other references to "free" playing are found on this page.

Second Life Pulse Prelude Page
(Kirkpatrick ms. no. 1821)



The second *Life Pulse Prelude* page is Ives's sketch of the "highest" five prime-number meters with music figuration and comments.

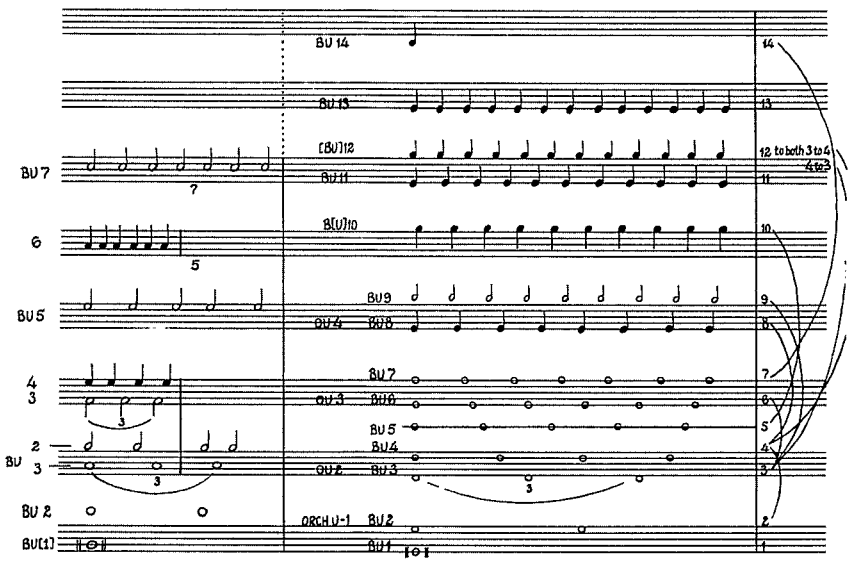
Tempo – The first definitive clue to the mystery of tempo in the *Life Pulse Prelude* and the *Universe Symphony* is found here. Ives felt that the "definitive single pulses" could be "heard as such" only up to 11/(B.U.×8 to 10 seconds). Above 11/8-10 seconds Ives declared that the pulses would sound more like rhythmic/melodic patterning than individually perceived metric pulses. For example, at a tempo much slower than ♩= 60 MM, or one beat per second, I theorize that one could, indeed, hear 13, 17, and 19, in

an eight-second measure, as fast metric pulses. Hence, about 40 to 80 MM seems the plausible tempo range, with 60 MM as the median.

Figuration – The sample here of "free," disjunct/conjunct figurations confirms Ives's feeling that these would not be felt as "single pulses." They are patterned rhythms and melodic sequences, not metric pulses.

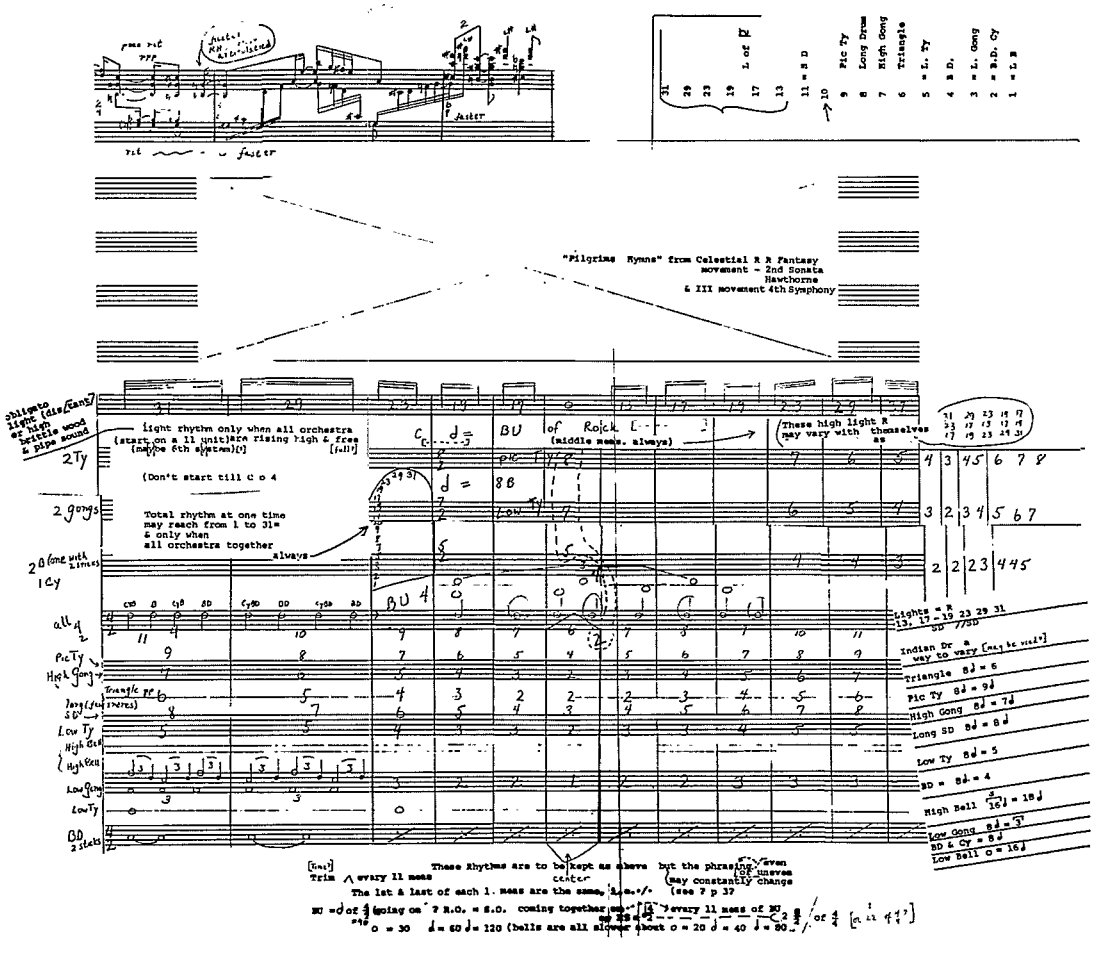
Instrumentation – "...(piano, piccolo, Bell-piano, celest [sic], 3rd system, Lights. electric buttons on – see page 8..." Here, "Lights" must, as it clearly does on pages 4 and 9, refer to delicate, "distant," "brittle," "high," "light," percussion such as triangles, orchestra bells, piano, wood and clay pipe sounds, celeste, etc. – not, of course, electric lights. The next words, "electric buttons on," certainly, at first, gives us pause to think that Ives's vision of the *Universe Symphony* might have included some kind of signal lights to keep the percussion parts in proper phase with one another and the "B.U." This, along with Cowell's observation that "the complex rhythms and timbral combinations in Ives's *Universe Symphony* are certainly much closer to possible realization on electrical instruments..." suggests that this sketch page could have, indeed, been created late in Ives's life, when such technology as metronomic lights was available for such an application (Cowell 1955). Is it only coincidence that Ives actually funded Leon Theremin, through Henry Cowell, to develop the Rhythmicon in the late '20s and reportedly heard a demonstration of this instrument which could accurately perform complex cross-rhythms, some of the smaller number combinations composed here for the *Life Pulse Prelude* (Mead 1978)?

Third Life Pulse Prelude Page
(Kirkpatrick ms. no. 1822)



Figuration – Here, Ives lays out, in graphic analog, the cross-metric patterning of the life pulse. Elapsed time equals spatial extensity. The sketch includes both prime number ("I.F.") meters and their related multiples.

Fourth Life Pulse Prelude Page
(Kirkpatrick ms. no. 1823)



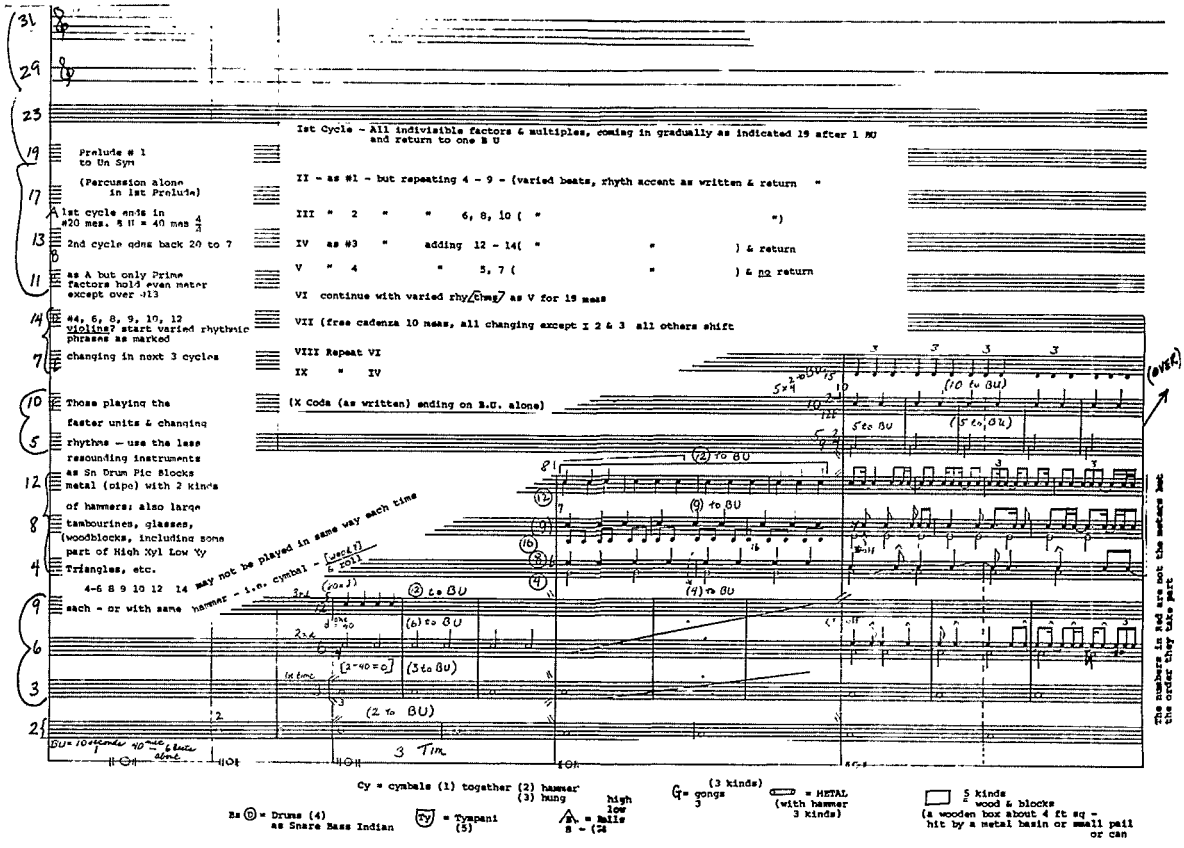
Figuration – This fourth *Life Pulse Prelude* page represents a sample realization of one-half cycle (11 measures – an "11 unit"), probably a later cycle (4th, 5th, or 6th), where instruments may "exchange" meters in palindromic sequence.

Tempo – There is, on this page, a wide range of information about tempo. Taking these considerations about tempo as well as all other metronomic or timing indications on all other sketch pages for the *Universe Symphony*, one finds the following range: ♩=30, 36, 40, 46, 48, 50, 53.3, 80, and even 120 MM. On this page, the tempo clues are " 𝅗𝅥=30, 𝅗𝅥.=60, ♩=120" and "better all slower about 𝅗𝅥=20, 𝅗𝅥.=40, ♩=80." Here ♩=80 MM seems to be what Ives settled on, though still seeming equivocal.

Instrumentation – Ives is definitive about certain percussion instruments he intends to use, calling for special instruments at the right of the page, terming six of them "light."

Improvisation – More references to improvisation appear: "...when all orchestra...are rising high and free..." or "...but the phrasing even or uneven may vary with themselves..."

Fifth Life Pulse Prelude Page
(Kirkpatrick ms. no. 1824)



Form – The fifth *Life Pulse Prelude* page represents the definitive structural format, not only for the *Life Pulse Prelude* percussion orchestra but, I maintain, for the entire *Universe Symphony*. We learn that a "cycle" is 40 measures of 4/4 or 20 of 4/2. The note that, "The numbers in red are...the order they take part," suggests that this and the two succeeding pages were considered the final form, so noted in red ink on the pencil manuscript at a later time.

Figuration – Did the syncopation rhythms emerging in measure 5 suggest 1) that Ives wanted, "as indicated," the "varied beats rhythmic accents" in the first cycle as well as succeeding cycles or 2) that Ives was realizing this half-cycle to suggest the style of the "changing rhythms" in later cycles? I think the second conclusion is correct.

Tempo – "B.U. = 10 seconds 40 *met* 6 beats about" is another tempo clue, but somehow misleading. If Ives meant the double whole-note to last 10 seconds, the metronome setting would actually be 48 MM, not 40 MM. What does "6 beats about..." mean, when 8 beats comprise the B.U.? Here, the apparent reference is to meter staves 3, 6, and 9, where Ives is indicating clearly that he wants ♩= 40, where there are six half-notes per full measure. If these six halves are to be performed at 40 MM and 12 quarters in 10 seconds at 80 MM, as clearly indicated,

then the *time* taken is not 10 seconds but actually 9! Since,

$$MM = BPM \times (60/TU)$$

where MM = metronome setting; BPM = beats per measure; and TU = number of seconds assigned each measure; then,

80 MM = 12 × (60sec/10sec) *is not correct*! Instead, it should be,

72 MM = 12 × (60/10), then,

80 MM = 12 × (60/9), which is much closer to 60 MM or 53.33 MM for the basic 4/2 meter, derived by

$$MM = 8\ BPM \times (60/9)$$
$$MM = 8 \times 6.66$$
$$MM = 53.33$$

Improvisation – "VII (free cadenza 10 meas, all changing except 1 2 & 3 all others shift)" is a clear reference to the fourth *Life Pulse Prelude* page, where a sample format of "shift" among the meters is shown. "Changing" and "shift" mean the same here, a strengthening of the concept of free improvisation Ives wants to achieve in the percussion orchestra. Whether each player works out the "shifts" on his own or coordinates them according to the fourth *Life Pulse Prelude* page is not revealed.

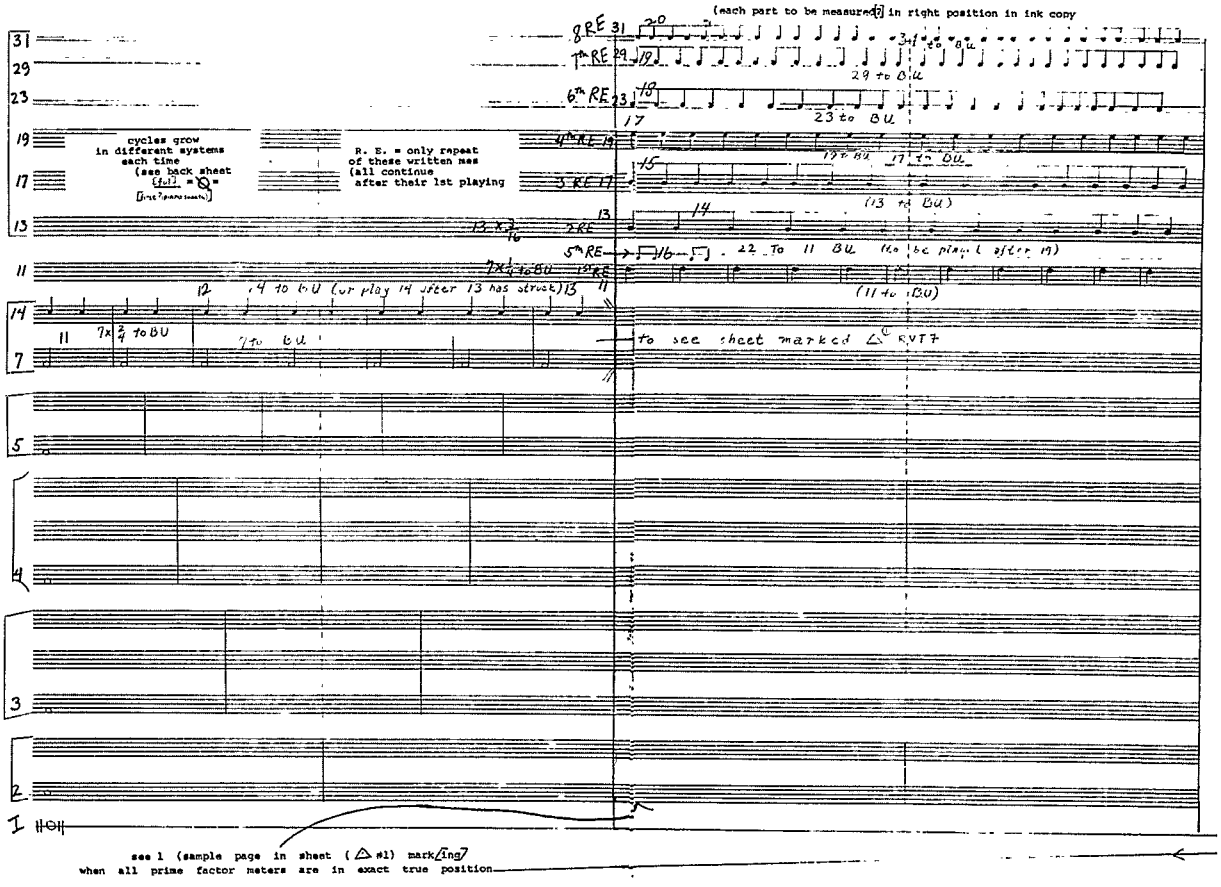
Form – Following is the structural plan, drawn from the information on life pulse cycles found on this page, with the B.U. metered in 4/2, where ♩= 30 MM:

Ives's Structural Plan for the Life Pulse Prelude

Cycle Number		Successive, Iterative Measures of Music	Total Measures
I:		1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2	20
II:		1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2	20
III:		1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2	20
IV:		1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2	20
V:		1,2,3,4,5,6,7,8,9,10,11 (with no retrograde)	11
VI:		"Varied rhythms" for 19 measures	19
VII:		"Free cadenza," improvisation for 10 measures	10
VIII:		"Continue varied rhythms for 19 measures"	19
IX:		1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2	20
X:	Coda	1,2,3,4,5,6,7,8,9,10,11,10,9,8,7,6,5,4,3,2,1	21
Total measures			180
Total seconds @ 8 seconds per measure			1440 seconds long

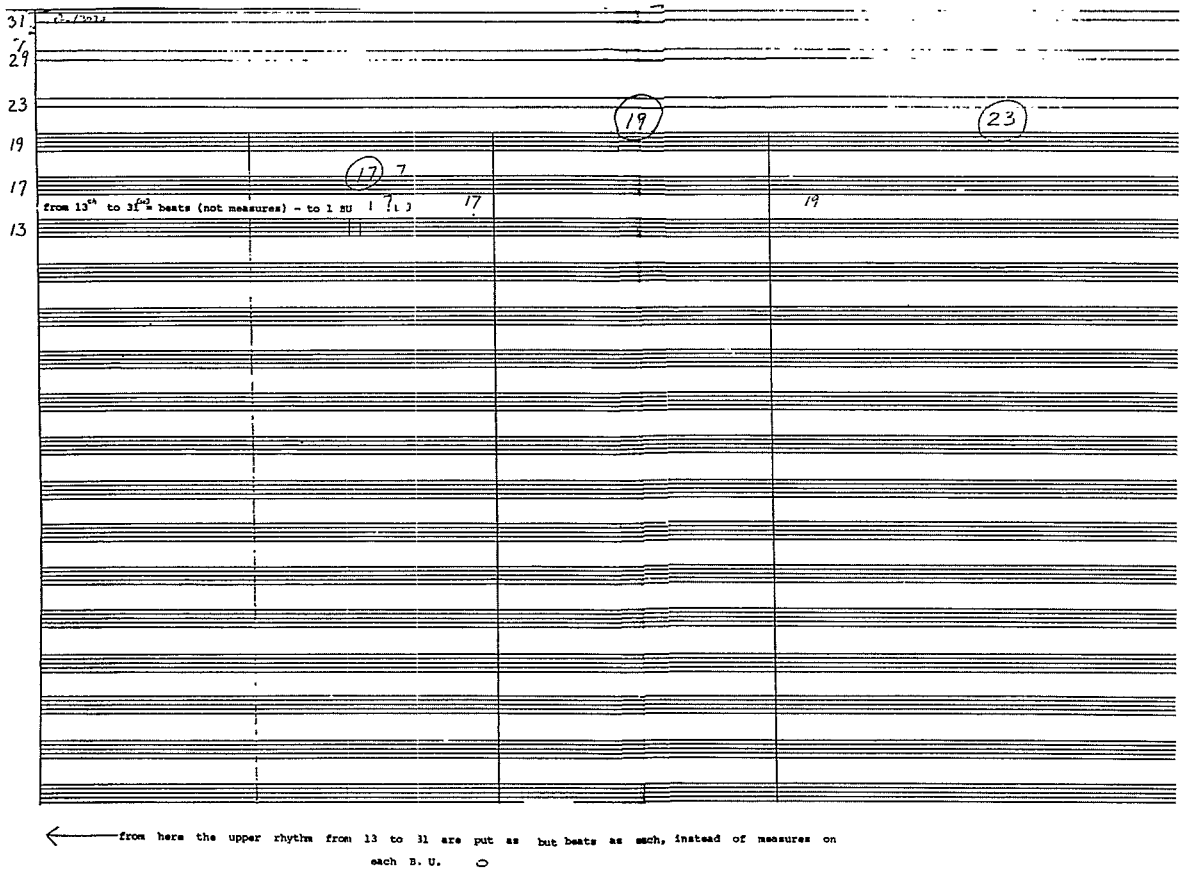
With this format, the total time for the *Life Pulse Prelude* is exactly 24 minutes, where the tempo is quarter-note = 60 MM. If a quarter-note were equal to 53.3 MM, the length would be 27 minutes. I have adopted the 24-minute length in my realization for two reasons: 1) nowhere in the sketches does Ives refer specifically to MM = 53.33, and 2) the metaphorical significance of the 24-hour day is, in such a transcendental work, inescapable.

Sixth Life Pulse Prelude Page
(Kirkpatrick ms. no. 1825)



Figuration – "(each part to be measured in right position in ink copy)" is not, I think, any passion for calligraphic exactness but more likely a need to see just how such complex rhythms appear to the eye. "13 × 3/16" must refer to 13 dotted eighths, performed in the time of 12 dotted eighths.

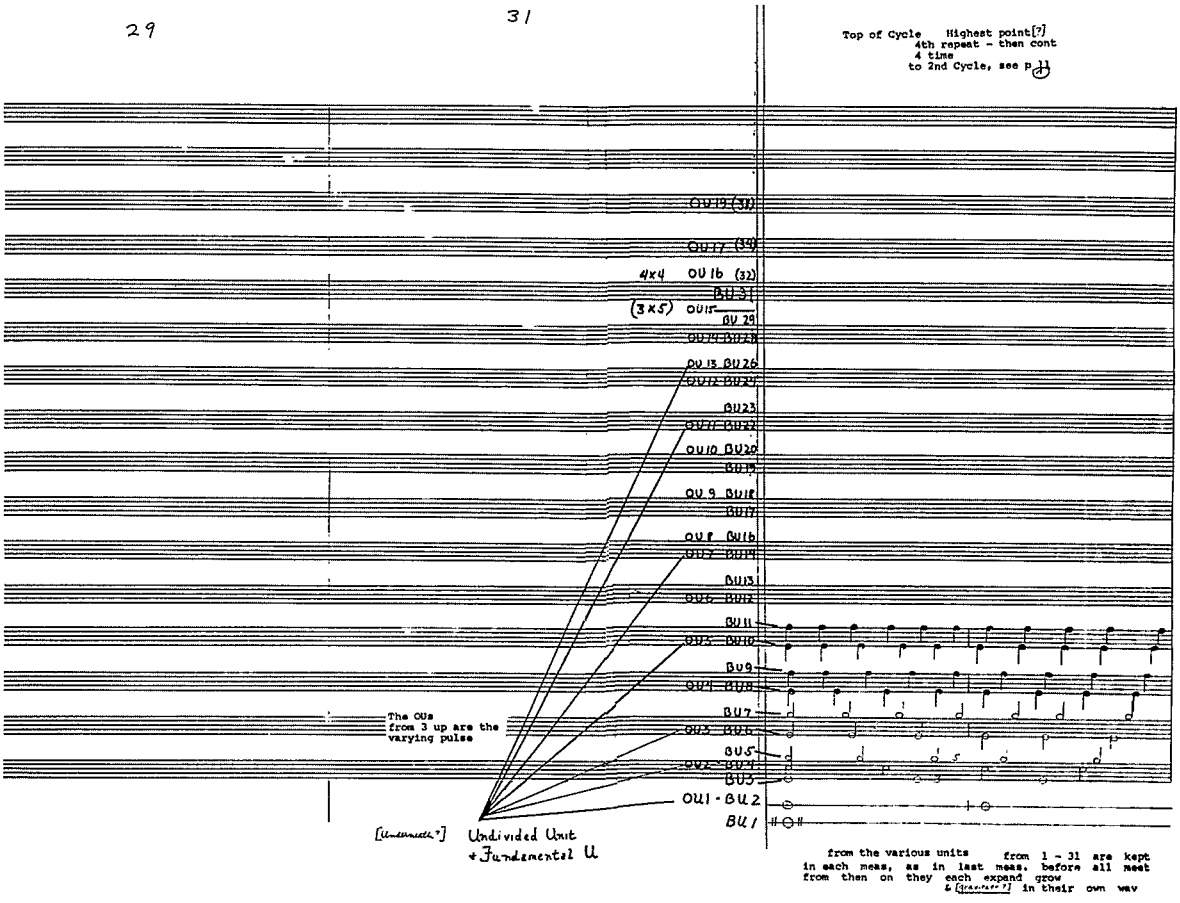
Seventh Life Pulse Prelude Page
(Kirkpatrick ms. no. 1826)



This page continues from page 6.

Tempo – Again, as on the fourth *Life Pulse Prelude* page, Ives feels that "the upper rhythms from 13 to 31..." are rhythmic figurations too fast to be perceived as single pulses, further substantiation of 60 MM or 53.33 MM as the nominal tempos.

Eighth Life Pulse Prelude Page
(Kirkpatrick ms. no. 1827)

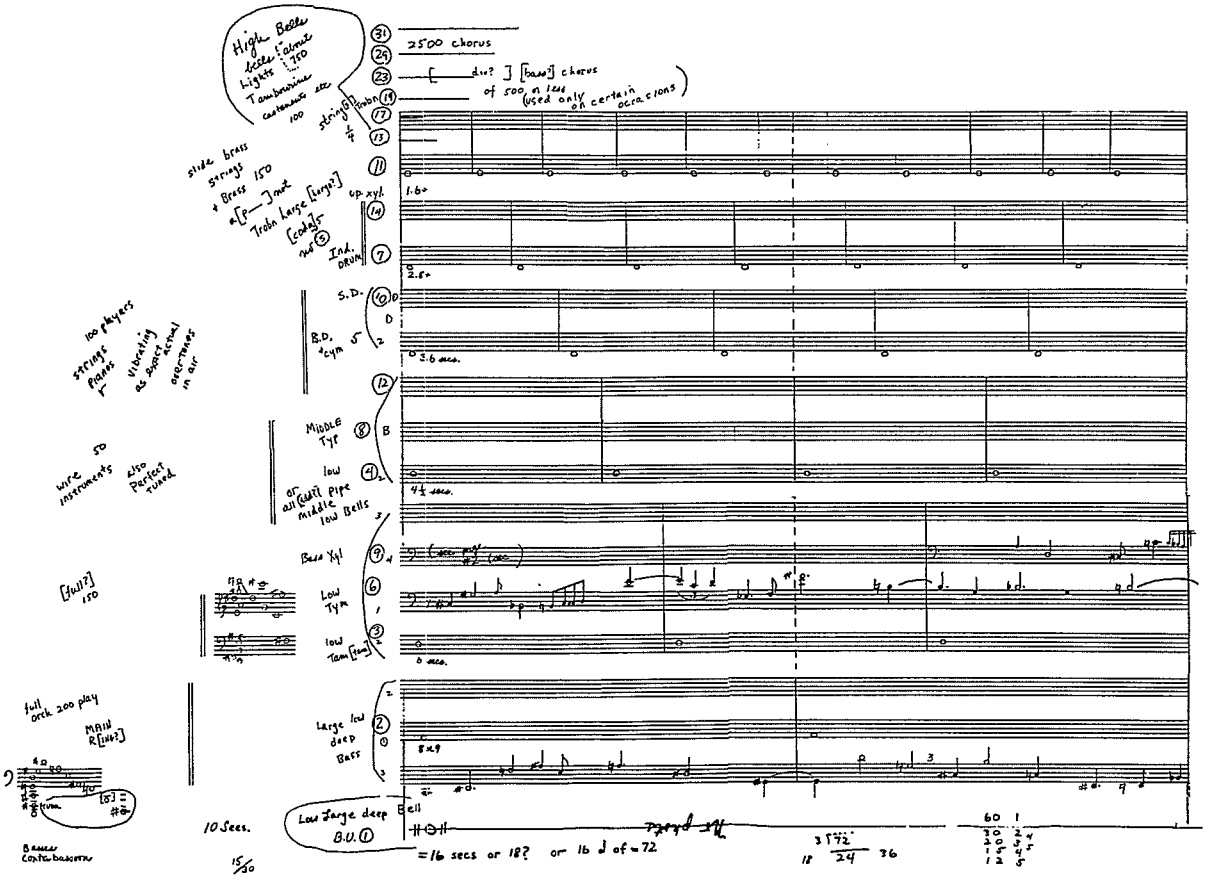


This page outlines the metrical relationship of the "B.U." to the percussion orchestra and the "O.U." ("orchestral units"?) to the Earth and Heavens orchestras.

Improvisation – Does "OUs" mean "orchestra units," the players "from 3 up" who "are varying pulse" representing yet another reference to improvisation? The statement "...from then on they each expand grow & create in their own way...", certainly refers to improvisation. Evidently, however, not everyone was free to improvise, since only prime number meters to 13, not their multiples, were designated as the "varying pulse." This seems in conflict with the fifth *Life Pulse Prelude* page, where "12" introduces a syncopation rhythm.

Tempo – "OU1" is definitely a reference to the relation of "orchestra unit 1" to "BU2," making the Earth and Heavens orchestras of section A twice the speed of the life pulse! Thus, it could be deduced that the anomalous metronome setting of "30 = ♩" found on Ives's page 1 of the full orchestra score could actually refer, correctly, to the life pulse percussion orchestra tempo, making the music of the Earth and Heavens orchestras actually ♩= 60 MM! I will show, however, that this is not the case.

Ninth Life Pulse Prelude Page
(Kirkpatrick ms. no. 1828)



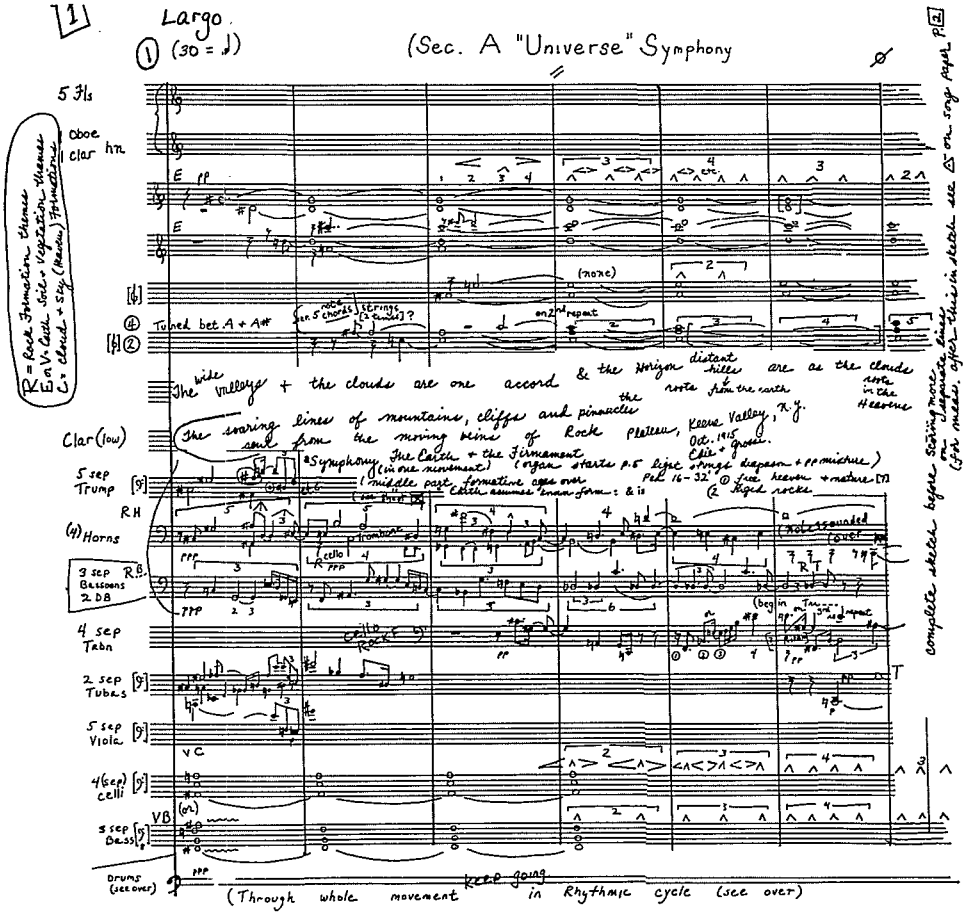
At what point did Ives cross out this entire sketch page? Evidently, subsequently composed music superceded this wide-ranging, formative draft. Helpful clues do appear, however, about the scope of orchestration and the tempo of the piece, and a try is made at an analog notation equivalence of the Earth theme and the B.U.

Tempo – The "10 Secs" notation is significant as a consideration, as well as the figures in the lower right corner, all multiples of 1, 2, 3, 4, and 5. Could "60 1" refer to 60 = ♩ and "30 2" refer to 30 = ♩? Ives's figuring of the MM for 18 seconds is not always precise, mathematically, since $11 \times 1.6 = 17.6$ seconds; $7 \times 2.5 = 17.5$ seconds; $5 \times 3.6 = 18$ seconds (right!); $6 \times 3 = 18$ and 2×8 or $9 = 16$ or 18 seconds.

Instrumentation – Ives calls for extremely large forces for the *Universe Symphony* on this page. If every number on the page is added, the musicians needed could number 4,520! A more likely notion is that each scribbled cluster of numbers and instruments/voices describes an instrumental or choral entity of like instru-

ments forming part of a much smaller number of musicians actually performing the *Universe Symphony*. This draft page may have been the outer limits of the *Universe Symphony* concept at some point, in the same "Christo spirit" as Cowell's report on Ives's intentions for the *Universe Symphony*: "Several different orchestras, with huge conclaves of singing men and women, are to be placed about in valleys, on hillsides, and on mountain tops..." or that Ives's *Universe Symphony* was to have had "...from 6 to 10 different orchestras placed on separate mountain tops, each moving in its own independent time orbit, and only meeting one another when their time cycles eclipsed..." Except for this page, to my knowledge, Ives nowhere indicates anything approaching the grand plan Cowell – or this page – claims for the *Universe Symphony* (Cowell 1955). In fact, these claims must indeed have kept many composers from seriously considering Ives's invitation in his memos that "...somebody might like to try to work out the idea..." (Kirkpatrick 1972). Subsequent, nearly complete score pages do not lend credence to the idea that Ives seriously required such large forces. I have calculated, based on a compilation of the different parts Ives refers to in all the *Universe Symphony* sketch pages, that about 214 instrumentalists are needed (close to "full orch 200 play") and, perhaps, 2500 in the chorus *or* 500. Adding 500 and 214 comes to 714 musicians, not so far from Ives's note on this page of "about 750." The trouble with this conclusion is, however, that no choral music sketches are extant for the *Universe Symphony*. In fact, except for the reference on this page, there probably never have been any choral sketches. Again, the concept of "orchestra," of course, clearly refers to orchestras of like instruments, rather than fully instrumented symphonic orchestras: 1) the percussion orchestra; 2) string orchestra A; 3) string orchestra B; 4) the low-strings, Earth-chord orchestra; 5) the band-like "Rock formation" orchestra of brass and winds; 6) 7) 8) 9) the four similar flute/violin/keyboard/percussion Heavens orchestras – a total of nine orchestras. Conceivably, these could very well be gathered in a large concert hall or cathedral, where an organ and pianos, referred to in the sketches, could be found.

Section A, Page 1
(Kirkpatrick, ms. no. 1830)



This is page 1 of the completely composed Section A, scored for the "Life Pulse orchestra," the "Earth and Rock Formation orchestras," and the "Heavens orchestras." Its study is important in understanding Ives's intentions for the *Life Pulse Prelude*, especially related to tempo and formal continuity.

Tempo – "Large 30 = ♩" seems unequivocal. Each four-beat measure on this page, according to this marking, should last eight seconds! The relation between the music of this page, using this tempo, and the *Life Pulse Prelude* percussion music preceding and accompanying it is, however, puzzling. This page and pages 2 and 3 that follow do present material that is formative, slowly evolving, and seemingly in accordance with the various tempi proposed for the *Life Pulse Prelude* in earlier sketches. The situation becomes difficult when one tries, at this extremely slow tempo, to perform the music of Ives's *Universe Symphony* page 4. If one keeps to 30 MM, the counter rhythms are so slow that the recurrent counter pulses, so necessary for musicians to execute the counter rhythms,

occur much too slowly for any degree of accuracy. At 60 MM, though, the rhythms are performable and, just as importantly, perceivable to the listener as a complex of counter meters, Ives's "durational counterpoint." Did Ives, then, intend at some later point to double the tempo? No such point is indicated in Section A. Are we left, then, either 1) to cope with a very slowly evolving Section A at 30 MM, 2) to believe instead that various tempos suggested on the fifth *Life Pulse Prelude* page (e.g., 53.33 MM) are more likely correct, 3) to ignore this marking as incorrect, or 4) to look for further tempo clues? I believe that the correct tempo is ♩=30 MM, not ♩=30 MM. I believe that Ives simply miscalculated his intention, especially since Ives's page 2 of Section A clearly indicates "30 – 40 = ♩ = BU." There is simply more evidence for the faster tempo.

Form – It is important here to refer to Ives's various musings in his memos about the combination of the Earth, Rock formation, Clouds and Life Pulse: "The pulse of the universe's life beat was by the percussion orchestra, who play their movement first, all through, before any of the other orchestras play...These two main groups (Earth and Heaven) come into relation harmonically only in cycles (how long? 16 seconds?) – that is, they go around their own (time) orbit, and come to meet each other only where their circles eclipse...I tried, for the percussion orchestra (Earth's motion and pulse)...(cosmic durations)" (Kirkpatrick 1972). This means that, while optionally separate, the percussion orchestra also served to provide the pulse and tempo for the Earth and Heaven orchestras. "Through whole movement keep going in rhythmic cycle ..." and, here, two staff lines are drawn as *part* of the combination Earth/Rocks/Heaven staff system! Here, too, the creation motif of the *Universe Symphony* is manifest: a) the changing, formative, turbulent nature of the rock formation themes, their irregularity; b) the elemental nature of the Earth chord, droning its cluster of fourths and tritones, occasionally swelling in counter rhythms to "soil and vegetation" chords, "their roots in the Heavens"; c) all the time with the primal "life pulse" of man. It is, indeed, a unique symphony expressing Ives's transcendentalistic vision of an ordered, timeless universe.

The Life Pulse Prelude Realization

The full realization of Charles Ives's *Life Pulse Prelude* has not been accomplished sooner by me or other composers for two reasons: 1) the *Life Pulse Prelude* cannot be performed with accuracy by human performers, unless some means is found to coordinate with precision the twenty different cross-rhythmic tempos and meters coming into phase every eight seconds; 2) the scope and requirements of the *Life Pulse Prelude* are formidable, even intimidating, and composers are not likely to take up the task, realistically, unless a performance of same is in the offing; and 3) not many composers relish the prospect of finishing another composer's piece, even if it is by Charles Ives. I took it up though, because Ives's ideas for the *Universe Symphony* so closely match my own compositional approach: I became Charles Ives's student.

This full realization of the *Life Pulse Prelude* in *live* performance grew from experience gained in two prior shorter versions for taped performance. The first, recorded in Florida in 1975, was accomplished by coordinating five performers with click cues generated by a PDP 11/10 computer, it in turn synchronized by a recorded 5000 Hz signal on a multi-channel tape machine, it in turn recording each of four recording passes, each pass a different combination of five meters/tempos/parts. It worked, but only two of the ten cycles could be realized, and, since my plan was to incorporate the "life pulse" percussion music in my first two fantasies on the *Universe Symphony*, I didn't feel all ten would work in taped performance. That was correct in hindsight: since hearing the full ten-cycle realization in live performance, a full-length taped version couldn't really capture its power and immediacy. The second, two-cycle realization was completed in 1981 in Texas, this time using a Synclavier II to create a very precise but still "non-immediate" synthetic percussion version recorded on tape. That version was used in the premiere performance of my *Phantasmagoria: Fantasies on Ives' Universe Symphony* for orchestra, narrator, tape (the "life pulse") and digital synthesizer.

In 1974, early in my transcription of the *Uni-*

verse Symphony, I sensed how important it was to work to realize the *Life Pulse Prelude*: such a project would yield valuable insights about the nature of the *Universe Symphony*. I started but found after I had written four cycles just how enormous the task had become. With no apparent performance possibilities for a completed *Life Pulse Prelude* and with deadlines for finished commissions impending, I set aside the *Life Pulse Prelude*, promising myself that I would take up the task again someday and finish it. The opportunity came in April, 1983, when, as a guest composer at the first North American Festival of New Music in Buffalo, I lectured on the *Universe Symphony* and discussed my work on the *Life Pulse Prelude*. Percussion virtuoso Jan Williams, one of the festival directors, was intrigued with the possibility, as I had proposed, that the legendary piece could actually be performed. We made a pact: I would complete the *Life Pulse Prelude* realization and create a 12-track cue-tape for the twenty performers; Jan would provide performers at SUNY Buffalo and present the premiere on the second North American Festival of New Music in April, 1984. Seventy-three years after Ives conceived the *Life Pulse Prelude*, it was heard with its full complement of performers and in its entirety for the first time. Note: Ives did organize a reading of a portion of the *Life Pulse Prelude* and stated in his memos that, "it sounded (with 8 players) better than I thought..." (Kirkpatrick 1972). The method I used in realizing the cycles was, perhaps, not unlike putting myself in the shoes of one of Ives's percussionists for that "reading." As I "played" each part, I carefully followed his instructions to create "varied rhythms," to create a "free cadenza," to "exchange" my metric rhythms with others, and all the time carrying out my singular role to preserve the integrity of my own unique tempo and meter specified for my part.

Instrumentation

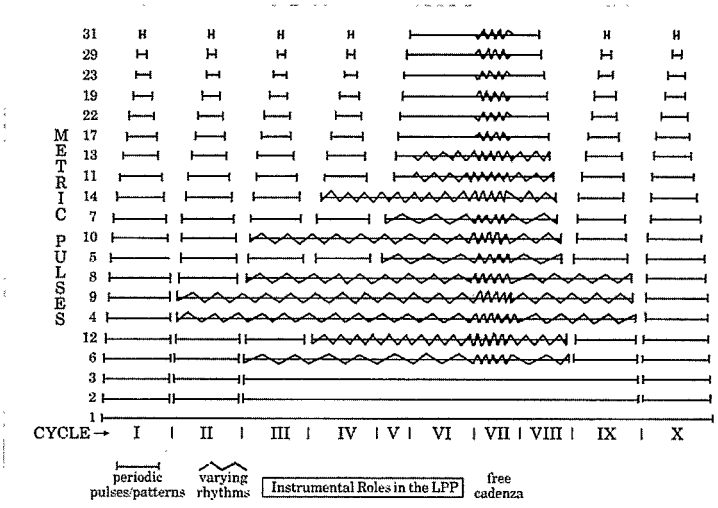
Below is the list of instruments selected from *Life Pulse Prelude* sketch pages 2, 4, and 5 with their individual tempo and meter for my realization of Ives's *Life Pulse Prelude* for modern performance:

Instrument(s)	Reference page(s) in *Life Pulse Prelude* sketches	Meter	Tempo (MM)
Piano	2	31/8	♪ = 232.5
Orchestra bells	2	29/8	♪ = 217.5
Piccolo	2	23/8	♪ = 172.5
Triangle/tambourine	2,5	19/8	♪ = 142.5
2nd Xylophone	2	17/8	♪ = 127.5
4 Ceramic bells (or cup gongs)	2,5	13/4	♩ = 97.5
5 Woodblocks (high to low)	5	22/8	♪ = 165.0
3rd Snare drum/tom-tom	4,5	11/4	♩ = 82.5
1st Xylophone	5	14/4	♩ = 105.0
Suspended cymbal/2nd tenor drum	4,5	7/2	𝅗𝅥 = 52.5
2nd Snare drum	4,5	10/4	♩ = 75.0
Bass drum, cymbal attached	4,5	5/2	𝅗𝅥 = 37.5
1st Snare drum (snares off)	4,5	12/4	♩ = 90.0
Marimba (for "piccolo tympanum")	4	9/2	𝅗𝅥 = 67.5
Tympanum (32")	4,5	6/2	𝅗𝅥 = 45.0
Tam-tam (or large gong)	4	3/1	𝅝 = 20.0
1st Tenor drum (for Indian drum)	4	8/4	♩ = 60.0
Low bell	4	4/2	𝅗𝅥 = 30.0
Large bass drum	4	2/1	𝅝 = 15.0
Large, low, deep, hanging bell	1,4,5	2/1	𝅝 = 15.0

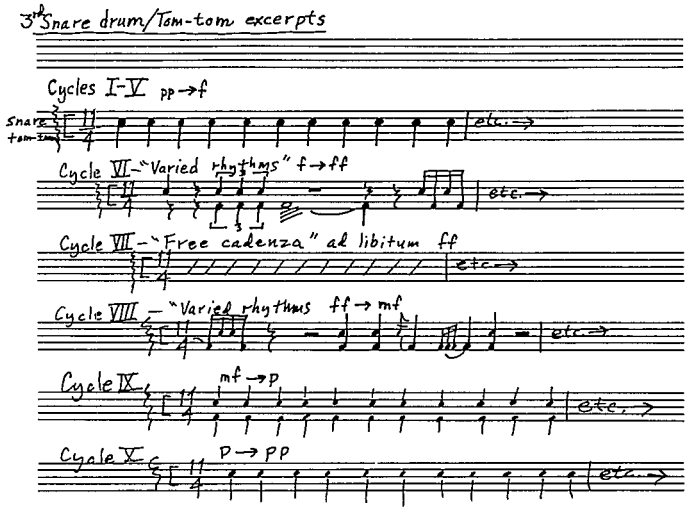
The instrumentation I have designated is subject to substitution and change, as future performances and experience with the *Life Pulse Prelude* may dictate. For instance, in the first performance Jan Williams and I agreed that the ceramic bells called for by Ives were much too "light" in such an ensemble with so many louder instruments. We chose temple cup gongs as optional instruments, still "light" but more penetrating than ceramic bells. My substitution of a marimba for the "pic ty" (piccolo tympanum) allowed an enhancement of the instrumental color spectrum, as well as a balancing foil to the large number of membranophones listed by Ives. As one studies the *Life Pulse Prelude* pages to determine if Ives had definitely settled on specific instrumentation, I am convinced that he hadn't and was keeping his options open, knowing he would want to experiment with different combinations in every performance situation. I recommend the same method for future performances.

Instrumental Roles in the Progress of the Life Pulse Prelude

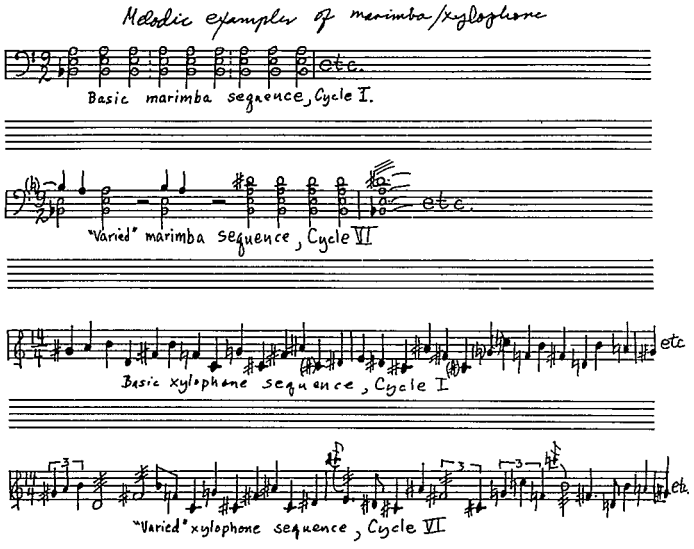
It is one thing to assign the instrumentation, another to determine the form, but to decide Ives's intent about the moment-to-moment progress of the *Life Pulse Prelude* must be left to a composer's instincts. There are, as I have pointed out, clues and models to help: 1) the palindrome form of the twenty-measure cycle Ives actually sketched on various *Life Pulse Prelude* pages; 2) the pyramid-like entrances, one by one, of the instruments, progressing from the slowest to the fastest pulses; 3) the references to the unchanging iterations of the melodic/rhythmic sequences of the instruments playing meters of 13 to 31 pulses, as well as the constancy of those playing 1, 2, and 3 pulses per measure; and 4) the varying rhythms of the remaining eleven performers, exchanging meters and improvising syncopated rhythms. All are extremely helpful, but the most important model for my work with the *Life Pulse Prelude* has always been Ives's metaphor for humanity's role on Earth: Man, the "life pulse" of the Universe, his birth, growth, and transcendence beyond death. I have taken this Man/Life metaphor and transposed it to the *Life Pulse Prelude*: through the first half of the ten cycles, the *Life Pulse Prelude* is born and slowly grows in intensity and complexity; through cycles VI, VII, and VIII, the "varied rhythms," the "free cadenza," and the return of "varied rhythms" create a dense, complex world of rhythmic/melodic/coloristic interaction; returning in the final two cycles to the simpler iterations of the first cycles, gradually attenuating until the low, deep, final toll of the hanging bell, alone, dies away. Below a chart depicts the overall progress of the piece through the ten cycles in relation to instrumental roles and activity:



As alluded on page 75, I have relied on my instincts as a composer to carry me through each of the thirteen "varying" parts: 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 17, 19, and 22. As each part progressed through the first half of the *Life Pulse Prelude*, rhythmic complexity was gradually increased, at its most complex or improvisational in cycles VI, VII, and VIII, gradually returning to the original patterns in the final two cycles. Three examples from each of these sections illustrate, below, this rhythmic progression:



Melodic sequences for two instrumental parts assigned to idiophones for meters 9/2 and 14/4 have been derived from pitch successions and combinations found in *Universe Symphony* sketches, specifically the pitches of the "Earth chord" and a series of pitches from *Universe Symphony* Kirkpatrick ms. no. 1829, a page full of pitch sequences and thematic fragments and chords. Below are examples of those parts:

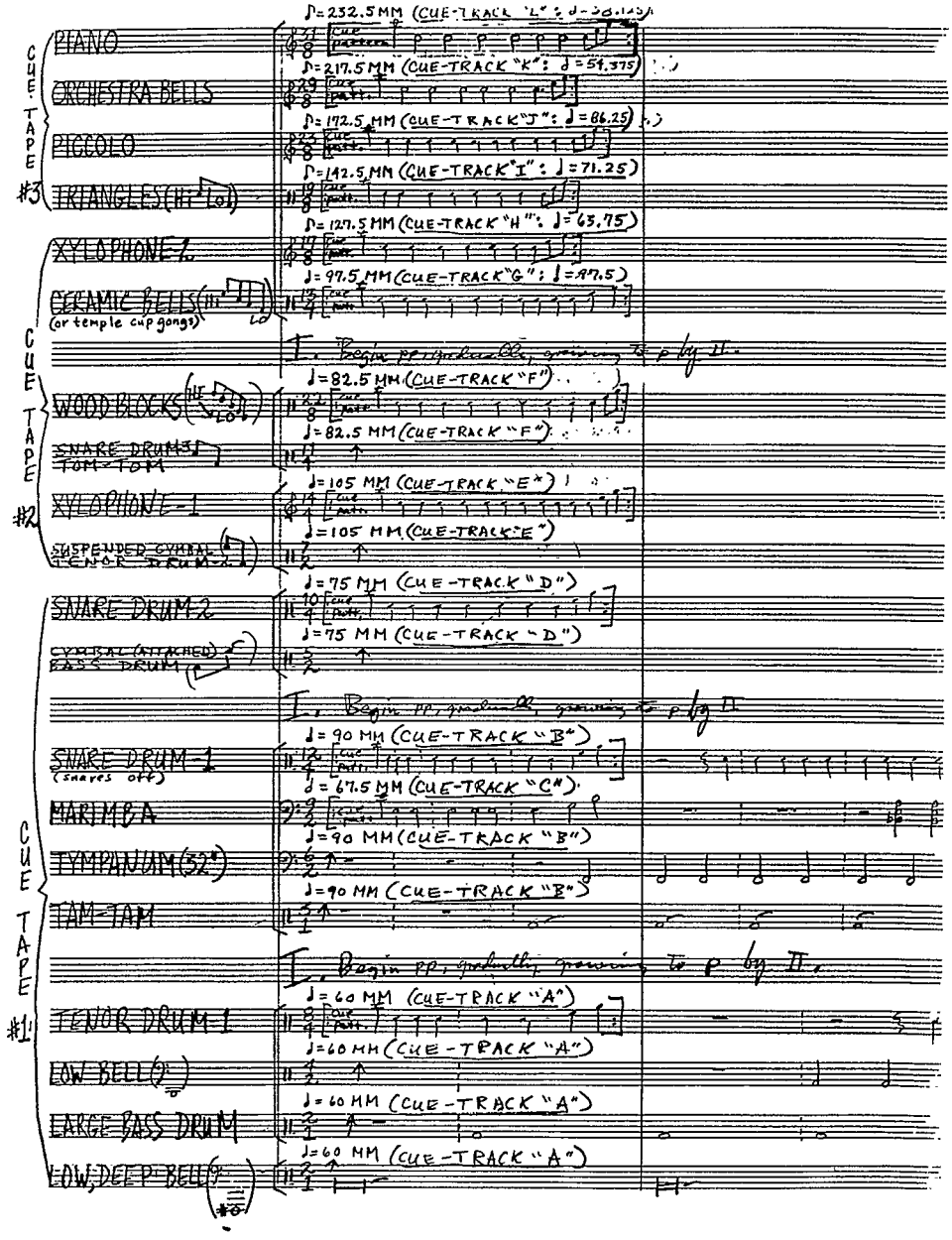


Synchronization

Aside from the logistics of providing headphones for twenty performers, each of whom must be able to hear the proper cue-track playback clearly, the technology of synchronizing the music of the *Life Pulse Prelude* has been available for the past ten years: a digital signal processor or synthesizer to generate the precisely timed pulses externally synchronized by and recorded on a 16-track tape machine used in live performance playback to the performers. In fact, the design and fabrication of a dedicated *Life Pulse Prelude* cuing device is underway utilizing standard microprocessor technology, to replace the 16-track tape machine in live performance.

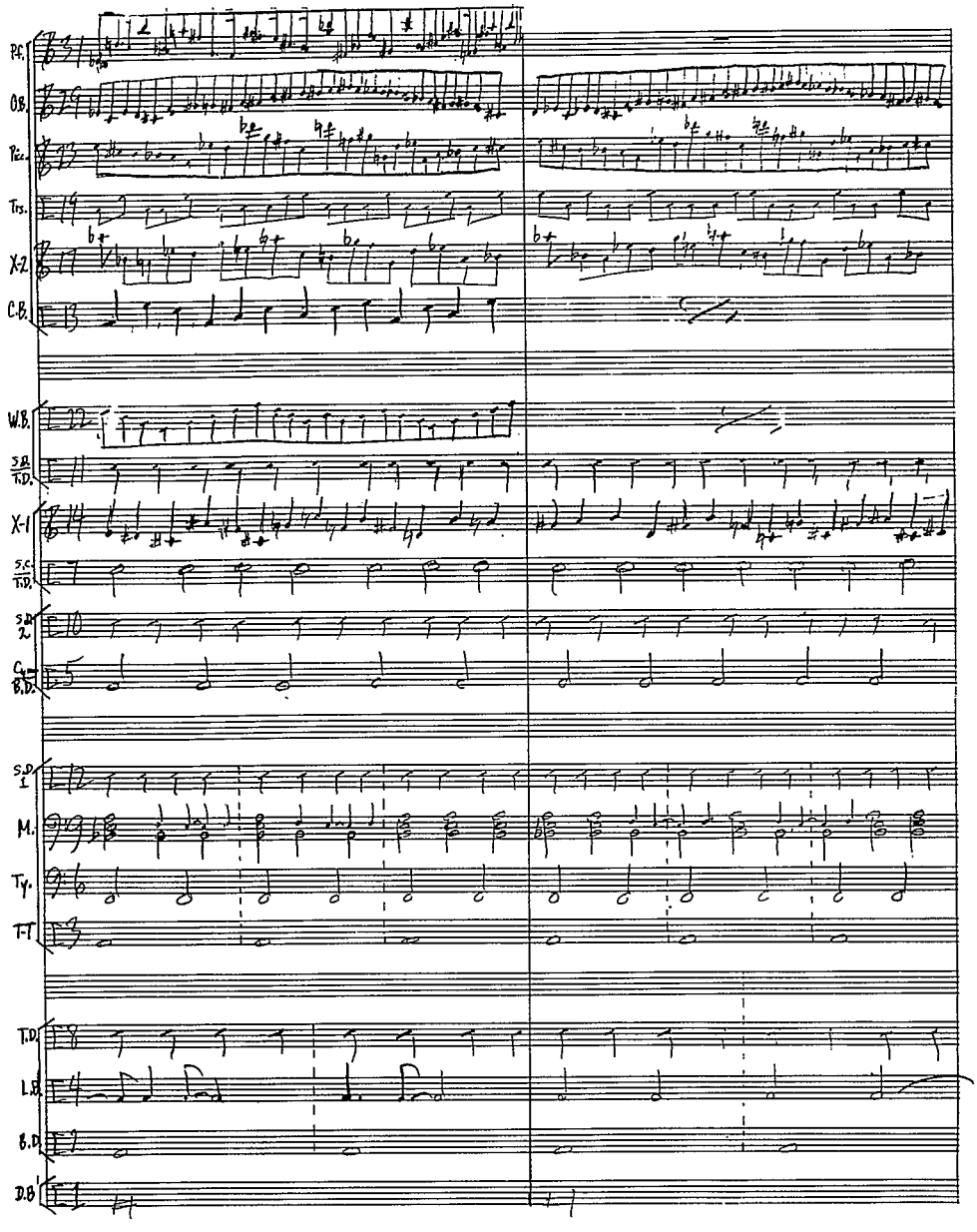
The first page of the *Life Pulse Prelude* realization score appears at right, showing the cue-pattern I developed for each part.

Twelve cue-patterns (A through L) are designated in brackets on each part; four performers follow cue-track A; three follow B; one follows C; two each follow D, E, and F; while the remaining six single performers follow prime numbers G through L. The cue-patterns worked well, incidentally, in the first performance. The only complaints from performers came from the type of headphone used: in the loudest cycles of the *Life Pulse Prelude*, those headphones that allow one to hear the "outside world" were unacceptable.


♪=232.5 MM (CUE-TRACK "L": ♩=58.125)
PIANO
♪=217.5 MM (CUE-TRACK "K": ♩=54.375)
ORCHESTRA BELLS
♪=172.5 MM (CUE-TRACK "J": ♩=86.25)
PICCOLO
♪=142.5 MM (CUE-TRACK "I": ♩=71.25)
TRIANGLES (Hi-Lo)
♪=127.5 MM (CUE-TRACK "H": ♩=63.75)
XYLOPHONE 1
♩=97.5 MM (CUE-TRACK "G": ♩=97.5)
CELESTE BELLS (or temple cup gongs)
CUE TAPE #3
Begin PP, gradually growing to p by II.
♩=82.5 MM (CUE-TRACK "F")
WOOD BLOCKS (Hi-Lo)
♩=82.5 MM (CUE-TRACK "F")
SNARE DRUM 3 TOM-TOM
♩=105 MM (CUE-TRACK "E")
XYLOPHONE 2
♩=105 MM (CUE-TRACK "E")
SUSPENDED CYMBAL TENOR DRUM 2
♩=75 MM (CUE-TRACK "D")
SNARE DRUM 2
♩=75 MM (CUE-TRACK "D")
CYMBAL (ATTACHED) BASS DRUM
CUE TAPE #2
Begin PP, gradually growing to p by II.
♩=90 MM (CUE-TRACK "B")
SNARE DRUM 1 (snares off)
♩=67.5 MM (CUE-TRACK "C")
MARIMBA
♩=90 MM (CUE-TRACK "B")
TYMPANI (32")
♩=90 MM (CUE-TRACK "B")
TAM-TAM
Begin PP, gradually growing to p by II.
♩=60 MM (CUE-TRACK "A")
TENOR DRUM 1
♩=60 MM (CUE-TRACK "A")
LOW BELL (D)
♩=60 MM (CUE-TRACK "A")
LARGE BASS DRUM
♩=60 MM (CUE-TRACK "A")
LOW, DEEP BELL (D)
CUE TAPE #1

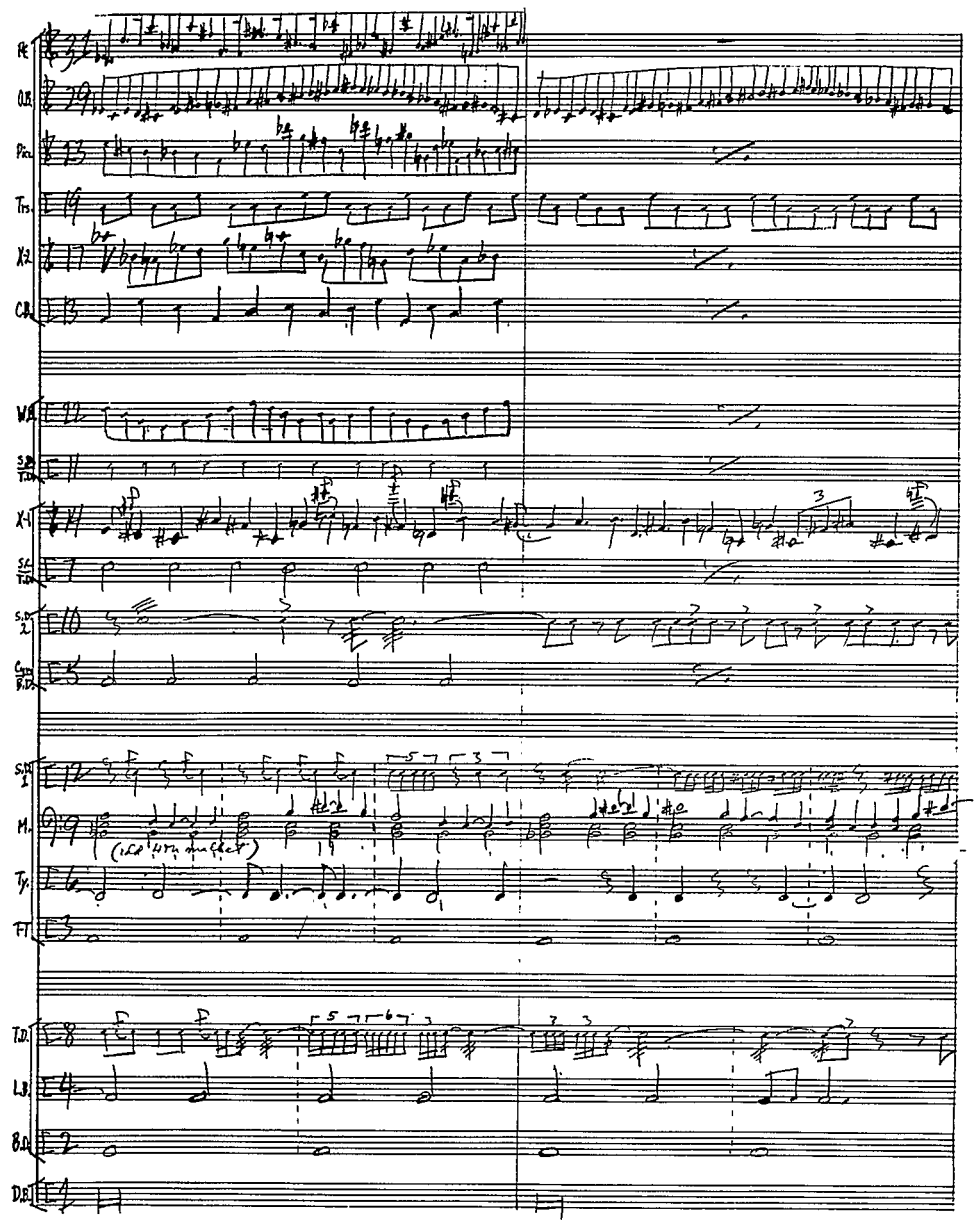
The Life Pulse Prelude Effect

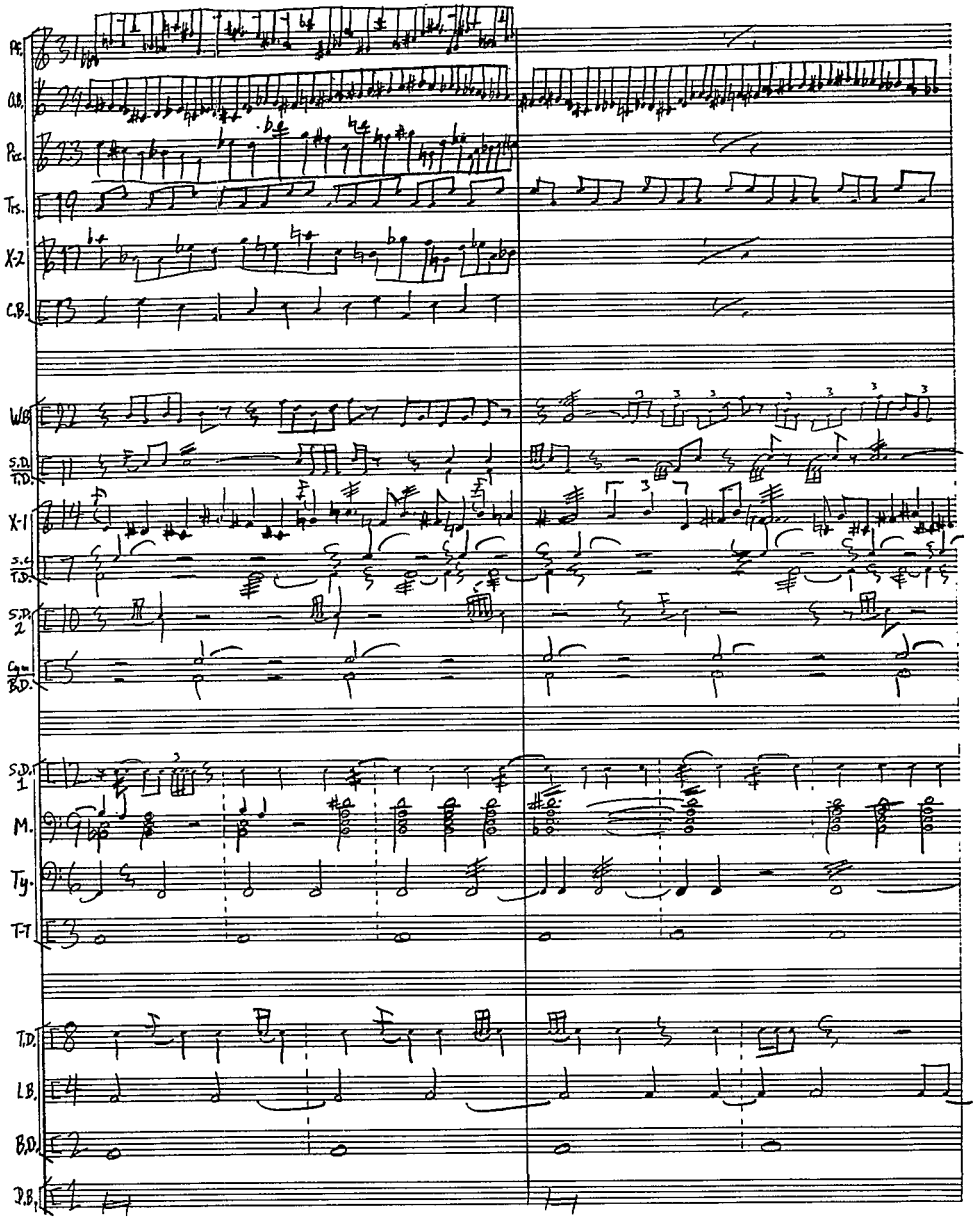
I believe that composers and percussionists have all, from time to time, experimented with the musical effect created by combining prime number pulses: e.g., clapping two-against-three or even three-against-five or several performers playing in different tempi coming into phase at some agreed-upon interval. Certainly, composers with access to computer music facilities have enjoyed the ease of exploration of such fascinating rhythmic complexes. Is the notion

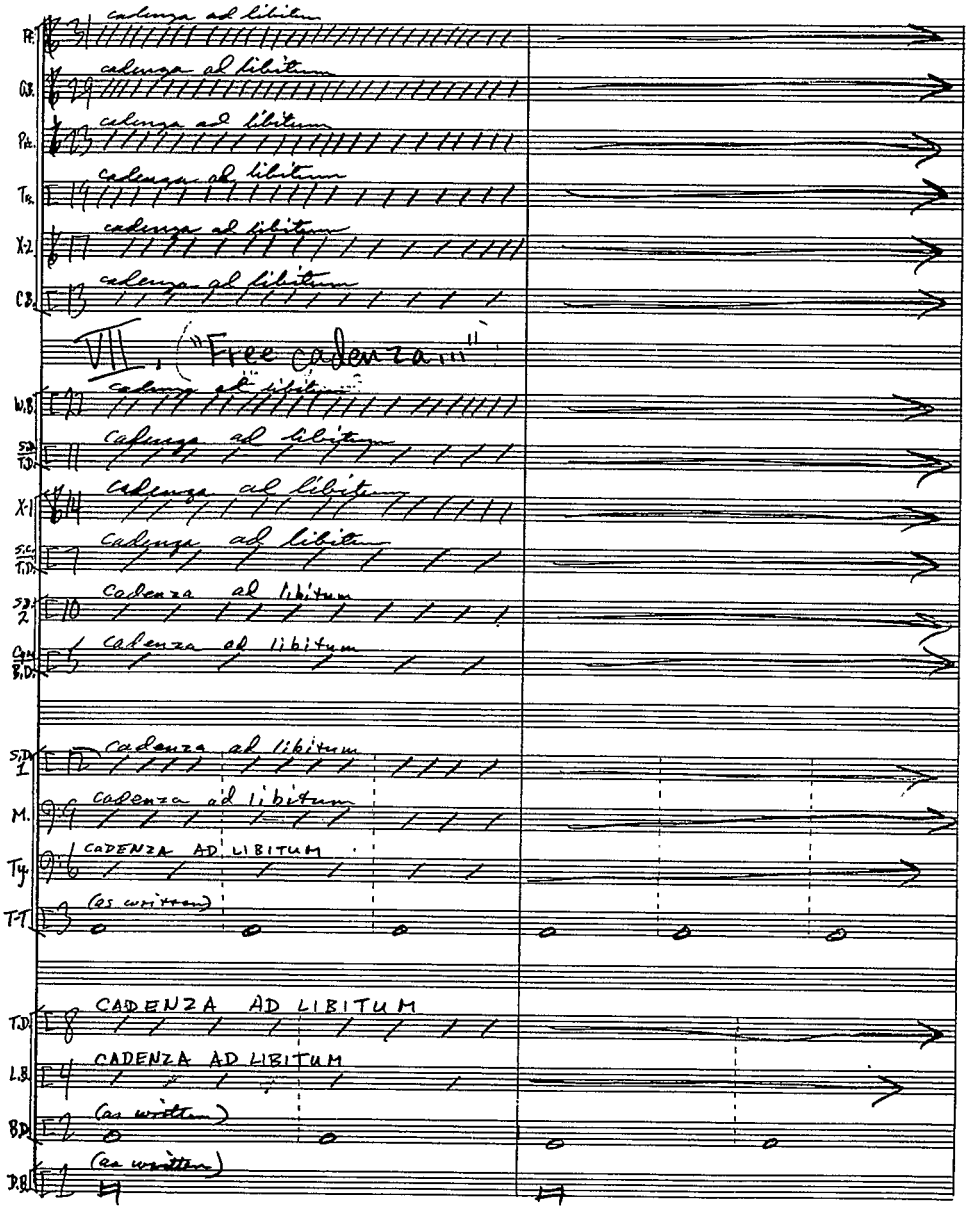


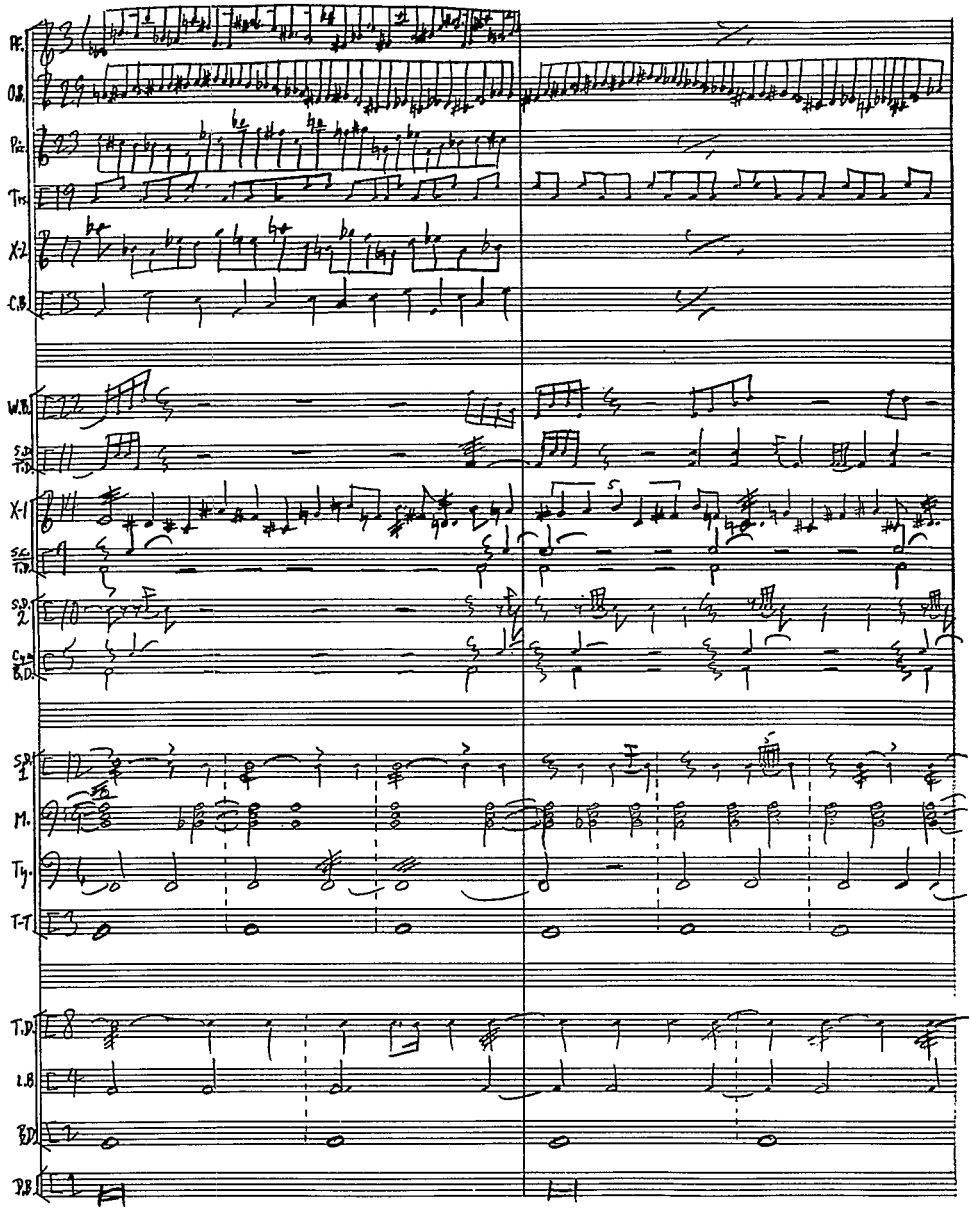
of combining 20 different meters and tempos, coming into phase every eight seconds, an elementary, even primitive idea? Yes. Was Ives really serious about this experiment? Yes. Is the musical effect of the *Life Pulse Prelude* special? Absolutely!

Finally, what I term "the *Life Pulse Prelude* effect" is: Ives's "durational counterpoint" *plus* sound-mass/pulsation-mass/event-mass/rhythm-mass/melody-mass *plus* the phenomenological synthesis of mesmerizing melodic/rhythmic iterations and an incessant improvisatory catharsis. It works. It does, indeed, seem like the life pulse of the Universe.




Fl.
Ob.
Pic.
Tbs.
X-2
C.B.
W.B.
S.D.
T.D.
X-1
S.D.
T.D.
S.D.
2
Gr.
B.D.
S.D.
1
M.
Ty.
T-T
T.D.
L.B.
B.D.
D.B.


cadenza ad libitum
VII. ("Free cadenza")
CADENZA AD LIBITUM
(as written)
CADENZA AD LIBITUM
(as written)
(as written)



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