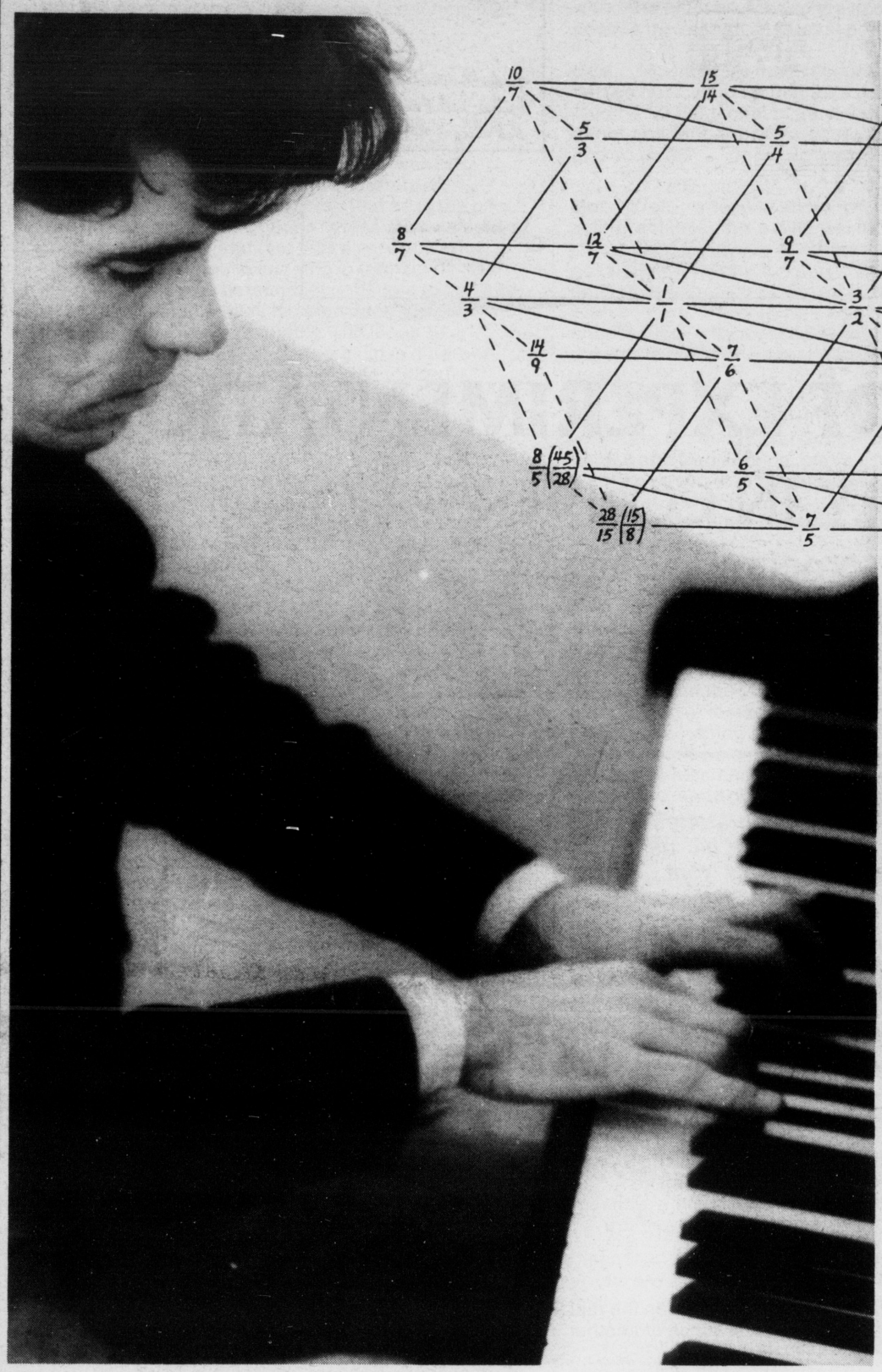
$2($6 WITH CASSETTE)

MUSICWORKS 27

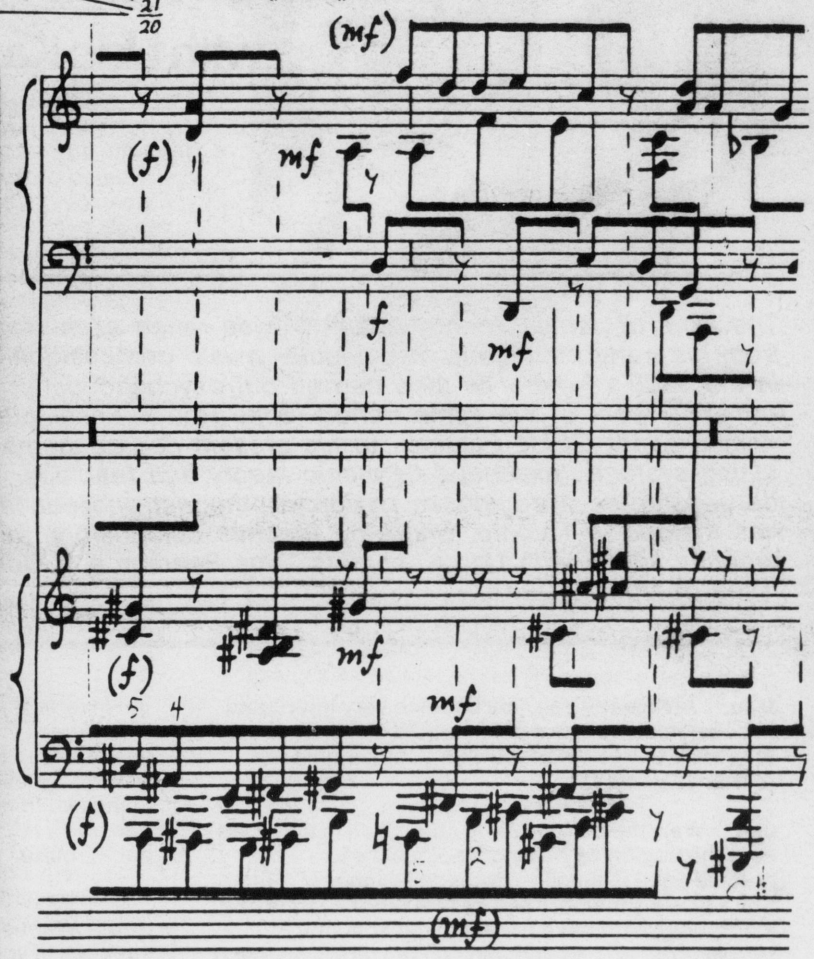


Schematic representation of the tuning for Bridge.

JAMES TENNEY

A Tradition of Experimentation
James Tenney in Conversation with Udo Kasemets and MUSICWORKS.

John Cage and the Theory of Harmony
by James Tenney



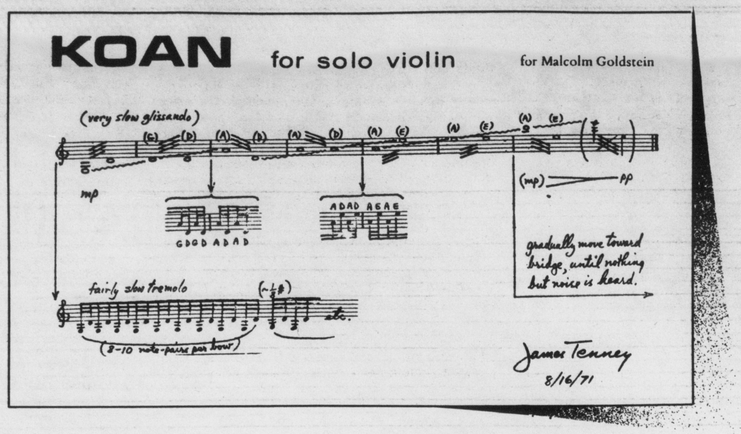
Excerpt from score to *Bridge*, for 2 pianos, 8 hands.

Spectral CANON for CONLON Nancarrow (1974)

This is a reproduction of a piano roll designed by James Tenney and hand-punched by Conlon Nancarrow (who has been composing for player piano since the 1940's). The piece is a canon in 24 voices; the point of entry of each voice and their successive rate of acceleration and deceleration being proportional to their harmonic ratios. The piece employs just intonation, where the player piano is tuned according to the harmonic series on low A (55 Hz.). A recording of **Spectral CANON** *appears on the MUSICWORKS 27 cassette.*

Spectral CANON for CONLON Nancarrow
James Tenney
1974

continued



(KOAN is a postcard piece.)

A TRADITION OF EXPERIMENTATION

JAMES TENNEY IN CONVERSATION

with Udo Kasemets and Musicworks

The work of James Tenney spans a wide range of musical investigation — from his early pioneering in computer music composition at Bell Laboratories in the 1960's (where he also carried out psychoacoustic research) and his performance work of the same period (Tone Roads Ensemble, Fluxus, New York Annual Avant Garde Festival) to his present-day concerns with alternative tuning systems, expanded harmonic theory and teaching. Tenney can equally be considered a composer, performer, theorist and educator. Since 1975, he has resided in Toronto, where he teaches composition at York University. He recently spoke with Udo Kasemets, Tina Pearson and Gordon Monahan for this issue of MUSICWORKS.

Udo: At an early age, you became very interested in science as well as music. I would like to know how these two things balanced with each other in the formative years.

Jim: Well, the curious thing about it all is that I can date the beginning of my conscious life to a very precise point in time — it was the summer of 1945. Somehow my memory before that is very vague and amorphous but I have a feeling that something turned on when I was eleven and the direction that it took was an interest in science, a kind of very hungry curiosity about the world. How that combined itself with music is a little bit hard to explain, but I was already involved with music in the way that kids get involved, you know, taking piano lessons, but it didn't mean too much to me. At around age 15, the music began to be more meaningful and from that time on I guess there's been nearly an equal interest in the two things, science and music — although I became a musician, science is always there in the background.

Udo: What do you consider have been the real influences of your life that in one sense or another have added questions to it?

Jim: Well the musical influences are easy to talk about. If you ask about influences on my **life** then it gets a little less clear because I start wondering what other names need to be there. But musically speaking, if I look at it chronologically in terms of my own work, the composers whose work has influenced my own in a way that was obvious to me were — Schoenberg, early Schoenberg, of Opus 11 or Opus 16[1] , not 12-tone Schoenberg; Webern, also early Webern, the Webern of the *Bagatelles*[2] ; Varese[3] ; Ruggles[4] and Cage[5] . I think that something of the work of all those composers can probably be heard in my own music of certain periods. There are some other influences that ought probably to be mentioned in there too. At a certain point, Xenakis[6] — this is the early 60's or late 50's actually - and Ives[7] , but that one has always been more difficult for me to pinpoint, more difficult for me to say, Ah, look here in this piece of music, do you see the connection with Ives? But it's been such a profound general influence that I can't leave out that name. The others that I mentioned are very specific in the ways they found expression in my own work. More recently one other name should come in here — Harry Partch[8] . But with Xenakis and Partch,as is often the case, it wasn't the stylistic aspects of the music, but the ideas of these people that influenced me.

Udo: I see that the people who you mention were the liberators of you at that time. When you talk about early Schoenberg, of Opus 11 and 16, you are talking about a person who took that chromatic romanticism apart and hadn't started to put it together yet into a kind of a system. And with the *Bagatelles* of Webern it was the same kind of thing. Ives was the greatest liberator of all times. Cage naturally is a liberator, and with Xenakis and Partch, it was again the same thing; it's not what they were doing in their music stylistically but that opening of these certain doors. But you see I have lots of arguments about what Schoenberg did later. Webern was the person who really created a revolution, that real liberation.

Jim: He's the one who separated the whole thing from its nineteenth century roots. He finally disconnected it in a way that Schoenberg was never able to do, never was interested in doing. He wanted to maintain the roots, and his personality was obviously more suited to that. And important as Webern has been and even given that he is the one who finally set us adrift, nevertheless, Schoenberg got us into the boat and that was a very powerful kind of achievement, wrenching in termsof his own history and his own personality — he had to pull and stretch and bend himself in some enormous ways to go as far as he went, beginning with Opus 11.

The way I see what Schoenberg did is different from how Schoenberg would have described it himself later. In fact, it's different from how he described it at the time. The break with tonality is the most obvious but not necessarily the most important aspect of say, Opus 11. What's important there for me is that I have the sense of listening to the sound for itself, more nearly for itself than seems to be possible in earlier music. The sound takes on a kind of tangible physical reality that it doesn't have in much nineteenth century music. And along with that, you notice that he's working with every parameter in a much more detailed and specific way. What that means to me is a focus on the sound and all the qualities of the sound, not just some kind of undercurrent of an effect that the sound is supposed to have on us, you know, or something that the sound is supposed to be expressing or making us feel. If you try to go by feeling when you're listening to Schoenberg, you're lost. My sense is that the attitude that is best and that is most appropriate for listening to that Schoenberg piece is precisely Cage's attitude about sound: Listen to the sounds for themselves. Now Schoenberg didn't see it that way. He interpreted what he was doing as this kind of super-expressivity, you know,something almost Freudian, getting into the subconscious and this hyper-intense expressive world. That's the way Schoenberg viewed it himself, so that when he got to the point of wanting to rationalize, to make more systematic what he had been doing for fifteen years, he was influenced by his own way of conceiving of it, his own conceptual framework which was that all of those things, all of those dynamic changes, those changes of phrase length, those different textures, all of that was expressive and as such, if it was expressive, you don't work that into a system. So all that was left was pitch. So his system only talks about pitch. We like to think that what he was doing was somehow systematizing, not just out of nothing, but systematizing on the basis of what he had been doing intuitively and spontaneously up until that point. But the way I see it is that when it came time to create a system, he left out of the system 90 per cent of what characterized that earlier music, which is really too bad, and it took later composers; Varese, Cage, and more recent ones, to see these things differently. Anyway, that's the way I see it and I can just rule out that whole expressive part and not worry about its Freudian implications and all the rest. To me, it's sound.

You see, all that nineteenth century music theory deals with is pitch. When Brahms was writing, the only thing that he was conceptualizing, the only theoretical handles he had on his music were from the theory of harmony. It didn't say anything about the other things; dynamics, timbre, rhythm, everything else. Those were 'expressive'. Schoenberg opened the door to another view of the various dimensions of sound, but he shut it again in his own work. But once he opened the door, it leaves things open to the rest of us, at least potentially.

Udo: Now that we have discussed Schoenberg for half an hour, why is it that 99.9 per cent of people including 99.9 per cent of musicians don't give a damn about Schoenberg, or Varese, or Ruggles, or Ives, and so forth?

Jim: Well, my feeling about it is that that music has a different meaning, a different function for us than music used to have — or different than it was at least possible to misconstrue music as having - and that most of us in most ways are still living in the 18th or 19th century. I think people want music to be entertaining — they want it to relax them and do a number of different things; it makes them have a feeling of status if they are at Roy Thompson Hall, or it may give them a sense of community if they're at a rock concert — it can do any number of things all of which are old things. But Schoenberg and Ives, Varese and Cage are not making music to serve that function anymore. It's a different function. I can't exactly say what I think it is, something that has to do with insight, understanding about our own perceptual processes, insight about our own possibilities.

Udo: Back again to where you started from, from what scientists are doing: the honest, really caring scientists are trying to understand life and different events in life, what they mean, how they come together, what life is about; and they try to use a certain kind of method. Like Fuller[9] says, do not believe in anything that you cannot verify through experience. Science really, essentially, is trying to find out what is. Only most science is put into a language and made dull, so that nobody can get into the little details about it. A genuine artist comes to grips with life as it is, poses questions into real experience in a situation, and does not use that other language for it. Now Fuller needed a language of his own to explain what he saw — a very complex language. But if you take a sentence of Fuller which tries to express what the universe or what synergetics is about, it really says it. Just like the clang of Jim Tenney says what it is, or a breath of Pauline Oliveros, or a thin wire of Alvin Lucier. All these things are saying the same thing that ought to be said or understood at that given time, in its total context.

Jim: I think we're all phenomenologists. The basic idea in phenomenology is making a more strenuous effort to see things as they are, depending on whatever one is focusing on. I think the best scientists and the best artists are precisely that — phenomenologists. We want to know, what is it . . . what is it really? By the way, I think it also needs to be said that not all scientists are of that kind, just as not all artists are. In the field of science, there's far too much of the kind of overspecialized work being done and no effort is being made to integrate results with other results or to find meanings in results and this I think is a dangerous aspect of modern culture. It's one of the things in our current ideas about the scientific method which have brought us to the brink of disaster — the very idea that you can have a science that totally separates itself from all questions of ethics and aesthetics. It's a Cartesian idea — it's 300, almost 400 years old, but we've got to grow out of it pretty fast, or we're not going to make it.

Udo: You are saying that the issues that ought to be considered are the issues of our time. If we talk about even Schoenberg, he's still of our time in a sense like Einstein is still of our time — they are of the same age. And Varese and Partch and Cage and Xenakis are all talking about a completely new social and learning situation that we have never had before.

Jim: Right. Let's go back to your question about Schoenberg. Why aren't people interested in Schoenberg? Because there's something in the human make-up that can't stand too much challenge, can't stand too much hard work mentally or spiritually. All of us, myself included — I recognize when I reach my limit on a given day or given hour or given week. I have to go to sleep, either literally or figuratively. This is a natural human thing and it's not something to berate other people for, How can you be so lazy? It's something to be understood but not to be swept under the rug.

Arnold Schoenberg.

Udo: I find that a most ridiculous thing in our time is this big deal about pushing all our **physical** limits, getting so many home runs or so many gold scores or getting muscles of the kind that Arnold Schwarzenegger has . . . Why should anybody be afraid to try to think and use your brain, and push that? Is it so great an honour to carry physical, menial tasks when you have a mind which you don't want to push to any kind of limit, which you want to leave just floating there in a very easy, casual way?

But back to my question — it's not so much why don't people want to think about Schoenberg, it's why would MUSICWORKS readers care about what you and I think about Schoenberg?

Jim: MUSICWORKS readers care about something. They care about what's going on now, and they are, like everybody, worried about the world. Now it would be presumptuous to presume that we are going to solve some of these problems of the world. I do think that there are connections that can be made though, and we can point to some connections without necessarily having the answers. But even looking at those relationships may help us to find some answers.

1. **Arnold Schoenberg** (1874-1954). Opus 11 (*Three Piano Pieces*) and Opus 16 (*Five Orchestral Pieces*) were written in 1908 and 1909. They mark a turning point in his compositional technique where he clearly leaves behind the tonal system of Late Romanticism in favour of organizational methods that would eventually develop into his twelve-tone system, first realized in Opus 23 (*Five Piano Pieces*) of 1923.

2. **Anton Webern** (1883-1945). A student and associate of Schoenberg's, Webern developed a style of writing concise and sparse pieces that integrated and developed Schoenberg's theory to include a logic of intervallic relationships. This sense of organization would eventually develop into what is known as 'serialism', and his rnusic would so influence later composers (eg. Stockhausen and Boulez) that the 1950's came to be known as the 'post-Webern' period.

3. **Edgard Varese**(1883-1965). Varese's music is primarily based on sound texture and timbre, as well rhythm. He described his composition *Espaces* as 'a shifting play of planes, volumes and masses in space.' He was one of the first western composers to write exclusively for percussion and to use electronic media and tape in music. Early on, he envisioned the new technology of the 20th century as giving composers the ability to realize any and all sounds.

4. **Carl Ruggles** (1876-1971). An American composer noted for his unique style of highly dissonant yet melodically expressive polyphony.

5. **John Cage** (1912-). In his early work he concentrated on writing for percussion ensemble, and in the late 1930's he discovered the prepared piano for which he wrote extensively. He has written many works for modern dance and multi-media performances in collaboration with Merce Cunningham, David Tudor and others. Since 1951, he has exclusively employed chance methods and indeterminacy in his compositional technique. Over the last ten years, he has concerned himself with writing pieces demanding extreme virtuosic technique and discipline.

6. **Iannis Xenakis** (1922-). His music embodies the concept of 'stochastics', where he employs various theories of probabilities and scientific laws, sometimes with the aid of a computer, to calculate the parameters of musical events such as glissandos, densities of 'clouds' of sonorities, and associations between 'points' of sound in space.

7. **Charles Ives** (1874-1954). He began his early music education with his father, who was a band leader with a tendency toward musical experimentation (it was he who conceived of music in quarter tones — later realized by Charles in a set of pieces for two pianos tuned a quarter tone apart). Ives composed for most of his life in artistic isolation, writing prolifically in a truly experimental manner but rarely hearing his music performed. His work can be characterized as being sometimes atonal, and often polytonal and polyrhythmic, where, for instance, different groups of the orchestra might be organized independently of each other in terms of rhythm, sonority and key.

8. **Harry Partch** (1901-1972). A self-educated musical philosopher, theorist and instrument builder. His work employs the use of 'just intonation' (a tuning system where each note of a scale is tuned to an harmonic of a common fundamental tone) for which he built or adapted many percussion and string instruments.

9. **Buckminster Fuller** (1895-1982). A scientist, philosopher and inventor who expounded the principle of synergy (understanding the behavior of whole systems).

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"We're not going to be able to get into the 21st century until we assimilate the tradition or heritage of the 20th century." -J.T.

Udo: I looked up the word 'tradition' in the dictionary — it means delivering, it means trading, it has to do with all these kinds of things. The tradition of experimentation in the twentieth century . . . the tradition of honesty — you see that tradition is really not related to some kind of lingering dogma of past rules or something like that. Tradition is something that has to do with quality.

> **tra-di-tion** (trə-dish'ən) *n.* **1** The transmission of knowledge, opinions, doctrines, customs, practices, etc., from generation to generation, originally by word of mouth and by example. **2** That which is so transmitted; a body of beliefs and usages handed down from generation to generation; also, any particular story, belief, or usage so handed down; hence, remembrance, or recollection existing as by transmission. **3** That body of Christian doctrine, handed down through successive generations and held by some churches to belong to the deposit of faith, even if it may not be found in the Holy Scripture. **4** Among the Jews, an unwritten code said to have been revealed to Moses on Mount Sinai at the time of the delivery of the Decalog and handed down through the oral teaching of prophets and doctors of the law. **5** The record of the acts and utterances of Mohammed, known as the *Sunna*, which, forming no part of the Koran, was formerly communicated only by verbal utterance from father to son. **6** In literature, the drama, and the fine arts, the accumulated knowledge, taste, and experience handed down from one generation of writers, actors, or artists to another; the historic conceptions and usages of a school, collectively, or any one such conception or usage: the *traditions* of the stage. **7** A custom so long continued that it has almost the force of a law. **8** *Law* Delivery of possession. [<OF *tradicion* <L *traditio, -onis* a delivery, surrender < *traditus*, pp. of *tradere* deliver < *trans-* across + *dare* give. Doublet of TREASON.] **—tra-di'tion-er, tra-di'tion-ist** *n.*
>
> *(Funk and Wagnall's)*

Jim: I have a notion in relation to tradition in the 20th century. I frequently find myself calling it permission. My sense of the stimulus that comes from the important work done in the past is that it in effect gives all of us permission. Obviously it shows us new possibilities, but of course for that to become a meaningful thing we have to see something valid or interesting or you have to see the quality of what was done. Somebody can do something strange and new and presumably it's not always going to strike us as having quality. But the more examples that we have of a given kind of thing, to become familiar with or to compare with each other, the sharper our perception can become about that thing, and so the clearer an idea we might have about what quality is. It's very hard to make judgments until we've had more experience, which means that we've learned to make distinctions

But back to tradition — we're not going to be able to get into the 21st century until we assimilate the tradition or the heritage of the 20th century. So we may not get into the 21st century until a hundred years late, but we have the possibility of actually getting into it sixteen years from now.

It used to be that the problem of tradition was being stuck with the dogmas. To some extent, that still exists but we also have the problem of misconceiving ourselves as having no tradition.

Tina: What are the characteristics of being stuck with a dogma in music?

Jim: Well, ideas about the relationship between the composer and his work - the dogma that the composer must determine everything that happens in his piece, for example, the dogma that Cage's revolution throws into question. It's a very deep-seated notion. One of the big things that frightened people was not *The Music of Changes*[10] — nobody would have gotten upset about *The Music of Changes* if Cage had lied about how he wrote it. If he had said, well here's a new piece and I just wrote this piece, period, nobody would have been upset. But what he said, and what upset people, was virtually, this piece wrote itself, or, I just discovered this piece, I didn't sit at the piano and sort of 'get' every next sound. That's what upset people because they're so attached to the romantic conception of how the artist works, that somehow every minute next decision comes out of himself in a way.

But I also see another problem, particularly here in Canada, and that is, really setting one's self adrift, not recognizing a tradition, refusing to accept the tremendous things that are available, right at hand, in the immediate past and in the present and valuing them and trying to build on them. I thought it was incredible that 1983 went by with not a single event in Toronto that I was aware of celebrating the 100th birthdays of Anton Webern and Edgar Varese. It's as though either nobody was aware of it, which is a problem of another sort, or, in spite of being aware of it, nobody felt stimulated by that to do something about it.

Tina: Well people would ask, why would we want to do that? We're in Canada, you know, and it's 1983.

Jim: Right. But the year before, 1982, there was at least one concert celebrating the 100th birthday of Stravinsky. So Stravinsky somehow made it through that filter. And what about Canada's own earlier innovators? Colin McPhee, Pierre Mercure, Henry Brant, for example. Why isn't their music played here more often? And still Beethoven is played a 100 times more than Schoenberg or Varese or any of these composers. My first response to that is to say, that is perverse! If Beethoven were living now, you know, Beethoven comes in a time machine and he takes a look at what is happening in the 20th century. He knows it's going to be different but obviously, in large things he'll expect certain parallels. He'll say, in my time, they played all my music. What's the matter with these people that they don't play the music of their *own* century?!

The thing is to really understand that we can't just berate people, because people are just doing their best, whatever it is, they're just doing whatever they do. People in the 19th century just did whatever they did — they played Beethoven for probably not great motives, even. So now they're **not** playing Schoenberg for not great motives and we won't solve the problem by attacking them but by trying to figure why this is happening. And I think it's happening because the music is too challenging. It's deeply challenging, not just in a matter of style that after a little while you get used to it, then you can enjoy. You never **enjoy** Schoenberg the same way — nobody is ever going to feel really like sitting back and **enjoying** listening to a piece of Schoenberg the way we can do with Brahms. It will never become Muzak!

> **ex-per-i-ment** (ik-sper'ə-mənt) *n.* **1** An act or operation designed to discover, test, or illustrate a truth, principle, or effect; a test, especially one intended to confirm or disprove something which is still in doubt. **2** The conducting of such operations or tests. **3** Something undergoing the test of actual experience, as opposed to that whose practicability or usefulness has been fully demonstrated: often used depreciatively: Your boasted institutions are but an *experiment*. **4** *Obs.* Experience. **—** *v.i.* (-ment) To make experiments; make a test or trial. [<OF <L *experimentum* < *experiri* try out] **— ex-per'i-ment'er** *n.*
>
> *(Funk and Wagnall's)*

Let me propose another idea here as a way into this. Since, let's say, Monteverdi, since about 1600 or the early 17th century, the models for music have all been very human models; they've been rhetorical, dramatic, emotional or psychological. If music can be even construed to be **about** something, what it's been about is the human condition; how do we feel, how do we think, how do we operate. Before that, that was not the case — music was about something outside of the human condition; it was about God, it was about the universe, it was about something else. In the 20th century, a great deal of the music is again about something outside of the human experience, the human condition. In Udo's pieces, the models are astronomical. They're only models for something, but he discovers and/or creates a sort of isomorphic relation between one thing and a piece of music. The thing that he's starting with isn't how he feels, or what he thinks or how **we** feel or think, it's something he's looking at outside of us and that's a very interesting thing that's happened in the 20th century. We've got Varese's *Ionisation*, which is about electrons and atoms, and Ives' *Universe Symphony*. Only occasionally does this show itself in the titles, but sometimes it does. Now, the music that tends to still be the standard repertoire is the music from that period in which the model for music was the human condition. The interesting, curious thing is that it's not just contemporary music people don't listen to, they don't listen to medieval music either. Nobody listens to Perotin. Why don't the Elmer Eisler Singers sing Perotin or Machaut? Well, I think it's because it's disturbing, it's too challenging to people to go outside of the human condition. We want mirrors on our psychic or emotional life, we want something that seems to be about us. Chopin is about us, about how we feel when we fantasize. This is an oversimplification, that's not what Chopin is about, but it's very easily misconstrued to be just that. But Palestrina is not, Machaut is not Dufay is not, Perotin[11] is not and Webern is not, Varese is not. Schoenberg is on the threshold between the two but Schoenberg made us uncomfortable in another way, just like Freud did — he started digging way down.

Tina: But Chopin isn't only about what we're feeling when we might be lovesick. There's something else there.

Jim: It's sound.

Tina: It's sound. And that's what we're ignoring.

Jim: Yeah. Right. The people having difficulty with the 20th century music are not hearing sound because they're not in a frame of mind to simply listen to sound for itself. That's why Cage is indispensable — Cage's revolution is absolutely necessary now.

Udo: The influence that Cage had on me is what you expressed right now — he really opens every aspect of it. If more people would see that there are other people who give them something and would acknowledge it, then we would all become friends eventually.

Jim: Yeah. Back in the 60's, we did the first big Tone Roads concert[12] , where we played Ives, Ruggles, Varese, Cage and Feldman. One of the most gratifying experiences about that event, for me, had to do with the party afterwards — Cage, Varese and Feldman were all at the concert and they all came to the party. Cage and Varese had not been friendly before but they got talking to each other and had a lovely old time. Well, that made me feel very good because what I wanted to say in producing the concert was that this music constitutes a tradition for us, now, and we're not interested in the old divisions, the old arguments that these guys may have had with each other. Those are irrelevant. For us, they are all meaningful and I think both Varese and Cage were persuaded that maybe that was the case and they could go along with that.

Udo: You have that particular understanding and feeling about tradition, and this is something that I think is terribly important to convey to the next generation of people who come around. They should know something about Schoenberg and about Varese and Ruggles and John Cage and their ideas, their attitudes — not dogmas, but what was it all about. But we go back again to the earlier discussion about why the hell 99.9 per cent of the people do not want to listen to anything about Schoenberg.

Jim: We get stuck, we get stuck. It's like we don't want to grow. We want to have the benefits of being grown without the pain of growing . . . we don't want to be born to begin with. After all, it's nice and warm and comfortable inside. I feel like the 20th century is a similar sort of transition time. We're in a time of birth of a new world and it's really very painful, there's no question about it. Most of what we have to go through is not pleasant and most of Schoenberg is not pleasant. We keep using Schoenberg, maybe unfairly, but it's not really pleasant.

Udo: We could say the same thing about Cage — he isn't pleasant for most people. For me, he's pleasant . . .

Jim: But only because you brought your sensibility across a threshold.

Udo: That was the word I wanted. There's a big question about sense — sensibility, sensitivity, sensuality, everything that has to do with senses in relating to everything that goes on.

Jim: Well, in a way, it relates back to phenomenology. What **isn't** sense, sensory, sensual, sensitive . . . what somehow stands over here separated from that group of things, are conceptual, dogmatic, habitual — these mind-sets that obscure.

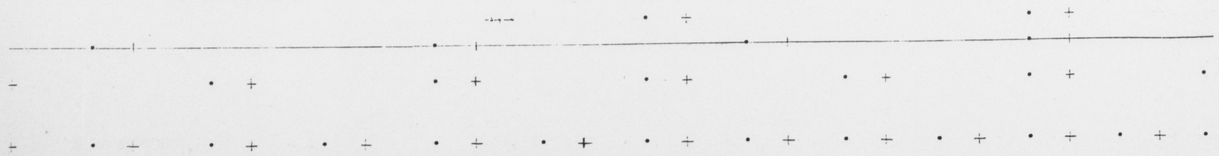
Udo: What's wrong about mind?

Jim: Nothing is — only when it's fixed. Nothing is wrong with mind, but mind-sets; rigid, fixated situations that obscure sensation, sensuality, sensitivity and all those things; they get in the way. They are interpretive systems that we automatically impose or interpose between ourselves and the thing. It relates to the whole problem of why people can feel like they understand a piece by Brahms and are put off by some piece of contemporary music. Because they are not simply listening to the sound, they are bringing into that experience something else. We have to try to take a phenomenological attitude which is to get rid of some of those fixations, to approach it using mind as much as possible without preconceptions and without presuppositions and without prejudice. And that's what's so hard.

10. **Music of Changes** (1951) for solo piano, was Cage's first piece where he employed the use of the *I Ching* (Chinese oracle book) to make compositional decisions and choices.

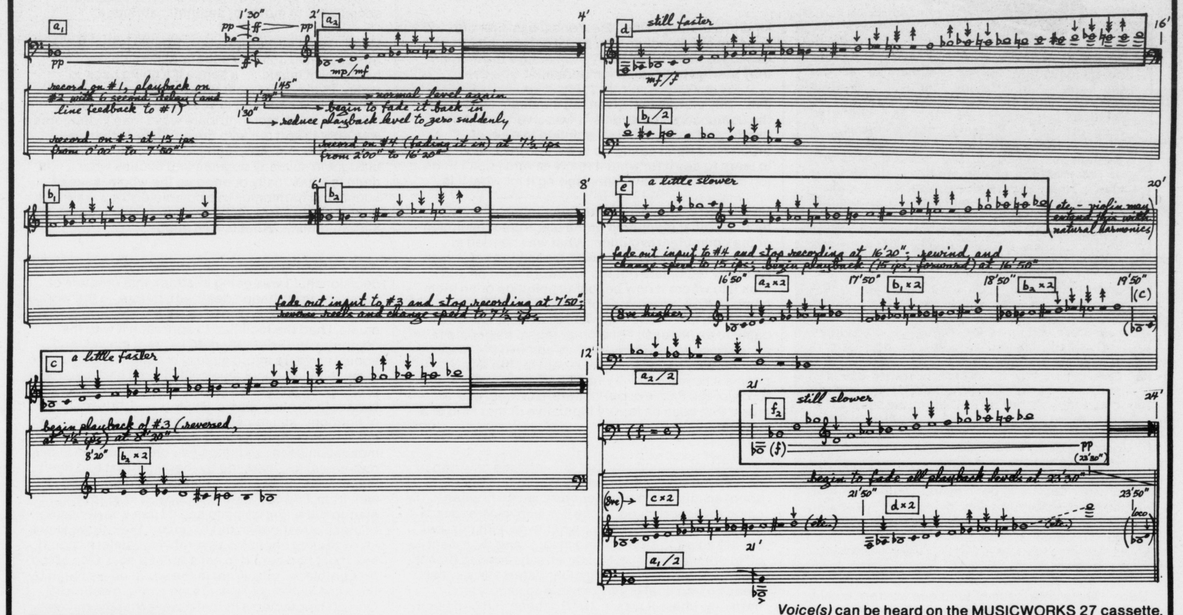
11. **Palestrina** (c. 1525-94), **Machaut** (1305-77), **Dufay** (c. 1400-74), **Perotin** (early 13th Century).

12. **Tone Roads** — An ensemble founded in 1963 in New York by James Tenney, Philip Corner and Malcolm Goldstein and dedicated to the performance of new music, including many then-unheard works of Ives, Ruggles, Varese, et al. The ensemble borrowed its name from an ensemble piece by Charles Ives called *Tone Roads*.



Voice(s)

for variable instrumental ensemble, voice(s), and multiple tape-delay system



Voice(s) can be heard on the MUSICWORKS 27 cassette.

Performance notes

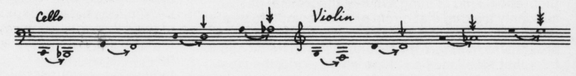
The ensemble should include at least one violin and one cello (with **scordatura** tunings as shown below), plus three or more of the following instruments: flute, alto flute, oboe, English horn, clarinet, bass clarinet, basson, saxophone (soprano, alto, tenor, baritone), viola, and trombone. There should be at least one soprano voice, but more voices may be used, including any number of altos, tenors and basses (note: singers must sing **without vibrato**).

The upper staff in each system of the score gives "available pitches" (drawn from the harmonic series on Bb). These are to be used by all performers in an improvisatory way to create melodic sequences of varying shape and duration (note: these pitches must be taken in the octave in which they are notated; if a pitch is out of an easily playable range for an instrument or voice it should be ignored).

In order to more closely approximate the pitches of the harmonic partials of Bb a special notation is used above certain notes to indicate deviations from the tempered pitch by increments of one-sixth of a (tempered) semitone, as follows:

↓ =one-sixth of a semitone flat
↑ =one-sixth of a semitone sharp
↓ =one-third of a semitone flat
↑ =one-third of a semitone sharp
↓ =one "quarter-tone" flat
↑ =one "quarter-tone" sharp

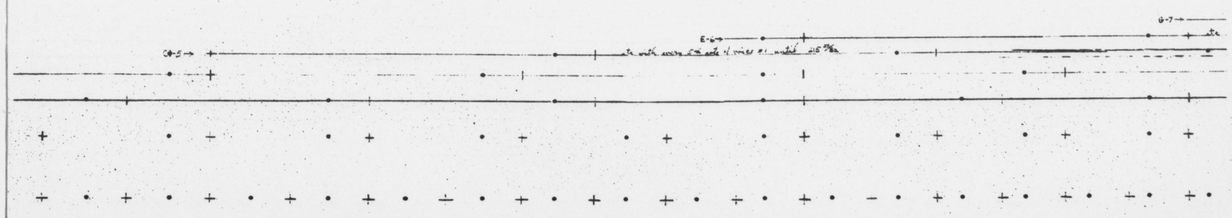
The **scordatura** tunings for the cello(s) and violin(s) are as follows:



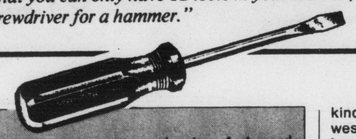
Natural harmonics on these open strings should be used primarily, if not exclusively, taking care that only those pitches in the appropriate register are heard (more detailed instructions for these instruments are given in the individual parts).

The tape-delay system involves four tape-machines. Machine #1 is used to record the istrumental sounds (and those produced later by machines #3 and 4). #2 plays back this same tape after a 6-second delay, simultaneously feeding the signal back to #1 at a slightly lower level (yielding a fade-out time of about 60 seconds). Machine #3 is used to record the first third of the performance at high speed, then to play it back at half-speed, reversed, during the last two-thirds of the piece. #4 is used to record during the first two-thirds of the performance (minus the first two minutes) at low speed, then to play it back at double-speed (forward) during the last third of the piece. During the playback phases of machines #3 and 4 their output is also mixed with the input to machine #1, and is thus subjected to the same 6-second delay being applied to the direct instrumental sounds themselves (note: the timings given in the score for these tape-manipulations must be observed as accurately as possible).

This piece was commissioned by the Ontario Arts Council for the New Music Co-operative



"If you think of a set of pitches as a set of tools . . . and somehow things work themselves out so that you can only have 12 tools in your toolbox, well, then you start having to use your screwdriver for a hammer."
-J.T.



har·mo·ny (här'mə-nē) *n. pl.* **-nies** 1 Accord or agreement in feeling, manner, or action: the *harmony* of a loving family. 2 A state of order, agreement, or completeness in the relations of things or of parts of a whole to each other. 3 Pleasing sounds; music. 4 *Music* a Any agreeable combination of simultaneous tones. b The science or study of the relations of combinations of tones or chords, their progressions, resolutions, modulations, etc., as distinguished from melody and rhythm. 5 A literary work to display the agreement of different books: a *harmony* of the Gospels. [<OF *armonie* <L *harmonia* <Gk. <*harmos* joint <*harmozein* join]

Synonyms: accord, accordance, agreement, amity, concord, concurrence, conformity, congruity, consent, consistency, consonance, symmetry, unanimity, uniformity, union, unison, unity. When tones, thoughts, or feelings, individually different, combine to form a consistent and pleasing whole, there is *harmony*. *Harmony* is deeper and more essential than *agreement*. *Concord* implies more volition than *accord*. *Conformity* is submission to authority or necessity. *Congruity* involves the element of suitableness; *consent* and *concurrence* refer to decision or action, but *consent* is more passive than *concurrence*. See MELODY, TUNE, SYMMETRY. *Antonyms:* antagonism, conflict, controversy, disagreement, discord, disproportion, dissension, disunion, hostility, incongruity, inconsistency, opposition, schism, variance.

(Funk and Wagnall's)

Udo: The whole issue of tuning in western music and where it happened to get to in the twentieth century, the whole issue of temperament: What happened in Bach's time was that this whole temperament situation was brought in as a theoretical kind of thing. On that theoretical basis, suddenly making that circle of fifths complete by altering something, there was an artificial situation brought into western music and it started to blossom from that. Of all musics of the whole world, the most interesting characteristic of western music is that it devoured its own system. It ended up in that chromatic mess where it found itself, all the time saying 'no' to the original, pushing it as far as it goes. With Schoenberg we are at that point where that system has been used up, really. There is nothing more to do with that system.

Tina: What do you mean, that it has devoured itself?

Udo: Well, it has devoured its own basis. You see, it starts with a very clear understanding of very natural sound relationships; the harmonic series and so on. that's still the basis of where it started from.

Jim: But that devouring of its own resources is a function of two things simultaneously. One is setting up a standardized, limited set of pitches. You can't devour, you can never use up **all** the possible pitch relations because it is truly infinite. You can and we did, very quickly, use up all twelve of our limited set of pitches — in terms of harmonic use, in terms of harmonic relationships. But the other factor is something that is unique to western music, as far as I can tell. And that is the impulse toward continual expansion, the impulse toward innovation. Some other kinds of music that we know, South Indian music, for example, doesn't have that impulse toward innovation except in subtle ways. A performer has a style, but there is no sense among the composers that somehow they would have to take a new step that's going forward.

Udo: Yes, that is exactly the thing. We developed a kind of a metaphysical, theoretical basis for our western music rather than a real nature-related basis. We took a step away from nature the moment they started to develop temperament, you see.

Jim: My view is that given the musical intentions of the composers at that time, it was a very practical, useful, and a very musical solution to a set of problems. I don't castigate it. It's just that we've got to learn to see it for what it really is. And I don't think too many people have been seeing it for what it is.

Udo: But we have industrial revolution and the technological revolution or the electronic revolution or the computer revolution. What was needed at those given times to cope with those kinds of issues **was** very legitimate but the followers went on and took it to where it now becomes pollution or an atom bomb and all these kinds of situations. That has happened in a sense with western music too, that it came to an impasse — no other music has come to an impasse. Western music has come in the twentieth century to an impasse except for the few people who are really trying to find, again, genuine roots for the music of our culture. But most of the music that goes on is very indicative of that kind of a lost culture.

Jim: Well, I would say that the impasse only had to do with harmony, because the marvelous thing about so much twentieth century music is when it came to that crisis point, the innovative composers just said 'Well, I don't know what to do with this, but I'm not going to stop making music,' and they went off in other directions. Mainly what happened then is that they started exploring other parameters, other means of musical organization, and simply left harmony where it was in 1910. I mean, if it had been really at that moment an all-inclusive sort of impasse, we wouldn't have all the fantastic twentieth century music we do. But it was a harmonic impasse because they were working with a limited set of approximations. If you think of a set of pitches as a set of tools that you use in your tool box and somehow things work themselves out so that you can only have 12 tools in your toolbox, well, then you start having to use your screwdriver for a hammer. Now there's a very literal way in which I mean that. In a piece in the key of A, a G may have to be used to mean several different functions. And I mean a G in a tempered tuning. I'm using one tool when what I would like to have is a whole set of distinguished, distinct tools for these different kinds of jobs. Well, the marvelous thing in spite of that crisis, in spite of that impasse, is that music kept going, which proved, among other things, that fantastic music can be made without the benefit of harmony. Obviously. It can be made with just noise.

Another thing that's happened is that, if not everyone, an awful lot of people, at some point began to forget what the original motivation for the 12-tone tempered tuning was. Even many of Schoenberg's followers. If they had read more carefully some of Schoenberg's own writings, they'd see that he didn't see the 12 tones as some kind of arbitrary division of the octave. He knew very well that it had developed as a practical solution to the problem of having fairly good approximations to basic important harmonic intervals. And he considered, at a certain point, another way out of the problem. He considered microtones. He talks about them in *The Theory of Harmony* . He considers it, and then says, No, I'm not going to go that direction. I think it was probably, mostly, for practical reasons. Also he must have been intrigued with these other possibilities that opened up, almost by necessity. If you can't deal with harmony but you are going to continue writing music, you start focusing on other things. Nevertheless, I find in his writings an anticipation of further developments in harmony later. He's postponing it. He doesn't know what to do with it now, it's too big a problem, but we won't just stop writing music. Someday, somebody's going to solve this. Well, we are at the point now of solving it and starting a development of harmony as such again.

Tina: How do you see this development happening?

Jim: I would like to see it happen in a way that doesn't set itself apart from the other innovations, like new developments in rhythm and timbre and ideas about form, even ideas about the possible social uses of music or aesthetic attitudes.

Udo: What strikes me very strongly is that there is this search to come to understand again the harmony of music. In a sense it's going back to where Pythagorus was: What is sound about? Today we understand in scientific terms so many things in much more intricate ways than Pythagoras was able to sort out with the equipment that was available to him. Although electronic music has brought in so many dogmas and cliches what it has done is it has really opened up the whole issue of sound and harmonics in a completely new way. Suddenly people, from whichever persuasion they come, start to rethink, What is it all about?

Jim: About ten years ago, I made a very conscious decision that I was going to attack this problem of harmony, that I hadn't dealt with before. In the work that I did all through the 60's, all the electronic music, I had the facilities to approach it with the computer, but I didn't. It didn't attract me yet. And about ten years ago, I guess I reached a point where in my thinking about music, I felt like I had reached a pretty good understanding of most other aspects of twentieth century music. But this one, this problem of harmony, still remained an enormous mystery to me, a puzzle. And I know it wasn't a theoretical motivation because things had been going on in my own music for years too by that time, that had been leading to this. But I just decided, all right, I've dealt with form, I've dealt with perception from that standpoint — I'm going to see if I can answer some of these questions about harmony. Well, there was a lot of casting about for several years before I could feel that I had begun to get a handle on it. One of the first problems was, What in the world do we mean by the word *harmony*? How are we going to define it? One of the problems in that area is that the developments in western music over the last several hundred years for sure and maybe longer, have led to a progressive narrowing of the meaning of the word *harmony*. So if you look it up in something like the Harvard Dictionary, you see how confined the word has come to be in terms of the meanings allowed to it. It meant chords, not even that — it meant triads. So with that kind of narrow definition of the word, musicologists were justified in talking about some non-western music or some pre-baroque music as not being harmonic; not involving harmony, which is manifestly absurd! It had come to mean in western art music theory as limited a thing as it means in a jazz band where you have the rhythm instruments and the harmony instruments, meaning piano or keyboard — anybody who can play more than one note at a time. So, that was the first problem, to find a workable definition of the word. And I came up with the definition that it's that aspect of music that involves the perception of relations between pitches other than those just involving sheer magnitude and distance; that aspect of pitch that determines contour. The definition doesn't require that we hear two or more pitches at once for harmony to be relevant — it can be relevant in a purely melodic, monophonic situation. When you start figuring out how to define these relations between pitches, that's when Partch's theory comes in as a technical basis for following through on this. Because the only language that I can think of that will make the distinctions that need to be made is what Partch calls the *Language of Ratios*. So, we're back to Pythagoras again, but with a new slant on things, a whole new view that results from all of our experience, our musical experience. I said earlier that I would like to see this happen without it taking the form of negating other things and you asked me to amplify on that, Tina, and I wasn't able to say very much. I think my interest in harmony is related to another very prominent phenomenon in music right now; pattern music, process music, meditative music; all the kinds of music that either work with a drone or with repeated pitch patterns. My interest in harmony is related to it but often when I hear that kind of music, I feel that although it's a manifestation of the same interest, it's regressive in certain ways. The harmonic relationships that we're able to hear in this kind of music are very often no different from what we are able to hear in pre-twentieth century music. This is not to say that that music is not in itself interesting, but it's interesting for other reasons. Harmonically, it's not going anywhere new, much of it — not all of it, but a lot of it. That's not a negation, but frequently, in the writings of the people involved with that kind of music, I do see negations. I see negations of Cage, for example. I see negations of complexity. I see negations of the avant garde idea and negations of that whole aspect of twentieth century music which is seen as, realistically so, I suppose, as less accessible to the audience than earlier music. So it's curious that that kind of regression to an earlier kind of harmony frequently goes along with a conscious effort to be more accessible.

I'm sure his ability to identify all those different mushrooms must make a walk through the woods for John Cage a much more exciting, a much richer experience than it would be for me, where they all just look like mushrooms . . . but you see? We can do the same thing with sound.
-J.T.

Tina: What isn't regressive about it? You said that there is some interest and it's not harmonic.

Jim: Yes, well, the process idea or the meditative drone idea is interesting and new. Those are the most difficult aspects of it. Those are not the accessible aspects of it. I mean, there are relatively more accessible aspects of it. Maybe I'm wrong, but I think that it's the simplicity of the harmony that makes it accessible and often then the simplicity of the rhythm too. It's the fact that harmonically it's not doing anything new that makes it accessible. What keeps it interesting, and it is still interesting, is that something else is being done that's new.

I have been thinking about it a lot and this is a kind of provisional viewpoint that I seem to have right now. When I look around or listen around to a lot of the new music that's being played now, I sense a very wide-spread concern to make the music accessible again. I see that, and I think the people that are doing it also see it this way, as a reaction **against** something that was going on before which was in the direction of increasing complexity, increasing demands on the listener and so forth. And that's what I mean by regressive.

What I would add to that is for a certain period during the 70's, some of the pieces I was doing I can include in that. Now, I justify it, personally. I've said this before — we all proceed two steps forward and one step back — it's just a natural, biological rhythm. And it was a step back for a purpose, and in my own music I can definitely see what I learned from it, the advantages that it had for me. But nevertheless, it was a step back. It was a period in which everything I was doing was simpler. It includes things like *Harmonium #5*, the string trio. I think that it's a very beautiful piece and I learned a lot from it, but it's very easy music, it's not difficult. Now I'm not putting up difficult music as some value in itself, but maybe I am. I think that being challenged is kind of a value in itself. I'm reminded of that whole thing that Ives said — too many people think that music is just something that lets us sit back in an easy chair. And I subscribe to the view that we should want to toughen our ear muscles, which is a way he might have put it. So that **does** place a kind of value on complexity.

Udo: Yes, but what is simple to you may be complex for other people and therefore it is, I think, very necessary.

Tina: I was thinking that *Voice(s)* is a good example of a piece that is very simple in its formal concept, but complex in terms of the difficulties in performing it.

Udo: Yes. There's a particular sensitivity of that kind of music that you are making or that you are writing about that involves the issue of performance. In *Soundings 13*,† Larry Polansky is saying that now that contemporary performance is promoted by every music school there is lots of hope that maybe something will happen. I personally don't have any great hope that something will happen to that kind of music that you and some composers of the same attitude produce because what is really developed in these music schools is a new virtuosity about coming to grips with all kinds of techniques and dealings with instruments. But **ear** training, the mind training, is still missing.

Jim: But look at what's happening right here in these recording sessions of *Voice(s)* at the Music Gallery. It's only six people, but that to me is a big start. An important start. Six people that are, in working on this piece, really straining every aural muscle. It demands a much more precise tuning than normal. It involves the harmonic series again. Even the fact that they're willing to try is a good sign and to me, it's the beginning of a process that will continue and develop. It's just going to take a while before the people who are **not** asking questions now begin thinking about them. But behind that statement is something else, which is the real belief that those six people will go out and each of them will contact more and it will increase geometrically.

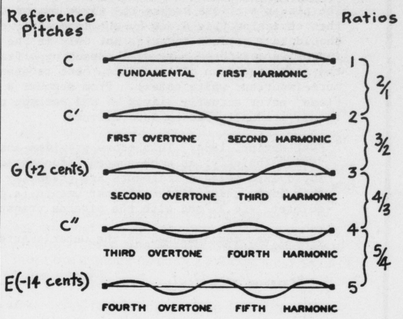
Udo: Synergetically.

Jim: Synergetically, yes right. In a sense, I feel like I am already one of those people down the diagram a little ways, down the chain. I'm not starting. I'm not this isolated individual at the top. I'm already the result of influences that go back right to Partch, for example, in terms of tuning and so forth, at least. Partch starts something and here I am, fifty years later, being concerned with something related to it, finding in Partch's work an important precedent. But I'm not the only one, there are several others also that stem directly from Partch in their interest in this. The same with Cage. I'm not initiating the way Cage did, this new attitude about things. I represent already someone who was influenced by that as you do, as Tina does, as a lot of people do. So we can find ourselves already in a fairly large community — it's spread around the world and it's just a few isolated individuals here and there, but if you add them all up, there are quite a few. All tracing back to one initial impulse, which was John Cage, 1951. O.K., so we're already in that process. Well, I wouldn't deny that things are critical now and there is a need for this to go farther faster, but I don't think that we can do anything more than what we do. If we tried to do anything more, I think it would be a political act and not a musical one.

Udo: I think the political act that one can make in his life is making his very personal statement about the issue in a very personal way. If you want to make your personal statement by making a statement on the harmonic situation, then that is the political act. Because it is not relating to how everybody else relates to that harmonic statement. Because everybody else takes it on the face value, listening to Boy George. Because all the harmonies come in there too, you see. Or from Beethoven or whoever it is. And I don't know with whom you have more arguments — with Boy George or Beethoven.

Jim: You know, I had an image — what Cage has done for us in this time is to sort of take us out of the indoors, out into the forest and said, Look at this incredible variety of things that are here. But I thought, What happens when we go out into a new kind of environment, full of this new richness and things that we have not been accustomed to experiencing? If we're open to it, we can have a very positive experience from this variety, this complexity, this newness and in fact, we kind of have to suspend most of our habitual, our old habits of judgement and concerns about value and all that in order to really appreciate it, really enjoy it. But do we stop there? I'm thinking that we don't stop there, just as in the case of the real forest, Cage didn't stop there, he learned to identify all those different mushrooms. Now apply that back to music. So we've heard all these sounds. The sounds of the environment. The sounds of virtually any possible sound. Do we stop with that? I think not. I think, in fact, if we want to enrich that experience still further. I'm sure his ability to identify all these different mushrooms must make a walk through the woods for John Cage a much more exciting, a much richer experience than it would be for me, where they all just look like mushrooms. They're all pretty much the same — I know they're different, but you see? We can do the same thing with sound.

The first five modes of vibration of a stretched string



Udo: The importance of people like Cage or Fuller or (Marshall) McLuhan, all of these people who have given a new insight into whatever goes on in our time, the real importance is that we pick it up from there, and go on, and do the next step. What is happening in the real twentieth century culture is an opening up. All these people, they open up and liberate.

Jim: Exactly. Liberation. Liberation is the key word, I think, of the twentieth century. But now, Udo — now, my question is, What do we do with our freedom?

Udo: We have great responsibility to deal with that freedom. You use your freedom to achieve something within that context. I mean, a mental context. And that's where I think a problem has arisen now, that a lot of younger composers have looked at what we're calling liberation movements in music, and they're looking at them a little differently — they're reacting **against** them and it's like they're bringing back self-imposed restraints that look an awful lot like the old colonialism. I'm mixing my metaphors freely here . . .

Tina: How do you mean this?

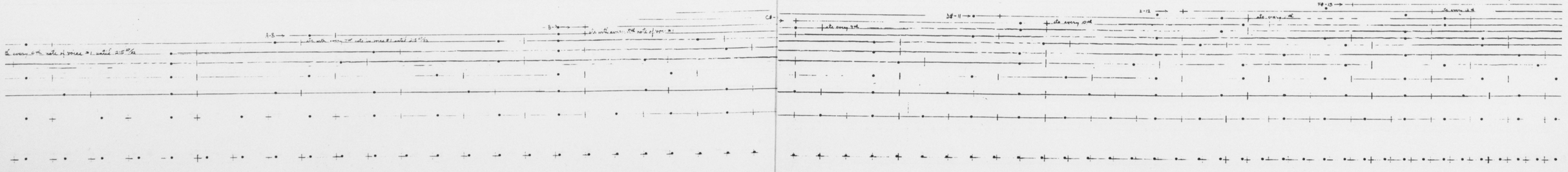
Jim: Well, of course, one of the freedoms that we have is to regress.

Udo: What do you mean, regressing? You bring that up again. Regression is not even possible.

Jim: Well, I think that mentally it is. Not pure, perfect regression, but nostalgia makes us regress. And that's what I think is one of the big motivating forces right now, is nostalgia; nostalgia for an older, more comforting kind of musical tonal world, a more comforting relationship with the audience. Phil Corner says that loneliness moves some of this and I think that's quite true. Nobody wants to be lonely but what do we do to change that or how far can you go to change that without falsifying yourself?

Udo: Accept to be alone, but not give in to that feeling of loneliness. We are almost in the middle of the 1980's, getting into the 1990's and the 2000's — we have no time, that's the last word in that essay about harmony — **time, time, time, time, time!** And we have no time to conform to those nostalgias or sadnesses or anxieties or forlornesses or lonelinesses or whatever people have — we don't need to do that.

†*Soundings 13*, **The Music of James Tenney**, was recently published by Peter Garland. It includes an extensive analytical paper entitled The Early Works of James Tenney by Composer Larry Polansky. (See notice on page 18.)



Saxony

for Saxophone Player(s)* and Tape-Delay System

James Tenney
1978/84

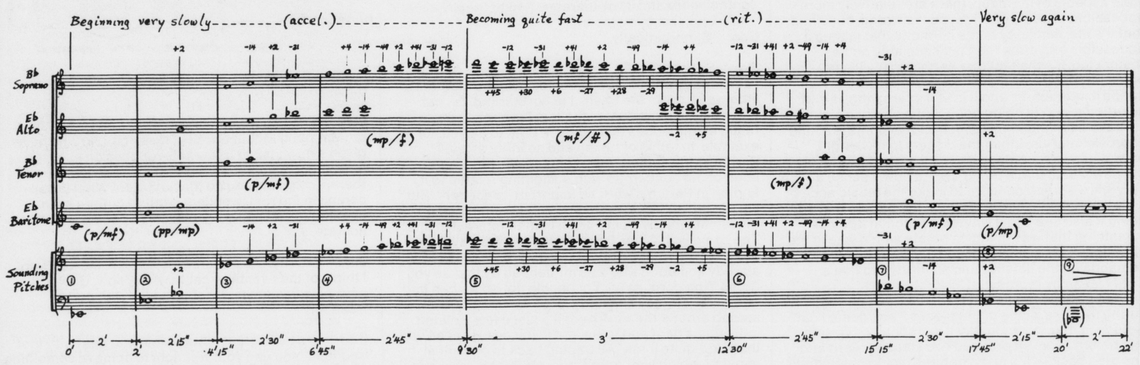
The score of Saxony is intended as the basis for an improvisation which -- though quite free in many respects (rhythmically, melodically, expressively, even stylistically) -- is totally controlled harmonically. The notation gives sets of available pitches to be used in the improvisation. These are derived from the harmonic series on Eb, with numbers above or below a note (e.g., +2, -14, etc.) indicating its deviation from the corresponding 12-tone tempered pitch in cents (i.e., hundredths of a tempered semitone). A new set of available pitches is specified for each of nine consecutive segments (separated by bar-lines), along with a range of dynamic levels for that segment (e.g., p/mf). The order in which these pitches are notated within a given segment is not important; all are to be considered "available" throughout that segment. The timings shown below the score need not be taken literally, but are suggestive of the temporal proportions intended -- each segment lasting from two to three minutes, their durations increasing to a maximum in segment 5, then decreasing again (the total duration of a performance should thus be somewhere between 18 and 27 minutes).

All sounds produced during a performance are "remembered" by the (cumulative) tape-delay system, which should be set for a delay-time of approximately 12 seconds, and a fade-out time which is as long as possible without a noticeable build-up of inharmonic system resonances. Note that -- because the tape-delay system is "cumulative" -- everything that has been played will become a part of the total sonority, recurring every 12 seconds, although the intensity of earlier events will gradually diminish with time.

The player's effort during the first two or three segments should be directed toward establishing a smooth, continuous drone on the low Eb, then enriching this drone by the intensification of its low-order harmonic partials. As progressively higher pitches are introduced, there should be a gradual increase not only in the average dynamic level and tempo (as indicated in the score), but of melodic activity and improvisatory freedom as well, reaching a peak in segment 5, where virtually "anything goes" (although an ideal realization would maintain the same precision of intonation here as elsewhere, with the black notes being treated as "auxiliaries" in relation to the harmonically-more-important white notes). From segment 6 onward the activity should subside again until the last segment, where the tape (sounding a "tone" never actually played -- and perhaps not even to be "heard" -- but one that is at least implied by the preceding pitches) is heard alone, gradually fading into silence.

* Post-script, 1984: This score provides instructions for a small subset of a very large number of possible realizations of the Saxony "idea" (briefly: an arch-shaped "stochastic canon" on the harmonic partials of a given fundamental and its lower octave, in which freely improvised melodic fragments are gradually submerged into a single sonority). I can imagine (and would welcome) other realizations of this idea, using different instruments (e.g., other groups of timbrally similar sustaining instruments: string trio or quartet, brass quintet, etc.), and with the pitches transposed, if necessary, to some other fundamental more appropriate to those instruments.

Saxony was commissioned by the Ontario Arts Council, and was first performed (Toronto, 1978) by Don MacMillan,



. . . It is sound that has always occupied my mind and interest. I think that's what all music is about. Sound. But I might be under just as much illusion as the Mongolian who thinks that all music is about horses. -J.T.

Jim: It is important for us to understand and to assimilate the challenge and mystery of twentieth century music — western music — and to understand all those different kinds of music, such as pre-Baroque western music and non-western music, because it provides us with an opportunity to learn something about our own perceptual processes and our own potential for growth that more familiar music does not.

Tina: How does that statement relate to your own work as a composer?

Jim: In my own work, I am concerned with the qualities of the sounds, the textures, the new kinds of forms, new kinds of pitch relations, new ways in which the music relates to me as a listener, what it may do to me or for me. In general, all of the things that make it difficult are the valuable things about it. Those are the things that we need, not what makes it accessible, because what makes it accessible tends to be the ways in which it relates to the more familiar music: the music that, as we said is preoccupied with self-expression. And that's an idea about music attached to only a certain body of music. But I think that most people have forgotten that. They somehow tend to associate it with music in general. It needn't be.

Tina: It's not associated with music of other cultures, for example.

Jim: Mongolians might imagine that all music has to do with horses, celebrating horses, which most of their music does. And they might think, well, that's just the nature of music, it's something you do — sing about and to your horse. Well, I think that's what we have done. We have the notion that all music is expressing feelings, personal feelings. Now, I don't mean to disassociate from feeling, I think that a lot of feeling is involved in the experience of listening to music, no matter how abstract it may be or unfamiliar or whatever. But the idea of self-expression and the idea of models having to do with human psychology is a much more limited notion than it has come to seem.

Tina: So your solution to the problem is to concern yourself at this point now with the nature of harmonic series.

Jim: Well, in general, I think that all my life as a composer, it's been concerned with sound. Now, what does that mean? When you begin to work that out that can mean a concern with a lot of different aspects of sound and for many years, the aspects of sound that interested me most involved timbre, tone quality, texture and form. But in the last ten years or so, that interest has shifted. It involves pitch now, and what I call *harmony*. And one manifestation of that is the harmonic series. But I would like it to be understood that this is an aspect of sound. And it is **sound that has always occupied my mind and interest. I think that's what all music is about. Sound. But I might be under just as much an illusion as the Mongolian who thinks that all music is about horses. Now, it's more than that. When I say sound, that means a couple of different things. On the one hand, it would be a misunderstanding to think that I only mean that it's about vibrations in the air — in other words, only the purely physical, acoustic aspect of it. I don't. When I say sound, I mean something which is simultaneously physical and perceptual, simultaneously objective and subjective. The physical, acoustical vibrations are an essential part of that, but the perceiving ear and mind of the listener is also an essential part. So, looking at the subjective side of it, I'm talking about an aspect of perception. I've been for twenty-five years absolutely fascinated with all kinds of questions about how we hear, how we perceive sound. And this is one thing that so much of the music in the twentieth century seems to me to have a great deal to teach us about, is the nature of sound in that large sense, that nature of our perception of sound.

Tina: So your pieces are trying to illuminate certain things about the perception of sound?

Jim: Both an effort to illuminate but also they involve very much a process of discovery, which is to say I don't always have some clear cut idea ahead of time what the result is going to be, which, because I know it, I can then project to other people. Frequently, my motivation for writing a piece is to find out what something will sound like.

Tina: What is the 'something'?

Jim: Well, it varies from piece to piece. It might be, what will it sound like if the pitches of the harmonic series are used exclusively in a context of six different instruments in a tape delay system? Like in *Voice(s)*. What will be the result? For example, given the kind of overlay that goes on and the fact that it builds up a more and more solid texture, a denser sound, will it ever occur that the listener will imagine that he or she is hearing but a single sound? Just a single tone? Now the fact is, in all of my experiments in that direction, it doesn't happen.

Tina: Why is that?

Jim: Because the texture is such that the ear is continually being given little cues that tip it off, that, no, this is not a single sound.

Tina: What cues would those be?

Jim: Attacks, decays, slight inaccuracies of intonation that may occur when it's actually a set of different people playing these notes. The ear is extraordinarily sensitive and acute. It's very difficult to fool it.

Tina: There is also a question about the form of *Voice(s)*. It moves through sections that reveal certain segments of the harmonic series, and there is half-speed and double-speed tape playback added. Also, the performers are not just uniformly playing for twenty-four minutes a single set of pitches: they start out tuning slowly, then gradually add a bit of melodic activity . . .

Jim: I said that up until about ten or twelve years ago, one of my main concerns was form, the perception of form. So, every piece of music has a form of some kind. In fact every sound or sound situation that we ever encounter has some sort of form in my sense of the word form, by which I do not mean sonata form or fugue form or any thing like that. I mean form just in the sense that we might use it in terms of visual perception, where we speak of the form of whatever we see. It might be the form of that group of stars up in the sky. The shape, the structure, the evolution of the sounds in time. Form and what's called content really involve the same thing at different hierarchical levels of perception. What we take to be the substance or content of a sound is really the result of formal shapes or structures at a microscopic or 'microphonic' level; particular envelopes, wave forms, and sequences of these — details in the sound. All form is just the same thing on a larger level, involving spans of time over, say, five or ten or twenty minutes or more. It's precisely the same thing, physically. So *Voice(s)* has a particular formal shape to it that those changes that you mentioned register, are determining. They are creating that shape. And the use of the double and half-speed tapes is meant to serve two purposes. One is to thicken the texture even more . . . What is the second purpose?

Tina: I seem to remember that you wanted to have some higher and lower partials included in the sound that are beyond the range of the instruments.

Jim: Right. Using the double-speed tapes simply transposes the same pitches up an octave which leaves them still within the same harmonic series. It just doubles all those harmonic numbers. But the harmonic series is only one limited manifestation of the kinds of possible pitch relationships that I'm interested in that relate to this thing that I'm calling *harmony*. They're involved because when they're played accurately, they relate to each other as simple integer frequency relations. But they're not the only kind of set of possible integer frequency relations.

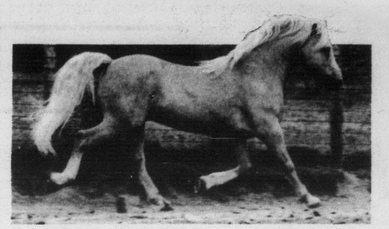
Tina: You have used just the odd harmonics in earlier pieces.

Jim: Yes, I have done some pieces that were based on the odd harmonics. The even harmonics are duplicated already lower down in the series. Any even harmonic in the harmonic series is merely an octave of a lower odd harmonic so if you are thinking in terms of what some theorists call 'pitch classes' — you know, a C is a C is a C, no matter what register it's in — then even harmonics introduce no new pitch class in the series because it's already present as a lower odd harmonic.

Tina: So you would focus on the odd harmonics simply because they introduce new and more difficult pitches for us to hear, and more difficult pitch relationships.

Jim: That's right. And the standard tuning, I shouldn't say the standard tuning, but diatonic music, the music of the last few hundred years, which now we are always hearing in standard tempered tuning, that diatonic music implies intervals of a type determined by only about the first three odd harmonics in the harmonic series. So one of the things that I've been doing is trying to push that limit farther. I use the word "limit" here kind of consciously because it relates to a terminology that Harry Partch introduced. He speaks of "prime limits." In his own tuning system he was working with an eleven limit, which can be understood to mean that it involves relationships that go up to as high as the eleventh harmonic but no higher. And you know, in *Voice(s)*, we're involved actually up to the thirteenth harmonic. Even higher ones are suggested. But it has been very interesting to hear players, whose musical training didn't prepare them for this at all, make this really very conscientious effort to produce pitches representing the seventh harmonic and the eleventh and the thirteenth harmonic.

One of the very beautiful things that happens is that these very exotic sounding intervals in that context sound quite natural and consonant. When I say exotic intervals I mean they're literally intervals that in the beginning are very difficult for people to hear, like the eleventh and the thirteenth harmonics. When they occur and they're tuned carefully enough in the context of these other pitches of the harmonic series, they sound perfectly natural, which they are! So that's been one exciting result. Another, which is maybe even more important to me, is a kind of verification or confirmation that the experience of working with this group has given me that it is indeed possible for players to learn to do it: Given the right attitude, it's not even all that difficult to learn to hear these things. So that makes me very hopeful about this aspect of the future of music, that some of these things that I've been trying to do are not going to be found impossible by people and that in fact in the future it's going to be easier and easier for them to do it. I won't be surprised if this kind of ear training, or the kind of ear training that's involved in preparing musicians to do this will soon get into



music schools. It's not going to be very long before it would seem absurdly primitive to only expect that young musicians learn to identify twelve different intervals within the octave. I mean, it's a bit like learning twelve letters of the alphabet.

Tina: Is this happening anywhere that you know of?

Jim: No.

Udo: You probably could do extremely good ear training with people who are totally uncorrupted about any kind of listening habits within our tonal systems but you get all these kids from school who have done a little bit of tuning so far and the first thing that they think about is the notation system. Maybe what is taught about music in the western culture is about notation, not the real sounds, and therefore it becomes such a difficult thing for us to think properly.

Jim: Well, that's probably true, But on the other hand, the tempered tuning does provide a kind of reference. And I have found, having learned it that way, that I was able to make the transition for myself. The tempered system is like a ruler — you know that the thing you want is not going to be at a given mark on the ruler, but you can use the ruler as a way of approximating what you are actually after.

Udo: Yes, but you have to go through a long process that you develop in your mind. Whereas if we take and try to train a young musician, we are against obstacles because we have to both clarify the history of the music and then clarify the reality of music and that's exactly what we have been trying to do in western music, all the time teaching all the things **about** it, rather than getting really into it.

Tina: You are teaching in post-secondary institutions, dealing with people who have really well-formed habits and attitudes about what music is and about notation and about hearing. So what do you do?

Jim: Well, the way it comes into my teaching right now, is in a students' very last year. In the seminar on contemporary music, I begin to present the music of Partch and then Ben Johnston and my own and so forth — the music that involves these other tunings. And at that point I can begin to get them to hear these sounds, these relations.

Tina: Do you find that you have to explain it intellectually, first — for example do you explain the differences between temperament and just intonation?

Jim: I try to do both simultaneously. That is, I'm a great believer in the use of the mind, but not without the ear! So, the best way, I think, is to let them hear the sound and then simultaneously talk about what it is they are hearing. We do seem to have to have some kind of language to refer to these things before we can use them. It's very hard to use the experience of hearing an interval unless you have some kind of name for it, some way of relating to it verbally or intellectually. So I think that both are important but they need to be carried along simultaneously. But obviously, that's a very unsatisfactory way. I'm not changing the educational system at all. I'm only, at the very last moment, inserting an element into it that I think needs to filter down. Eventually, I would hope that this will happen in the first year at university and then still earlier. And I believe that it will. I do believe it will.

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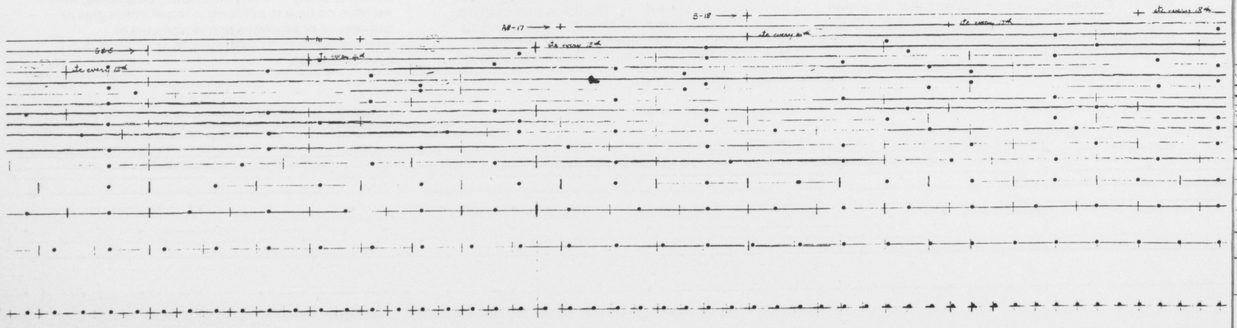
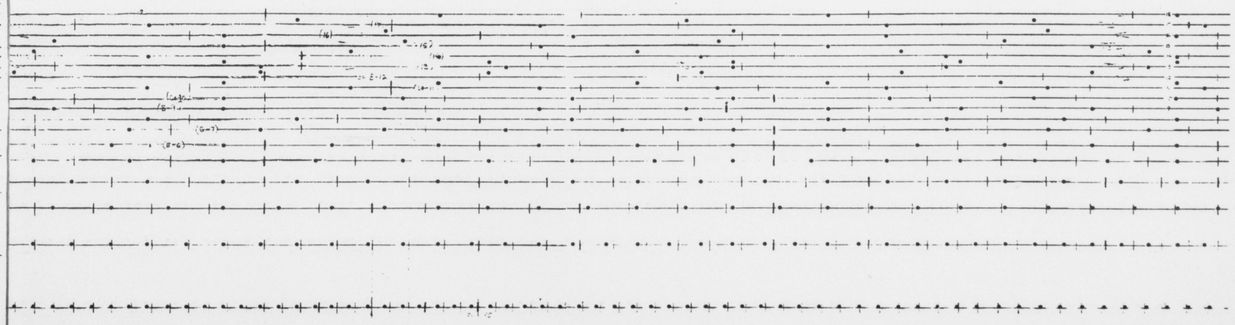




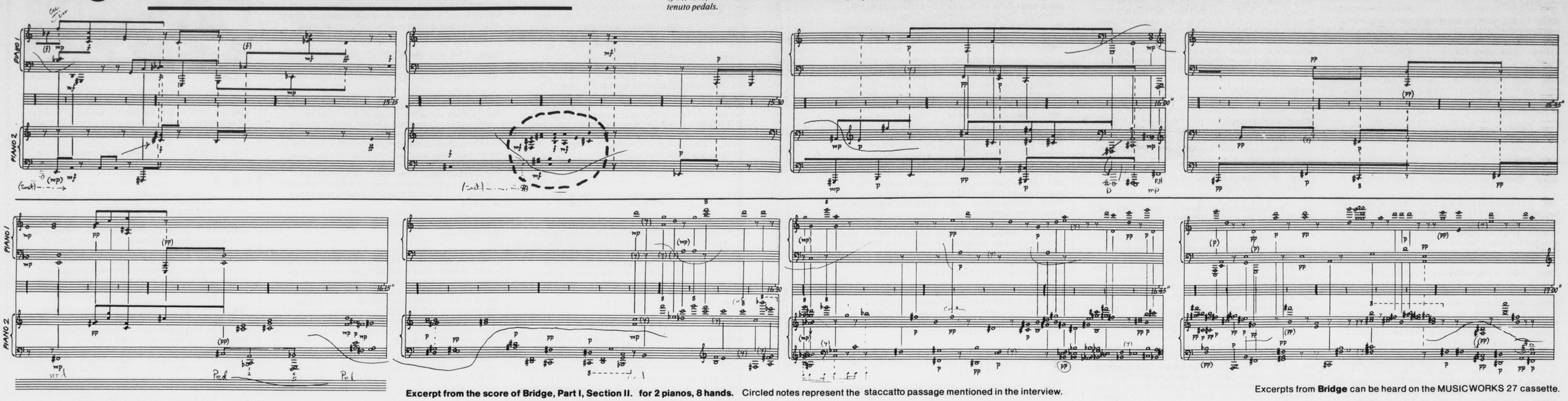
Bridge

"What I'm trying to do in **Bridge** *is make a tangible connection from one kind of musical organization to another and to make the connection in a way that shows them both as parts of the same universe of possibilities, and doesn't set them up as opposing poles."* -J.T.

Excerpt from performance notes for Bridge.

The rhythmic notation in this score (as in many of the works of John Cage) is "in space equal to time," with each system (22cm.) equal to 15 seconds (and thus 1 sec. = 1.467 cm.). Notes are of three kinds: black notes with no stems are to be played staccato; those with stems are to be played legato, with the length of the beam indicating the length of the tone; white notes are to be sustained as long as possible, either manually or by means of the damper and/or sostenuto pedals.

It is assumed that four pianists will be required for a live performance of this piece, two at each of the two pianos. The players at a given piano may distribute their parts in any way that seems feasible. Even so, situations may arise in which it is impossible to realize the sounds as notated. In such a case, the players are free to resolve the difficulties at their own discretion.



Excerpt from the score of Bridge, Part I, Section II. for 2 pianos, 8 hands. Circled notes represent the staccatto passage mentioned in the interview.

Excerpts from **Bridge** can be heard on the MUSICWORKS 27 cassette.

Gord: You've mentioned that *Bridge* is a major turning point in your writing. Could you explain how it's a turning point?

Jim: I think because it brings together a number of different things, many of them from earlier in my work, and it brings those together with some new elements — it's a kind of synthesis that seems new to me. The formal aspects of the piece derive from work that I did 20 years ago at Bell Labs. In *Bridge*, I used the computer in the composition process, and the way I programmed the computer was essentially just an extension of ways I had developed for programing the composition process at Bell Laboratories. But, here the question of the tuning adds a whole new element to that. It's something that I was not working with 20 years ago. *Bridge* is also a big piece in the sense that it's long — it's 40 minutes long — and in the sense that it took me two years to finish — that is, from the initial conception of the piece to the point of having a final score. And right now, it's still not absolutely final. I've still got revisions to make, things to add to that score that we're working with. And, one other thing, which is kind of personal: I've written very little for piano in all of my career as a composer, so that I've very seldom had any of my own work that I could perform as a pianist. Some things I have conducted but not played, and this has been interesting to me to finally have something that involves me as a pianist.

Also, I guess this has always been true for me, every piece suggests two or three new pieces, one could say because of flaws in a piece, or because of ideas that I get about how I would like to do things differently. I guess all of my music can really be called experimental but in a sense different from how John Cage uses the word, and a bit different from how it's been used to describe the experimental tradition, and so forth. It's more literally an experiment like a scientific experiment, and in science, in scientific work, one experiment always does lead to another one. New questions are raised, which a given experiment does not answer, but it does raise the questions, and that's really interesting.

Tina: How was the computer used in *Bridge*? What were the parameters you were dealing with in the program?

Jim: Well, that's a little bit hard to describe in general terms. I said that the formal aspects of the piece were involved there, but in a way that includes everything, right? The computer is used to create a certain kind of texture, a formal process that is a form of stochastic music — quite different from what Xenakis does, but nevertheless, stochastic is the best term that I can find to describe it. But it's more than that,too. The way I understand stochastic is that it is a constrained random process. Or a directed random process. Which means even a completely free random process can be thought of as a special case of the all is possible constrained random processes. I see it as a kind of generalization that's extremely useful, a generalization that includes what Cage does as one form. It also includes what Xenakis has done and what I've done. Xenakis has pointed out that, in fact, he's not the one that coined the word, because it had been used in mathematics and so forth for some time. But he points out that the root is a Greek word meaning aim, as in aiming at a target. And a good image for the kind of textures that can arise is the pattern of hits on a target. They're clustered around in a certain region, and within that region they are random, but they're not all over the place.

Tina: There's a certain order in the intention.

Jim: That's right. There was an aim. But if everyone of those arrows had hit precisely in the middle, you wouldn't have a very interesting pattern either. Anyway, the computer was used, because to do that requires the use of random number generation and that can be done by hand, so to speak, but it's very slow, and tedious. But more than that, my reason for using the computer really is that a lot of other procedures were involved

Tina: So in the generation of random numbers, what exactly did the computer determine?

Jim: It determined where the target was. The target moves. The target changes size and moves around, if we're using that image. And in fact there are targets within targets. Regions within regions. It's hierarchial, or what I have recently decided to call holarchical instead of hierarchial. Because a hierarchy implies different degrees of value — that one thing is more important than another, or one thing is more powerful than another, and I don't mean that. All I mean is that one thing includes another, as in *Bridge*, where I'm working with several holarchical levels, one within another. So, for example I have in mind a particular staccatto passage in piano two that then is finally answered and finished by piano one. It's only about four seconds long, but it's characterized by certain properties. It's all staccatto, it's all at a certain average speed, it's at a certain dynamic level, and so forth. That corresponds to one of the small targets. But that passage occurs within a longer one, which also has certain characteristics that include those that this small passage realizes, but would be somewhat broader. And that larger one now is probably also a target within a still larger target. That's the way the piece is organized, or at least that's part of it. Another part is that I wanted to be able to create very gradual transitions from one kind of condition to another. For example, in Section II of Part I, there is a transition, or a bridge, to use that term in a narrower sense than I mean it in the title, but I meant to include this too, like a bridge passage in traditional music is a transition from one kind of situation to another. But I wanted to create this transition over a period of 12 minutes. The computer is extremely useful with that kind of thing.

Tina: How did you create the transition?

Jim: By linear evolution, a linear interpolation. Imagine a space, let's call it the musical space — I'm using a metaphor of space for a set of conditions. So, at the beginning of that section, the space involved is, let's say, over in this corner of the room, and gradually, over 12 minutes, the space involved moves to that corner. From one set of conditions *gradually* to this other set of conditions. And if you just imagine drawing a straight line between them, between the centre of these two regions, and seeing to it that whatever happens is centered around that, the point that is moving in that straight line, then you will have this gradual transition. In this case, because of the holarchical level structure and the stochastic process, or random process, the computer is the obvious tool to use. It would have taken me 10 years, not two if I had to work that out by hand-methods, although it would have been possible.

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                                    33     145      45     127       0       0       0       0
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                                   124       0       0       0       0       0       0       0
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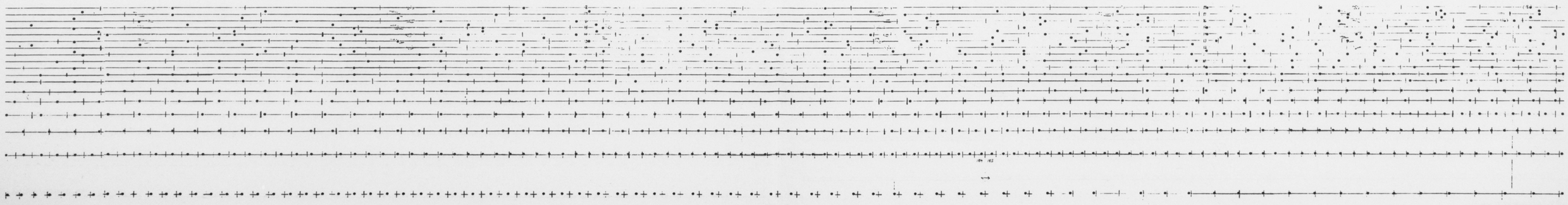
from the computer program and print-out for *Bridge*.

Jim: By the way I'm realizing that is not by making specific choices, to go from this combination of pitches to that combination of pitches at this moment, you see, but rather setting up a situation corresponds to my taste in a way: The decision to use a random process is an expression of taste, isn't it? There's a wonderful kind of paradox here, or ambiguity, that that decision implies an acceptance of the detailed results, whether or not those details correspond to one's taste. Now in the process of working on the piece, I've several times been tempted to change things, and once or twice I've made some small changes, according to taste. But not just simply that. I could usually justify the changes in some other sense, but, sure, sure, it was according to taste. It was usually because something was just kind of awkward and it got us to effective result more directly by making that change. But, in fact, out of 80 pages I've made damn few of those and in fact they're little more than the kindsof things that any performer does with any score: Given the score and intention to realize the musical properties of that score, there are things that one does.

Gord: In fact there's much more demand for adherence to detail than in, say, a classical score, in terms of the freedom that is implied in the use of traditional notation. Although that freedom comes into *Bridge* too, and more so as the piece progresses into the 'other corner', as you say.

Jim: Another really important aspect of the piece for me is the tuning system and this notion that it's doing something with harmony. Now a lot of people are going to listen to that piece and after reading my program notes about it that mention harmony, they will come out saying, I don't know what you mean by harmony. But it really does manifest a concern with harmony and I think it really does *do* something with harmony, but in a sense rather different from what we are accusomed to meaning by the word. Now here again in a sense my taste determined the tuning system and my taste, if we can call it that, determines my intention to do something with harmony. But the way I'm realizing that is not by making specific choices, to go from this combination of pitches to that combination of pitches at this moment, you see, but rather setting up a situation



where potentially, and eventually, everything could happen. All the possible permutations and combinations of these pitches could occur. They don't, even in 40 minutes, I'm sure, but there are an awful lot of combinations. And they occur in ways that are again stochastically organized. That is, there is a target at any given point.

Gord: It seems there are targets for tuning, intonation and combinations of pitches that you get in these small segments that, I suppose could be called clangs, where there's almost implied key areas.

Jim: Right, right. Momentarily, if you extract a short passage from the piece, in a given polyphonic part, you could very well identify it as being in A flat major or something like that.

Tina: But those things were determined by the computer's choices.

Jim: Yes.

Gord: But you had organized it in such a way.

Jim: I had organized it in such a way that that could happen, but I wasn't saying when it's going to be in A flat. It could go into tonal regions, key regions, at any moment, and then could go out of them into another one. But the way it moves among these, well, it's the fastest rate of modulation in the history of music!!

Tina: What **is** the tuning system of *Bridge*?

Jim: Again, that's a little bit hard to describe except that it's a harmonically based tuning system which in the form we are working with right now involves a very close approximation to a just tuning system of a kind that Partch would have called a seven-limit system. I call it quasi-just though, because in fact it is tempered in a certain way, for the same reason we temper our 12 pitches in equal tempered tuning, which is to make possible a greater freedom of modulation. But it comes as close as possibl, and I think sufficiently close, that the effect is essentially the same as in a just system, and we have some of the important harmonic intervals more precisely tuned than we get in the 12-tone tempered system. One result of that is that the range from maximum consonance to maximum dissonance is considerably extended compared to what is possible in a 12-tone tempered system

Tina: What do you mean by 'maximum consonance' and 'maximum dissonance'?

Jim: Well just think about the range of quality in terms of consonance and dissonance that are possible at the equal-tempered piano now. We have available to us a certain range of quality there, from the maximal consonance of the octave and the very high degree of consonance of the tempered fifth and fourth, to a degree of maximal dissonance that we get with a minor second or a major seventh or a minor ninth. Well in the tuning system used in *Bridge*, I can't get more consonant than the octave, but we get some intervals much more dissonant than the minor second of the 12-tone system and we also fill in some regions down toward the consonant end that are not available to us: There are more consonant sounds in this tuning system, like the major third. The major third in the 12-tone tuning system is actually a very ugly dissonant sound. It's just that nobody listens to it carefully enough to notice. The reason that we imagine it's a consonance is because the ear interprets it as representing what it is close to.

Tina: So if it's in the general ball park, your perception will 'fix it'?

Jim: I think so, yes. I think the ear interprets intervals within a certain tolerance range. We interpret intervals as being the simplest kind of interval, the most consonant interval that they're close to. It's like if somebody draws a free-hand circle, and says, Here's a circle and you say, Yes I see a circle, yes, I agree it's a circle, we'll call it a circle. It wasn't done with a compass, it's not precise, it's an approximation, but it's close enough that we can all agree it's a circle. I think the same thing is true with the major third in the 12-tone tempered system. They're close enough that we all agree that the intention is a major third, but in fact it's a pretty funky major third. Just like the free-hand circle is a pretty funky circle. Now what's happening in the *Bridge* tuning system is that when it's supposed to be a circle it's damn close to a circle, it really is very close. But it's not only circles, we've got some other things too, some triangles . . .

Gord: Trapezoids . . .

Jim: Right. Ellipses and all kinds of things, all of which are more precise than they can be in the 12-tone system. In fact the intervals are for the most part nothing more than intervals that are implied in the 12-tone system — implied but not actually realized.

Gord: But then as well you have quarter tones, third tones, sixth tones.

Jim: Well, a number of different sizes of intervals. Yes. But it's a bit misleading when people hear the term 'quarter tone'. The implication, I think, is that the motive behind extending the tuning system is just to have more pitches and smaller intervals or something like that, more pitches and more intervals, but that's not the motive here. Although it is important, by itself it's not sufficient to do what I want to do. In fact, quarter tone music has been written since the early years of the century and some of it is very interesting and beautiful music, but in my view, it is not addressing the matter of harmony. I have a notion about this that there is in fact a progressive evolution of our musical perception, and that the primary thing that was evolving in western music in the 200 years or so up until the beginning of the twentieth century, was harmony. But at that point, because of the limitations of our tuning system, of the 12-tone tempered tuning system, that evolution of harmony reached a kind of dead end, an impasse, as we talked about earlier: Music continued to develop and to evolve; our musical perception continued to evolve but mostly in other directions involving other aspects of music, rhythm and texture and so forth. But now we are at a point where we can get back on that harmonic track if we wish. I see my own work as trying to get back on that track and develop things harmonically again.

Gord: I did have one more question about *Bridge*: What is implied by the title word?

Jim: Well I have in mind several possible meanings of the word 'bridge', or perhaps they're all the same meaning but different applications, A bridge connects one thing to another. What I'm trying to do in the piece is make a tangible connection from one kind of musical situation to another, from one kind of musical organization to another, and to make the connection in a way that shows them as both parts of the same universe of possibilities, doesn't set them up as opposing poles. One way of making this even more explicit is to say that I'm trying to create a tangible bridge between the musical world of John Cage and another musical world which, though certainly very different in sound to that of Harry Partch, has some aspects in common with that, at least in the sense that it involves a new tuning system and so forth. Which brings up another point: With all this talk about harmony it will be very easy for someone to misunderstand and to imagine that I want to go back to some earlier kind of musical situation. Unless a broader definition of the word *harmony* is understood to begin with, any concern with harmony is liable to imply something opposed to the innovative directions that have been taken by composers in the 20th century, and I don't want that misunderstanding. I think that there are some composers who would describe their own concerns as involving harmony also, but would see them as in opposition to what's been called the avant garde. This is an opposing tendency, a reaction.

Tina: It's a reaction against the challenge that Cage represents.

Jim: Right. The complexity, the austerity, the challenge. I'm *not* opposing these things. I want to develop **from** them, I want to move forward **from** that point, and I think we can do it by picking up all the threads of things that have been going on throughout the 20th century. And several important threads that got cut in about 1910 and that have just been left there dangling.

Tina: It seems that *Bridge* is your way of putting these threads together not only in terms of this tradition, but in your own work too, it seems that you're fusing the different areas that you've explored.

Jim: Yeah. That's the way I view it. There's a synthesis involved, and often that can be seen as the end of something — you've got all this stuff and finally you put it together. In a way it would be presumptuous to say that I have managed to synthesize all those things. But it is my concern. The beauty of it though is that I see it as a beginning, not as an end. It's almost that seeing the possibility of putting these things together, these disparate things, putting them together suddenly throws all of it into a new light.

Tina: I think that a lot of your work has that quality about it. *Voice(s)* certainly the quality of a beginning — beginning to tune, just in terms of the process that the performers go through. It wasn't an attempt to make any sort of conclusion about it at all.

Gord: So there's a beginning on a performer's level, not just for you as a composer. In any instrumental piece of yours that I can think of, it's a beginning for the performers, which is so much and important part of what music has to be.

Jim: Well that's in the nature of an experiment, isn't it? Every new experiment is another beginning.

Tina: You were talking about *Bridge* being a beginning and there were some pieces you were seeing developing out of it.

Jim: I've got three new pieces in my mind. One is for three pianos, one is for string quartet, and another would be for six guitars.

Gord: Electric guitars?

Jim: Yeah. Well, either way. I think it would be interesting to have the range of possibilities with the atmosphere of the piece varying from six spanish guitars in a very close up intimate kind of ambience to six big electric guitars on Marshall amplifiers, you know, filling the C.N.E. (Canadian National Exhibition stadium).I also just have written a new piece since the concert that was motivated by hearing the *Koan** played so well. I start thinking about how each of those intervals that we hear in that piece can have a harmonic interpretation. Each of them understood in a certain way does have a harmonic meaning. But that harmonic sense of the interval, except for a few of the simplest intervals, is out of reach of the listener, any listener, me included. But there is a way to put those intervals in a context in which they can be heard to have that harmonic sense. So, there's a new piece which is a Koan for string quartet, in which the violinist is doing precisely what the violinist does in this piece, but the other three instruments are being used to create an audible harmonic context for each of those intervals. Again the piece arose out of a kind of problem in the perception of the first piece. But the string quartet that I mentioned before is something else. Now all three of those pieces arising from *Bridge* are going to require a computer to do what I want to do with them, I think.

Gord: This new piece for 3 pianos — you mentioned before that it involves one person as a roving preparer of pianos.

Jim: Right. I have the idea to make a piece that could be written for the four players that now perform *Bridge*. In fact I think I would call this piece *Bridge II*. The same four players at three pianos, so it will have to be designed in such a way that, first of all, the parts are possible to be played by one player at each piano. That leaves a fourth player and my idea is that that fourth player would be involved in three things: producing tones on the insides of the pianos by plucking or striking or bowing or whatever; preparing piano strings on any one of the three pianos; and possibly also using a few percussion instruments. So the range of timbres can now be extended considerably as well as extending the range of pitches, the number of pitches in an octave. The timbral consistency, timbral homogeneity and timbral limitation of the piano will suddenly be opened up. One of the ideas is that the result of the preparations would be that in the course of the whole piece, which probably again would be on the order of 40 minutes, there would be this very gradual transformation of the sound form clear pitch to various varieties of noise and unclear pitch; from rational to irrational; from determinate to indeterminate. So in a sense if *Bridge I* starts with Cage's world and ends up somewhere else, *Bridge II* will return to another aspect of Cage's world.

Gord: I think that there is also another element that's so much a part of *Bridge*, that involves part of what Cage is doing now, and that's the discipline required on the performers' part to realize the difficult score. In another sense you've incorporated your earlier work in psychoacoustics by involving an ensemble of four pianists to work with a score that is not precisely rhythmically notated — it uses the space-time notation of Cage, but where Cage may have written *Bridge I* for two players, you've used four to make it easier technically on the keyboard, but that involves a much more complex relationship or coordination.

Jim: Right. That was something that evolved gradually. When I originally conceived the piece I imagined it for two players, one at each piano. But as work on the piece progressed I eventually realized that it was not going to be playable by just two people. Then with four players, new difficulties arise. And that's been absolutely fascinating to work with. That difficulty has forced us to learn the music in different ways, in new ways, in new ways. We've had to learn to hear, to work out this coordination by ear, by eye, by the time-sense and I think probably in other ways, too, well, kinetically. We have to learn what it feels like to get that thing happening with somebody else. Now obviously you have to learn what it feels like to play any piece. But his is a very different feeling, because you're correlating a feeling in regard to your own action with a result that involves somebody else in a very different way.

The problem arises partly because we don't have the ideal instruments. The ideal instrument would be one piano with 22 pitches per octave. Then you might do this whole thing with two players, you know, super-piano, 4 hands. But as it is we have to somehow create the illusion almost that these two pianos are one instrument, are this super-piano. So if the culture doesn't present us with the right technology, the super-piano, we have to solve that problem in a human way. We have to solve it through human interaction. I suddenly realize that's a marvelous model for all kinds of things: If the mechanism isn't there . . . we've come so much to depend on our technologies, but what have they done to us? They've done a lot of things **for** us, but they do some things **to** us and one is make us less dependent on each other and less involved with each other. When the technology breaks down, that's when people get together. When the bus blows a tire, out in the middle of nowhere, people suddenly **talk** to each other, and they didn't say a word until the tire blew, right? Wonderful! I never thought of that before. Never thought of it that way. See everything is a new beginning!

You know for several years I've thought that I should write a book, about my researches in harmony, because I've done an awful lot of purely theoretical work in this. It had to be done. I mean I couldn't just work these things out in pieces. So I felt a kind of, almost as if it were a responsibility that I had to put this stuff down and I've tried several times to do that but it, it's so inconclusive. I mean because it's so open-ended I can't seem to arrive at a point when I say okay now I'm ready to write about it, I'm ready to put it out. But recently I've come to think that maybe the most appropriate way to put it out is in the pieces. ■

* *Koan*,for solo violin, was performed by Anne Lindsay in a concert at the Music Gallery.

JOHN CAGE AND THE THEORY OF HARMONY

by James Tenney

Part 1

Many doors are now open (they open according to where we give our attention). Once through, looking back, no wall or doors are seen. Why was anyone for so long closed in? ***Sounds one hears are music.***[1]

Relations between theory and practice in Western music have always been somewhat strained, but by the early years of this century they had reached a breaking point. Unable to keep up with the radical changes that were occuring in compositional practice, harmonic theory had become little more than an excercise in *historical musicology*, and had ceased to be of immediate relevance to contemporary music. This had not always been so. Most of the important theorists of the past — from Guido and Francesco through Tinctoris and Zarlino to Rameau (and even Reimann) — had not only been practicing composers, but their theoretical writings had dealt with questions arising in their own music and that of their contemporaries. Arnold Schoenberg (one of the last of the great composer-theorists) was acutely aware of the disparities between what could be said about harmony (ca. 1911) and then-current developments in compositional practice. Near the end of his *Harmonielehre* he expresses the belief that *continued evolution of the theory of harmony is not to be expected at present.*[2] I choose to interpret this statement of Schoenberg's as announcing a **postponement** of that evolution, however — not the end of it.

One of the reasons for the current disparity between harmonic theory and compositional practice is not hard to identify: the very meaning of the word *harmony* has come to be so narrowly defined that it can only be thought of as applying to the materials and procedures of the diatonic/triadic tonal system of the last two or three centuries. The word has a very long and interesting history, however, which suggests that it need not be so narrowly defined, and that the *continued evolution of the theory of harmony* might depend — among other things — on a broading of our definition of *harmony*.

. . . and perhaps, of *theory* as well. By *theory* I mean essentially what any good dictionary tells us it means —

> *. . . the analysis of a set of facts in relation to one another . . . the general or abstract principles of a body of fact, a science, or an art . . . a plausible or scientifically acceptable general principle or body of principles offered to explain phenomena . . .*[3]

. . . which is to say, something that current textbook versions of the *theory of harmony* are decidedly **not** — any more than a book of etiquette, for example, can be construed as a *theory of human behavior*, or a cookbook a *theory of chemistry*.

It seems to me that what a true theory of harmony would have to be now is a theory of **harmonic perception** (one component in a more general theory of musical perception) — consistent with the most recent data available from the feilds of acoustics and psychoacoustics, but also taking into account the greatly extended range of musical experiences available to us today. I would suggest, in addition, that such a theory ought to satisfy the following conditions: First, it should be **descriptive** — not pre- (or pro-) scriptive — and thus, **aesthetically neutral**. That is, it would not presume to tell a composer what should or should not be done, but rather what the results might be if a given thing ***is*** done. Second, it should be culturally/stylistically **general** — as relevant to the music of the 20th (or 21st!) century as it is to 18th (or13th) century music, and as pertinent to the music of India or Africa or the Brazilian rainforest as it is to that of Western Europe or North America. Finally — in order that such a theory might qualify as a *theory* at all, in the most pervasive sense in which that word is currently used (outside of music, at least) — it should be (whenever and to the maximum extent possible) **quantitative**. Unless the propositions, deductions, and predictions of the theory are formulated quantitatively, there is no way to verify the theory, and thus no basis for comparison with other theoretical systems.

Is such a theory really needed? Perhaps not — music seems to have done very well without one for a long time now. On the other hand, one might answer this question the way Ghandi is said to have done when asked what he thought of Western civilization: *It would be nice.*[4]

Is such a theory **feasible** now? I think it is, or at least that the time has come for us to make some beginnings in that direction — no matter how tentative. Furthermore, I believe that the work of John Cage, while posing the greatest conceivable **challenge** to any such effort, yet contains many fertile seeds for theoretical development — some of them not only useful, but **essential**.

Such an assertion may come as a surprise to many — no doubt including Cage himself, since he has never shown any inclination to call himself a theorist, nor any interest in what he calls *harmony*. The bulk of his writings — taken together — sometimes seem more like that *thick presence all at once of a naked self-obscuring body of history* (to quote his description of a painting by Jasper Johns)[5] than a *body of principles* constituting a theory. But these writings include some of the most cogent examples of pure but practical theory to be found anywhere in the literature on 20th-century music. His work encourages us to re-examine all of our old habits of thought, our assumptions, and our definitions (of *theory*, of *harmony* — of *music* itself) — even where (as with *harmony*) he has not done so himself. His own precise definitions of *material, method, structure, form*, etc. — even where needing some revision or ex-

reprinted from Soundings 13.

*[Any emphasis (**bold type**) in the quotations are my own — JT]*

tension to be maximally useful today—can serve as suggestive points of departure for our own efforts.

I propose to examine some of Cage's theoretical ideas a little more closely, and then to consider their possible implications for a new theory of harmony. Before proceeding, however, I want to clarify one point. Some of Cage's critics (even friendly ones) seem to think that he is primarily a philosopher, rather than a composer—and my own focusing on his contributions as a theorist might be misunderstood to imply a similar notion on my own part. This would be a mistake. I believe, in fact, that it is primarily **because of his music**—his very substantial credibility **as a composer**—that we are drawn into a consideration of his philosophical and theoretical ideas. To imagine otherwise is to *put the cart before the horse*. In a letter defending the music of Erik Satie, Cage once wrote:

> *More and more it seems to me that relegating Satie to the position of having been very influential but in his own work finally unimportant is refusing to accept the challenge he so bravely gave us . . .*[6]

The same thing can truly be said of John Cage himself.

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> *Definitions . . . Structure in music is its divisibility into successive parts from phrases to long sections. Form is content, the continuity. Method is the means of controlling the continuity from mode to mode.* ***The material of music is sound and silence.*** *Integrating these is composing.*[7]

Cage's earliest concerns—and his most notorious later innovations—had to do with **method**—*the means of controlling the continuity from note to note*. His music includes an astonishing variety of different methods, from one *dealing with the problem of keeping repetitions of individual tones as far apart as possible* (1933-34) and *unorthodox twelve-tone* procedures (1938) though the *considered improvisation* of the ***Sonatas and Interludes*** and the other works of the 40's, to *moves . . . charts analogous to those used in constructing a magic square* (1951), chance operations based on the ***I Ching*** (from 1951 to the present), the use of transparent *templates made or found* (1952-), the observation of imperfections in the paper on which a score was written (1952-), etc. [8] Surely no other composer in the history of music has so thoroughly explored this aspect of composition—but not merely because of some fascination with *method* for its own sake. On the contrary, Cage's frequent changes of method have always resulted from a new and more penetrating analysis of the **material** of music, and of the nature of musical activity in general.

Before 1951, Cage's methods (or rather, his *composing means*) were designed to achieve two things traditionally assumed to be indespensible to the making of art: on the one hand, spontaneity and freedom of expression (at the level of *content* or *form*), and on the other, a measure of structural control over the musical material. What was **unique** about his compositional proceedures stemmed from his efforts to define these things (*form, structure*, etc.) in a way which would be consistent with the essential nature of the musical material, and with the nature of auditory perception. These concerns have continued undiminished through his later work as well, but in addition he has shown an ever-increasing concern with the larger **context** in which musical activity takes place:

> *The novelty of our work derives . . . from our having moved away from simply private human concerns towards the world of nature and society of which all of us are a part. Our intention is to affirm this life, not to bring order out of chaos nor to suggest improvements in creation, but simply to wake up to the very life we're living, which is so excellent once one gets one's mind and one's desires out of its way and lets it act of its own accord.*[9]

In this spirit, he had begun, as early as 1951, a series of **renunciations** of those very things his earlier methods had been designed to ensure—first, **expressivity**, and soon after that, **structural controls**. The method he chose to effect these renunciations (after some preliminary work with *moves on charts . . .*) involved the use of chance operations, and in writing about the ***Music of Changes*** (1951) he said:

> *It is thus possible to make a musical composition the continuity of which is free of individual taste and memory (psychology) and also of the literature and "traditions" of the art . . . Value judgements are not in the nature of this work as regards either composition, performance, or listening. The idea of relation (the idea: 2) being absent, anything (the idea: 1) may happen. A "mistake" is beside the point, for once anything happens it authentically is.*[10]

This statement generated a shock-wave which is still reverberating throughout the Western cultural community, because it was interpreted as a negation of many long-cherished assumptions about the creative process in art. But there is an important difference between a *negation* and a *renunciation* which has generally been overlooked: to renounce something is not to deny others the right to have it—though it does throw into question the notion that such a thing is universally **necessary**. On the other hand, such things as taste, tradition, value judgments, etc. not only can be but often (and habitually) **are** used in ways which are profoundly negative. Cage's *renunciations* since 1951 should therefore not be seen as negations at all, but rather as efforts to **give up the old habits of negation**—the old **exclusions** of things from the realm of aesthetic validity, the old **limitations** imposed on musical imagination, the old **boundaries** circumscribing the *art of music*. And the result? As he has said:

> *. . . nothing was lost when everything was given away. In fact, everything was gained. In musical terms,* ***any sounds may occur in any combination and in any continuity.***[11]

The fact that his own renunciations need not be taken as negations should have been clearly understood when he said, for example:

> *The activity of movement, sound, and light, we believe, is expressive, but what it expresses is determined by each one of you . . .*[12]

or again:

> *. . . the coming into being of something new does not by that fact deprive what was of its proper place. Each thing has its own place . . . and the more things there are, as is said, the merrier.*[11]

but here, it seems, his critics were not listening.

It should go without saying (though I know it won't) that we don't **need** those old *habits of negation* anymore—neither in life (where they are so often used in ways that are very destructive), nor in art. Still less do we need them in a theory of harmony—and this is one of the reasons I find Cage's work and thought to be essential to new theoretical efforts. His *renunciations* have created an intellectual climate in which it is finally possible to envision a theory of harmony which is both *general* and *aesthetically neutral*—a climate in which a truly **scientific** theory of musical perception might begin to be developed.

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> *Composing's one thing, performing's another, listening's a third. What can they have to do with one another?*[13]

While the question of method is naturally of interest to a composer—and has been, in Cage's case, the subject of greatest concern to his critics—what is actually **perceived** in a piece of music is not method as such, but **material, form,** and **structure**. Cage's most radical earlier innovations had involved extensions of material, and these may one day turn out to have more profound implications for theory than his investigations of method. The pieces for percussion ensemble, for prepared piano, and for electrical devices—composed during the late '30s and '40s—greatly extended the range of musical materials, first to include **noises** as well as tones, and then **silence** as well as sound.

These extensions were not without precedent, of course. As Cage has said, it was "Edgard Varese who fathered forth noise into twentieth-century music."[14], and who

> *. . . more clearly and actively than anyone else of his generation . . . established the present nature of music . . . which . . . arises from an acceptance of* ***all audible phenomena as material proper to music.***[15]

But Cage was the first to deal with the **theoretical** consequences of this acceptance. Since *harmony* and other kinds of pitch-organization did not seem applicable to noise,

> *The present methods of writing music . . . will be inadequate for the composer, who will be faced with* ***the entire field of sound.***[16]

More especially,

> *In writing for these electronically produced sounds, as in writing for percussion instruments alone, the composer is dealing with material which does not fit into the orthodox scales and harmonies. It is therefore necessary to find some other organizing means than those in use for symphonic instruments . . . A method analogous to the twelve-tone system may prove useful, but . . .* ***because of the nature of the materials involved,*** *and because their duration characteristics can easily be controlled and related,* ***it is more than likely that the unifying means will be rhythmic.***[17]

This statement, which reads like a prediction, was actually a description of the state of affairs that had already prevailed in Cage's work since the ***First Construction (In Metal)*** of 1939, but it was not until 1948 that the idea took the form of a general principle—even a rather dogmatic one:

> *In the field of structure, the field of the definition of parts and their relation to the whole, there has been only one new idea since Beethoven. And that new idea can be perceived in the work of Anton Webern and Erik Satie. With Beethoven the parts of a composition were defined by means of harmony. With Satie and Webern they are defined by means of time lengths . . . There can be no right way of making music that does not structure itself from the very roots of sound and silence—lengths of time . . .*[18]

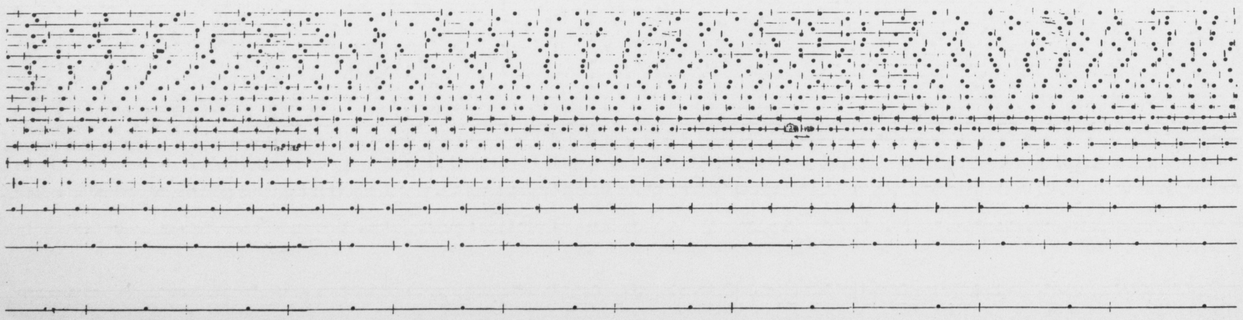
A year later this principle is repeated, but with a slightly different emphasis:

> *Sound has four characteristics: pitch, timbre, loudness and duration. The opposite and necessary coexistent of sound is silence. Of the four characteristics of sound, only duration involves both sound and silence. Therefore, a structure based on durations . . . is correct (corresponds with the nature of the material), whereas harmonic structure is incorrect (derived from pitch, which has no being in silence).*[7]

Cage was right, of course, in emphasizing the fundamental importance of time and structure in music, but—as compelling and persuasive as this argument is—there is a serious flaw in it. On the one hand, **all** music manifests some sort of temporal structure (including harmonically organized music; Beethoven), and on the other hand, neither Webern nor Satie nor Cage himself had ever managed to *define* the successive parts of a composition purely *by means of time lengths*. Such time lengths—in order to be perceived as *parts*—must be **articulated** by some other means, and these means may or may not include the specifically "harmonic" devices of cadence, modulation, etc. In the works of Cage intentionally organized according to this concept of time-structure (as in the music of Satie and Webern), the successive parts in the structure are in fact articulated by various kinds of **contrast**—changes of dynamic level, texture, tempo, pitch-register, thematic material, etc.—and such contrast-devices have **always** been used (with or without the benefit of *harmony*) to articulate temporal structure.

We needn't be too concerned, however, with the *dogmatic* aspect of these statements, since it was to be only a few years later that Cage would cease to be concerned with determinate structure at all. What is more important is the way in which he was thinking about **the nature of sound**:

> *A sound does not view itself as thought, as ought, as needing another sound for its elucidation . . . it is occupied with the performance of its characteristics: before it has died away it must have made perfectly exact its frequency, its loudness, its length, its overtone structure, the precise morphology of these and of itself . . . It does not exist as one of a series of discrete steps, but as the transmission in all directions from the field's center.*[14]



This line of thought gradually crystalized into a conception of what Cage calls *sound-space*—that perceptual *space* in which music (**any** music) must exist. His clearest and most complete description of this concept is perhaps the following:

> ***The situation made available by these [tape-recording] means is essentially a total sound-space, the limits of which are ear-determined only, the position of a particular sound in this space being the result of five determinants: frequency or pitch, amplitude or loudness, overtone structure or timbre, duration and morphology (how the sound begins, goes on, and dies away). By the alteration of any one of these determinants, the position of the sound in sound-space changes. Any sound at any point in this total sound-space can move to become a sound at any other point. . . musical action or existence can occur at any point or along any line or curve. . . in total sound-space; . . . we are . . . technically equipped to transform our contemporary awareness of nature's manner of operation into art.***[11]

Note that the list of *four characteristics* given in 1949 has now been increased to *five determinants*, and in a later passage a sixth one is added (*an order of succession;*).[8] Even so, such a list is by no means exhaustive, and important clues regarding the nature of harmonic perception will emerge from a consideration of the *determinants*, parameters, or what I will call **dimensions** of *sound-space* which are missing from all of these lists.

By his own definitions (pre-1951), **form** is *content, the continuity*, and **method** is *the means of controlling the continuity*—i.e. of controlling **form**. After 1951, of course, Cage's methods were no longer intended to *control* form in this same sense, and yet a certain necessary causal relationship still holds between method and form—no matter what the intention—and as a result most of Cage's works since 1951 exemplify an important new formal type which I have elsewhere called *ergodic*.[19] I use this term (borrowed from thermodynamics) to mean **statistically homogeneous** at some hierarchical level of formal perception. For example, it can be said about many of Cage's post-1951 pieces (and something like this often **is** said, though usually with negative implications not intended here) that any 2 or 3 minute segment of the piece is essentially the same as any other segment of corresponding duration, even though the details are quite different in the two cases. I interpret this to mean that certain **statistical properties** are in fact *the same*—or so nearly identical that no distinction can be made in perception.

The relation between the ergodic form and Cage's later methods involving chance and/or indeterminacy is this: an ergodic form will always and inevitably be the result when the range of possibilities (with respect to the sound-elements in a piece and their characteristics) is given at the outset of the compositional process, and remains unchanged during the realization of the work. Such a form is quite unlike the dramatic and/or rhetorical forms we are accustomed to in most earlier music, and has been the cause of much of the negative response to Cage's music of the last thirty years. A different attitude is obviously required of the listener to be able to enjoy an ergodic piece—and it is perhaps ironic that it is an attitude that most people are able to adopt quite easily in situations outside the usual realm of *art* (e.g. the sounds of a forest). In this respect, many of Cage's pieces represent an *imitation of nature* in more than just *her manner of operation*, but in her *forms* (or, as I'm sure Cage would prefer to say, her *processes*) as well.

Cage's inclusion of *all audible phenomena as material proper to music* did not mean that distinctions were no longer to be made. On the contrary, it now became possible to distinguish many more varieties of the elementary sounds—some of which Cage called *aggregates*. In writing about his ***Sonatas and Interludes*** for prepared piano (1946-48) he says:

> *. . . a static gamut of sounds is presented, no two octaves repeating relations. However, one could hear interesting differences between certain of these sounds. On depressing a key, sometimes a single frequency was heard. In other cases . . . an interval (i.e. a dyad); in still others an aggregate of pitches and timbres. Noticing the nature of this gamut led to selecting a comparable one for the String Quartet . . .*[8]

This concept of the aggregate is, I believe, extremely important for any theory of harmony, since such a theory must deal with the question: under what conditions will a multiplicity of elementary acoustic signals be perceived as a *single sound*? When this question is asked about a compound tone containing several harmonic partials, its relevance to the problems of harmony becomes immediatly evident.

Aside from their possible implications for a theory of **harmony**, as such, Cage's extentions of the range of musical materials to include *all audible phenomena* have created a whole new set of problems for the theorist, but his efforts to understand the **nature** of those materials have also indicated ways in which these problems might be solved. One of his statements about composition might also be applied to theory:

> *Something more far-reaching is necessary: a composing of sounds* ***within a universe predicated upon the sounds themselves*** *rather than the mind which can envisage their coming into being.*[8]

****

> *. . . when Schoenberg asked me whether I would devote my life to music, I said, "Of course." After I had been studying with him for two years, Schoenberg said, "In order to write music, you must have a feeling for harmony." I explained to him that I had no feeling for harmony. He then said that I would always encounter an obstacle, that it would be as though I came to a wall through which I could not pass. I said, "In that case I will devote my life to beating my head against that wall."*[20]

This metaphor of the wall and other sorts of boundaries, barriers, or enclosures—is a recurring one in Cage's writings:

> *. . . once a circle is drawn my necessity is to get outside of it . . . No doubt there is a threshold in all matters, but once through the door—no need to stand there as though transfixed—the rules disappear.*[21]

> *. . . my philosophy in a nutshell. Get out of whatever cage you happen to be in.*[22]

There were many such walls, but *harmony*—in its narrowest sense (the materials and proceedures of traditional, tonal, textbook harmony)—was for Cage a particularly obstructive one:

There were many such walls, but *harmony*—in its narrowest sense (the materials and proceedures of traditional, tonal, textbook harmony)—was for Cage a particularly obstructive one:

> *Harmony, so-called, is a forced abstract vertical relation which blots out the spontaneous transmitting nature of each of the sounds forced into it. It is artificial and unrealistic.*[23]

> *Seeking an interpenetration and non-obstruction of sounds . . . a composer at this moment . . . renounces harmony and its effect of fusing sounds in a fixed relationship.*[24]

> *. . . series equals harmony equals mind of man (unchanged, used as obstacle. . .)*[25]

Only once does he suggest the possibility of defining the word differently:

> *. . . this music is not concerned with harmoniousness as generally understood, where the quality of harmony results from a blending of several elements. Here we are concerned with the coexistence of dissimilars, and the central points where fusion occurs are many: the ears of the listeners wherever they are.* ***This disharmony****, to paraphrase Bergson's statement about disorder,* ***is simply a harmony to which many are unaccustomed.***[11]

Here, Cage was closer than he may have realized to Schoenberg (in the latter's writings, at least, if not in his teaching)—as when he had said:

> *What distinguishes dissonances from consonances is not a greater or lesser degree of beauty, but a greater or lesser degree of* ***comprehensibility . . . The term emancipation of dissonance*** *refers to this comprehensibility . . .*[26]

What is it then, in Cage's vision, that lies beyond these *walls*? An **open field**—and this is an image that he evokes again and again in his writings:

> ***I have never gratuitously done anything for shock, though what I have found necessary to do I have carried out, occasionally and only after struggles of conscience, even if it involved actions apparently outside the "boundaries of art". For "art" and "music" when anthropocentric (involved in self-expression), seem trivial and lacking in urgency to me. We live in a world where there are things as well as people. Trees, stones, water, everything is expressive. I see this situation in which I impermanently live as a complex interpenetration of centers moving out in all directions without impasse. This is in accord with contemporary awareness of nature. I attempt to let sounds be themselves in a space of time . . . I am more and more realizing . . . that I have eyes and can hear. My work is intended as a demonstration of this; you might call it an affirmation of life.***[27]

This open field is thus life itself, in all its variety and complexity, and an art activity *imitating nature in her manner of operation* only becomes possible when the limitations imposed by *self-expression, individual taste and memory*, the literature and traditions of an *anthropocentric* art—and of course, *harmony*—have all been questioned so deeply and so critically that they no longer circumscribe that activity—no longer define *boundaries*. Not that these things will cease to exist, but *looking back, no wall or doors are seen . . .* ***Sounds one hears are music.*** No better definition of *music*—for our time—is likely to be found.

The field—thus understood as life or nature—is much more than just music, but the "sound-space" of musical perception is one part of that total field, and Cage would have us approach it in a similar way. Its limits are **ear-determined only**, the position of a sound within this field is a function of **all aspects of sound**, and

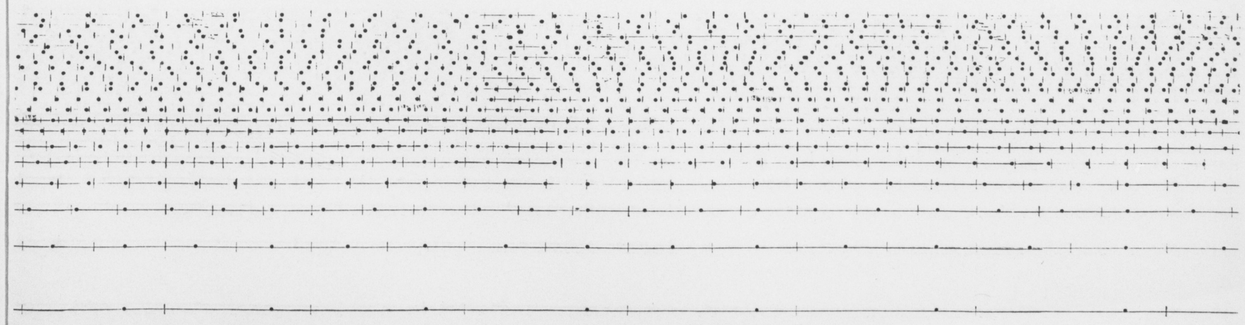
> *. . . each aspect of the sound . . . is to be seen as a* ***continuum****, not as a series of discrete steps favoured by conventions . . .*[15]

This *total sound-space* has turned out to be more complex than Cage could have known, and within it a place will be found for specifically **harmonic** relations—and thus, for *harmony*—but not until this word has been redefined to free **it** from the walls that have been built around it.

Originally, the word *harmony* simply meant **a fitting together** of things in the most mundane sense—as might apply to pieces of something put toghether by a craftsman. It was later adapted by the Pythagoreans to serve a much broader philosophical religious purpose, describing the order of the cosmos. Its specifically musical uses must have been derived from the earlier sense of it, but for the Pythagoreans, the way the tones of a stretched string *fit together* was seen as an instance—in microcosm—of that cosmic order. Even so, it did not refer to simultaneous sounds, but simply to certain **relations between pitches.**

Similarly for Aristoxenus: The discipline of *harmonics* was the science of melody, considered with respect to pitch (and thus to be distinguished from *rhythmics*—the science of melody with respect to time). These senses of the word *harmony* are carried through in the writings of the mediaeval theorists. Only after the beginnings of polyphony in about the 9th century did the word begin to carry a different connotation, and since that time its meaning has become more and more restricted. Apel defines it as *the vertical aspect of music*[28] i.e. chord structure, and (to a limited extent) relationships between successive chords. But in fact the word has come to imply only a limited set of such relationships—a certain **type** of vertical structure. Thus, even in the case of some kinds of music in which tones are heard simultaneously (e.g. Indonesian gamelan music) it has been said that *harmony* is not involved. But it is quite absurd to imagine that the Indonesian musician is not concerned with the *vertical* aspect of his music.

The word *harmony* obviously needs to be freed from its implied restriction to triadic/tonal music—but this is not enough. Even in a purely *horizontal* or monophonic/melodic situation, the realities of musical perception cannot be described without reference to **harmonic relations** between tones. Clearly, **a new theory of harmony will require a new definition of *harmony***, of *harmonic relations*, etc., and I believe that such definitions will emerge from a more careful analysis of the *total sound-space* of musical perception.



Part 2

This project will seem fearsome to many, but on examination it gives no cause for alarm. Hearing sounds which are just sounds immediately sets the theorizing mind to theorizing, and the emotions of human beings are continually aroused by encounters with nature.[11]

Minimum ethic: Do what you said you'd do. Impossible.[29]

More stringent ethic: . . . make affirmative actions, and not . . . negative . . . critical or polemical actions . . .[30]

Cage has always emphasized the **multidimensional** character of sound-space, with pitch as just one of its dimensions. This is perfectly consistent with current acoustical definitions of pitch, in which—like its physical correlate, frequency—it is conceived as a **one-dimensional continuum** running from low to high. But our perception of relations between pitches is more complicated than this. The phenomenon of *octave-equivalence*, for example, canot be represented on such a one-dimensial continuum, and octave-equivalence is just one of several specifically **harmonic relations** between pitches—i.e. relations other than merely *higher* or *lower*. This suggests that the single acoustical variable, frequency, must give rise to **more than one dimension** in sound-space—that the *space* of pitch-perception is itself multidimensional. This multidimensional space of pitch-perception will be called **harmonic space.**

The metrical and topological properties of harmonic space have only begun to be investigated, but a provisional model of such a space will be outlined here which seems consistent with what we already know about harmonic perception, and may eventually help to clarify aspects of harmonic perception which are not yet very well understood. In this model, pitches are represented by points in a multidimensional space, and each is labeled according to its frequency ratio with respect to some reference pitch (1/1). Thus the pitch one octave above the reference pitch is labeled 2/1, that a perfect fifth below 1/1 is labeled 2/3, etc. But since our perception of pitch intervals involves some degree of approximation, these frequency ratios must be understood to represent pitches within a certain **tolerance range**—i.e. a range of relative frequencies within which some slight mis-tuning is possible without altering the harmonic identity of an interval. The actual magnitude of this tolerance range would depend on several factors, and it is not yet possible to specify it precisely, but it seems likely that it would vary inversely with the ratio-complexity of the interval. That is, the smaller the integers needed to designate the frequency ratio for a given interval, the larger its tolerance range would be. What Harry Partch called *the language of ratios*[31] is thus assumed to be the appropriate language for the analysis and description of harmonic relations—but only if it is understood to be qualified and limited by the concept of interval tolerance.

For a given set of pitches, the number of dimensions of the implied harmonic space would correspond to the number of **prime factors** required to specify their frequency ratios with respect to the reference pitch. Thus, the harmonic space implied by a *Pythagorean* scale, based exclusively on fifths (3/2), fourths (4/3), and octaves (2/1), is two-dimensional, since the frequency ratios defining its constituent intervals involve only powers of 2 and 3 (see Figure 1). The harmonic space implied by a *just* scale, which includes natural thirds (5/4,6/5) and sixths (5/3,8/5), is three-dimensional, since its frequency ratios include powers of five, as well as two and three. A scale incorporating the natural minor seventh (7/4) and other *septimal* intervals would imploy a harmonic space of four dimensions, and Partch's *11-limit* scale would imply a harmonic space of five dimensions (corresponding) to the prime factors 2,3,5,7, and 11)—if (and only if) we assume that all of its constituent intervals are distinguishable. Whether all such intervals among a given set of pitches are in fact distinguishable depends, or course, on the tolerance range, and it is this which prevents an unlimited proliferation of *dimensions* in harmonic space. That is, at some level of scale-complexity, intervals whose frequency ratios involve a higher-order prime factor will be indistinguishable from similar intervals characterized by simpler frequency ratios, and the prime factors in these simpler ratios will define the dimensionality of harmonic space in the most general sense.

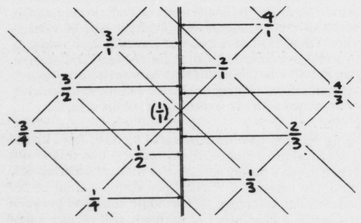


Figure 1: The 2,3 plane of harmonic space, showing the pitch-height projection axis.

The one-dimensional continuum of pitch-height (i.e. *pitch* as ordinarily defined) can be conceived as a central **axis of projection** within this harmonic space. The position of a *point* along this pitch-height axis may be specified, as usual, by the logarithm of the fundamental frequency of the corresponding tone, and the distance (or **pitch-distance**) between two such points by the difference between their log-frequency values. That is:

$$PD(f_a,f_b) \propto \log(a) - \log(b) = \log(a/b),$$ where f_a and f_b are the fundamental frequencies of the two tones, $a = f_a / \gcd(f_a,f_b)$, $b = f_b / \gcd(f_a,f_b)$, and $a \neq b$.

Although the pitch-height axis is effectively continuous, harmonic space itself is not. Instead, it consists of a discontinuous network or **lattice** of points. A distance measure which I call **harmonic distance** can be defined between any two points in this space as proportional to the sum of the distances traversed on a shortest path connecting them (i.e. along the line segments shown in the figures). (the *metric* on harmonic space is thus not a Euclidean one, but rather a *city-block* metric.) This measure of harmonic distance can be expressed algebraically as follows:

$$HD(f_a,f_b) \propto \log(a) + \log(b) = \log(ab).$$

Here again, the tolerance condition must be kept in mind, and it is useful in this connection to formulate it as follows: an interval is represented by the **simplest ratio within the tolerance range** around its actual relative frequencies, and any measure on the interval is the measure on that simplest ratio.

In this model of harmonic space, octave-equivalence is represented by another sort of projection—of points in a direction parallel to the *2-vectors* (the right-ascending diagonals in Figures 1 and 2; vertical lines in Figure 3). Alternatively, it

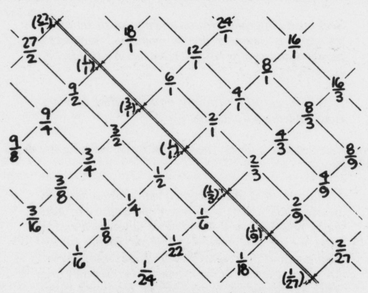


Figure 2: The 2,3 plane of harmonic space, showing the pitch-class projection axis.

can be conceived as a *collapsing* of the harmonic space in this same direction, yielding a reduced **pitch-class projection space** with one-fewer dimensions. In a two-dimensional harmonic space, this will be another projection **axis**, as shown in Figure 2. In a three-dimensional (2,3,5) harmonic space, the pitch-class projection space will be a two-dimensional (3,5) **plane**, as in Figure 3. This pitch-class projection plane can be used to display the primary (*5-limit*) harmonic relations of

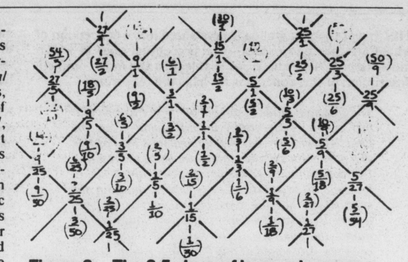
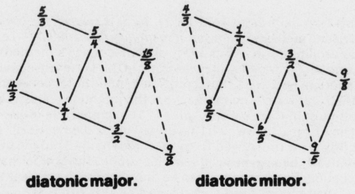


Figure 3: The 3,5 plane of harmonic space as a pitch-class projection plane within 2,3,5 space.

triadic/tonal music. For example, the diatonic major and minor scales appear as shown in Figure 4 (using Partch's labeling convention, whereby a given pitch-class is identified by the ratio it has in the first octave it has above 1/1). With the addition of two scale degrees not included in Figure 4 (the minor 2nd and the augmented 4th), these two scales can be combined into a composite structure (similar to what Alexander Ellis called the *harmonic duodene*[32] which shows many of the primary harmonic relations available within the 12-tone chromatic scale (see Figure 5).



diatonic major. **diatonic minor.**

Figure 4: Primary Harmonic relations within the chromatic scale.

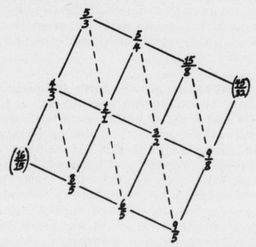


Figure 5: Primary harmonic relations within the chromatic scale.

In representing what has become an equally tempered version of this chromatic scale with low-integer ratios in harmonic space we implicitly assume a fairly large tolerance range (on the order of fifteen cents or more), but this is precisely what is implied by the use of the tempered scale for triadic/tonal music. Thus it is no wonder that the evolution of harmony as a clearly functional force in Western music reached a **cul de sac** around 1910. New compositional approaches to harmony will almost certainly involve new *microtonal* scales and tuning systems, and this model of harmonic space provides a useful tool for the design of such systems, as well as for the analysis of old ones. For example, Ben Johnston has for several years now been using what he calls *ratio lattices*—identical in every respect to those described here—for this very purpose of designing new scales and tuning systems. Although he does not use the term *harmonic space* explicitly, he does refer to *harmonic neighborhoods* demonstrated by the lattice structures, and he distinguishes between what he calls the harmonic and the melodic *modes of perception* in a way which is entirely consistent with the concept of harmonic space presented here.[33]

The physiological correlate of the pitch-height projection axis is surely the **basilar membrane** of the inner ear, while that of the surrounding harmonic space (and of the **pitch-processing centers** in the central nervous system (including some form of *short-term* memory). The functional characteristics of harmonic space will naturally depend on those of its physiological correlate, and a theory of harmonic perception based on this concept requires the elaboration of a viable model of the auditory system. No such model has yet been developed, but preliminary work in that direction suggests the following:

1) Before a point in harmonic space can become activated, the corresponding point on the pitch-height axis must be clearly defined. That is, there must be both pitch-**saliency** and relative **stability** of pitch—and this requires **time**. During the first few hundredths of a second after the onset of a tone, its *image* on the pitch-height axis will not be a well-defined point, but will be spread over some considerable portion of the pitch-height axis, above and below the point representing its nominal pitch. With time, the spread of this image will gradually be reduced to an effective point (i.e. a region confined to the tolerance range), and the corresponding point in harmonic space will then be activated.

2) Once activated, a point in harmonic space will remain active for some considerable amount of time after the tonal stimulus has stopped sounding. That is, points in harmonic space are characterized by a certain **persistence** (due to a sort of neural *resonance* in short-term memory). The extent of this persistence depends primarily on the number and nature of the sounds which follow the first one.

Note that both of these functional characteristics of harmonic space would involve **time**—and they provide some clues to the question that was asked earlier, in regard to Cage's concept of the **aggregate** : *under what conditions will a multiplicity of elementary acoustic signals be perceived as a 'single sound'?* From a purely physical standpoint, nearly every sound we hear is some sort of *aggregate*, made up of a large number of components. But during the first few tens of milliseconds after the onset of a sound it is impossible to distinguish those individual components. As the sound continues, of course, it may gradually become possible to make such distinctions, and these will depend on the separability of those components' *images*—either in harmonic space or on the pitch-height axis alone. There are, however, two common acoustical situations in which a multiplicity of components resists this kind of aural *analysis* almost indefinitely: (1) noise bands, and (2) compound tones with harmonic partials.

In the first case—though there may originally have been a large number of individual frequency components (as in a *tone cluster*— their mutual interferences are such that no one of them remains stable long enough to elicit a tonal percept (i.e. long enough for its image to become a well-defined point on the height-pitch axis). Thus, points in harmonic space will not be activated by a noise band, but its image will appear as a cluster of contiguous points (or regions) along the pitch-height axis.

In the second case, the points in harmonic space activated by the several harmonic partials (assuming them to be stable) also form a *cluster of contiguous points*— but now projected outward (and upward, into the shape of an inverted cone) from the pitch-height axis into the surrounding regions of harmonic space (see Figure 6). What is actually perceived in this case, of course, is a single tone with a pitch corresponding to that of the vertex of the *cone*—whether or not a component of that frequency is actually present in the sound—and a timbre determined by the relative amplitudes of the partials.

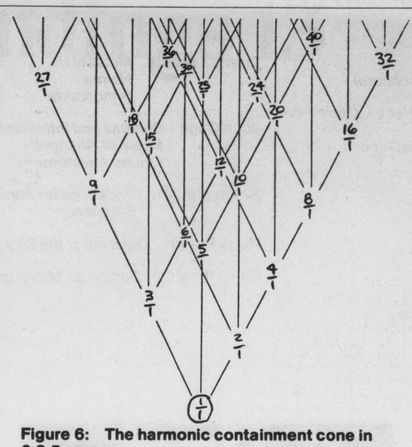


Figure 6: The harmonic containment cone in 2,3,5 space.

On the basis of these examples, the initial question might be answered as follows: a multiplicity of elementary acoustic signals will be interpreted as a single sound—even long after the initial onset—when their images form **a cluster of contiguous points** either in harmonic space or on the pitch-height projection axis alone.

The two most important problems in earlier harmonic theory—regarding the nature of consonance and dissonance, and the tonic phenomenon (including the whole question of chord roots)—have not yet been mentioned here. I suspect that harmonic theorists in the future will be far less concerned with these problems than earlier theorists were, but I think the concept of harmonic space may shed some light on them, for what it's worth. The problem of consonance and dissonance has been considerably confused by the fact that these terms have been used to mean distinctly different things in different historical periods. [34] And yet there is one simple generalization that can be applied to nearly all of these different conceptions of consonance and dissonance, which is that tones represented by proximate points in harmonic space tend to be heard as being in consonant relation to each other, while tones represented by more widely separated points are heard as mutually dissonant. Now this statement does not serve either to clarify the distinctions between differences of consonance and dissonance mentioned above or to *explain* any one of them. It does, however, indicate an important correlation between consonance and dissonance and what I am calling harmonic space.

Regarding the *tonic phenomenon*, our model does not, in itself, suggest either an explanation or a measure of it, but we can incorporate into the model the simple observation that there is a kind of directed *field of force* in harmonic space such that a tone represented by a given point will tend to *become tonic* with respect to tones/points to the *right* of it (in most of my diagrams—i.e. in the 3/2 or *dominant* direction), and to a lesser extent, *above* it (in the 5/4 direction). Such a tone seems capable of absorbing these other tones into what might be called its *tonic field*, and to be absorbed, in its turn, into the tonic field of another field to the *left* of it (i.e. in the 2/3 or *subdominant* direction), or *below* it. This is analogous to the way in which the harmonic partials in a compound tone seem to be absorbed into the fundamental, but this analogy must not be carried too far, or taken too literally. The harmonic (or *overtone*)—series has too often been invoked to explain both consonance and dissonance (e.g. Helmholz)[32] and the tonic/chord-root phenomenon (e.g. Rameau) [35] But the harmonic series cannot truly explain either of these things (any more than this concept of hamonic space can explain them). Although there is one sense of consonance and dissonance which does depend on the harmonic series (and in respect to this one sense of the terms I believe Helmholz was essentially correct), There are other senses which remain applicable to tones even in the absense of harmonic partials. And it is not—as Rameau postulated—the **son fundamental** which *generates* the triad, but the other way around: when there is a sense that a particular pitch is the root of a chord it is surely the chord itself which creates that sense.

To understand the real relation between the harmonic series and musical perception we must ask the following question: why is it that a compound tone consisting of many harmonic partials is normally and immediatly perceived as a **single tone** rather than as a *chord*? The science of psychoacoustics does not yet provide a satisfactory answer to this question, but I predict that—when it does—it will be seen that it is the nature of harmonic perception in the auditory system which *explains* the unique perceptual character of the harmonic series, not (again) the other way around. The harmonic series is not so much a causal factor in harmonic perception as it is a physical manifestation of a **principle** which is also manifested (though somewhat differently) in harmonic perception. That principle involves the mutual compatibility—as elements in a unitary gestalt or *system* (whether physical-acoustical or psychoacoustical)—of frequencies exhibiting certain rational relations to each other.

We can now define **harmony** as **that aspect of musical perception which depends on harmonic relations between pitches—i.e. relations other than *higher* or *lower***. Thus defined, *harmony* will still include all of those things it now includes—the *vertical aspect of music*, chord-structure, etc.—but it is no longer limited to these, and it is certainly not limited to the *materials and procedures of the diatonic/triadic tonal system*. . . It would, for example, also include pitch-relations manifested in a purely melodic or monophonic situation, and—by this definition—nearly **all** music will be found to involve harmony in some way (not just Western *part-music*). In addition, the model of harmonic outlined here suggests an important *first principle* for a new theory of harmony—that **there is some (set of) specifically harmonic relation(s) between any two salient and relatively stable pitches**.

Yet, by definition, *harmony* does still have some limits in its application, and these are important to recognize. In the case of any music in which no salient and stable pitches occur at all (and there is a great deal of such music in the contemporary literature), harmony—even by this broader definition—would not be relevant. A theory of harmony, therefore, can only be one component in a more general theory of musical perception, and that more general theory must **begin**—as the work of John Cage repeatedly demonstrates—with the primary dimension common to all music: **time**.

[The original manuscript of **John Cage and the Theory of Harmony** *(as published in Soundings 13) included* **A Chronological Bibliography of Writings by John Cage** *which served, in part, as footnote references. Due to lack of space in this printing, we were unable to include the complete bibliography, and have therefore re-arranged the footnote numbers and bibliographical listings. - Eds.]*

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13. John Cage, *Experimental Music: Doctrine*, S.
14. John Cage, *A History of Experimental Music in the United States*, S.
15. John Cage, *Edgard Varese*, S.
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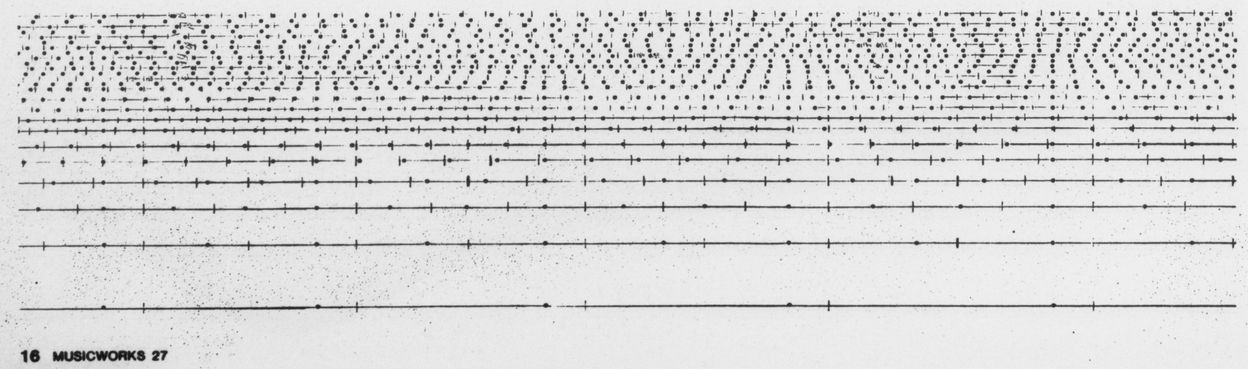

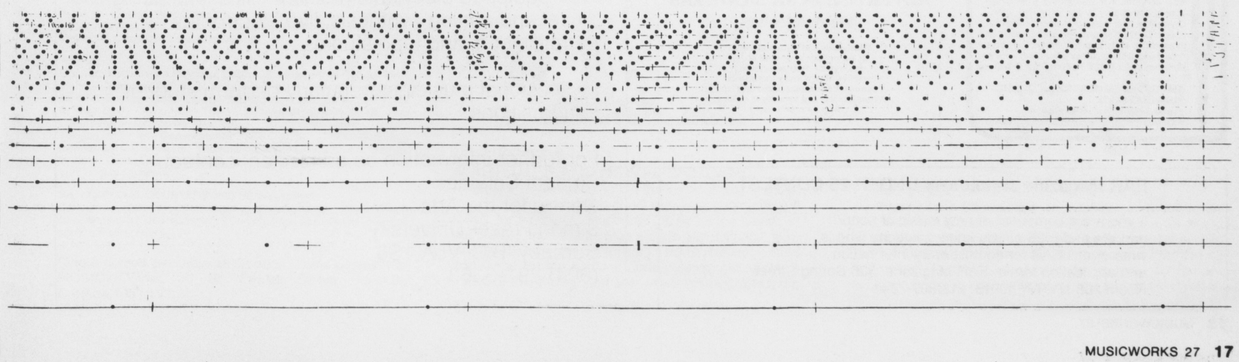

LISTENING LIST

Charles Ives *Fourth Symphony*
Piano Sonata no.2 (Concord)

Arnold Schoenberg *Three Piano Pieces, Opus 11*
Five Orchestral Pieces, Opus 16

Carl Ruggles *Evocations*
Angels
Sun Treader

Edgard Varese *Ionisation*
Octandre
Integrales
Poeme Electronique

Iannis Xenakis *Metastasis*
Herma
Pithoprakta

John Cage *Sonatas and Interludes*
Music of Changes
Etudes Australes

Anton Webern *Variations for Piano*
Bagetelles

Harry Partch *Delusion of the Fury*

Ben Johnston *Sonata for Microtonal Piano*

"If somebody will look from another planet in the next century down to the twentieth century at what you call an individualistic and alienated people, they will see a very common group of people." -U.K.

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Jim: We've said how the important musical developments of this century have had to do with liberation. I often wonder if younger people don't have the mistaken notion that some of the great composers of the earlier twentieth century themselves had no sense of tradition, themselves came out of the blue: Virtually every composer who is important to us strikes us as extremely individualistic, and almost, in some superficial way, as unrelated to any of his contemporaries, or unrelated to his predecessors. This liberating aspect of the twentieth century — without a deeper understanding, there's a danger to it. Without another element, a leavening element, an effect of that liberation has been alienation, isolation, and I'm concerned about that. In an effort to emulate what we most highly value of the earlier twentieth century, we may feel that we, too have to isolate ourselves, start from scratch, eliminate all idea of influence and just make it on our own.

Udo: But what has been happening is that all these composers you talk about are having a very new common perspective. Every one of them is illuminating that large overview that we can have now in the twentieth century that we never had before. They all just illuminate different aspects of it and therefore they really all come together. If somebody will look from another planet in the next century down to the twentieth century, what you call an individualistic and alienated people, they see a very common group of people.

Jim: You see it, and I see it, but I guess I must have a feeling that most people don't see it that way. One of the things that I would want to get across is that we need to see it that way — precisely the way that you're describing it.

Udo: So, then. We see, you see, I see, we all see the linkages to the past and of course they are not isolated, everything is always related to everything anyway. But western culture has this heavy baggage from the past.

Jim: I think what needs to be done is that the culture in general comes to see its own unity, its own coherence in the twentieth century.

Tina: What do you mean by 'the culture'?

Jim: By 'the culture' I mean people at large. The culture at large, with more and more people in it so that this becomes a common understanding of the twentieth century, the common understanding of the history of the twentieth century. The T.V. documentary understanding of the history of the twentieth century is not one that has much positive coherence to it, does it? It's one of one disaster after another, one outrage after another, one madness after another. Even in the view of the arts, it's of one radical innovation after another. There is a very profound need to get that overview, that large, unified view of cultural artistic developments in the twentieth century, to come to a deeper understanding of them, assimilate them, and to build upon them.

Tina: You refer to 'culture' as all people and developments in the twentieth century. You're not including non-western cultures like the Chinese, or more primitive cultures like the Inuit.

Jim: No, I mean western, post-industrial, urban culture. We're the ones who are in deep trouble.

Udo: Culture is the way of living. Culture is not just fine arts. Culture is the whole issue of being. Jamie Highwater, an Indian thinker, has a very nice statement. He doesn't like the phrase 'primitive' cultures — he calls it 'primal' cultures, which is a very nice way of putting it. But what Jim is talking about is the way things have gone in western urban society, basically, and taken in these terms that is where all these issues; the technology, and the new scientific understandings and scientific thinking have developed. Which make a linkage **now** with primal cultures — we suddenly **see**. Lots of people have pointed that out — Fritjof Capra in his book *The Tao of Physics* and so on. But that's exactly where cultures come together because what is done in some of that new art and new music research, science arts, is very much related in its essence with the things that people of these other cultures have taken for granted, understood, and not even needed to question because they have considered them to be what Fuller calls the *general principles of the universe*.

Jim: As Udo is suggesting now, I would also want to say that we have a very profound need to learn from other cultures. But I was thinking and speaking in terms of western culture, what it needs to do with its own house. Western culture, this one that I am picking on because I'm speaking as a member of it, is clearly the powerful culture, the dominant culture, the one that will blow all of them up — it's technically powerful. And that power means that we're the ones that have got to get these things straightened out or the whole world is going to be in trouble. It already is in trouble. So I wouldn't presume to speak for or about those other cultures, although I do see that more and more, they've become westernized and to some extent, we've begun to take in things from them and that's a very good sign, that latter. I'm not so sure about the westernization that's going on in them, but maybe that's necessary, I don't know.

Tina: You were talking about, in terms of the important twentieth century composers, a unity in what they are trying to do, and that there is also a linkage between the composers past and present in western culture who are considered 'great.'

Jim: Yes. It's exploring sound, exploring perception, liberating us from the old habits and limitations.

Tina: So this common concern, the exploration of sound and perception — do you see a similar link with some of the values in non-western cultures, or primal cultures, and what their music does?

Jim: No, I don't. There may be one, but I don't see it. The difference I see is that those cultures seem to be much more static, sort of a steady state, whereas ours is not. Western culture is, for better or worse, a rapidly developing one, and a rapidly evolving one, in so many respects.

Tina: But doesn't the fact that there's a commonality between these people who are important over I don't know how many hundreds of years, make something that's static? And that is the idea of challenge, and of exploring the perceptions.

Jim: Your question is a very good one but it's very difficult. I think that I answered it wrong, I think that probably there's an important connection, but it's very subtle. It's very hard to compare the arts in western culture with what we call the arts in non-western cultures.

Tina: Because it's not 'art' to them.

Jim: No, it's part of life. It's very different. They don't have the specialization. They don't have the separations in different domains of activity that we do.

Udo: Like Jamie Highwater says, there is no word for 'art' in his language.

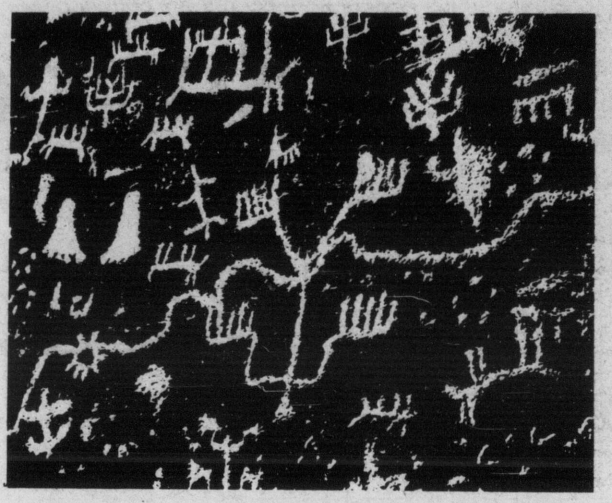
Jim: Yeah. That's just part of the kind of activity that one does under certain circumstances. We call it music — we go there and we hear them make sound in a certain way and that to us means music — but I'm not sure how they understand it. It's part of a larger configuration of activities. Now, in the west, we've got a very different situation. It's a lot more fragmented, specialized, there's more alienation and isolation — I have brought those words up before, it seems to be almost a characteristic element of western culture in our time. That's why one of the things that's so profoundly needed is that the society as a whole has to move towards integration, synthesis, healing the wounds, putting the parts back together. The knowledge is there, the techniques are there, the power is there, the possibility is there, but, unfortunately, the motivation and the will is not. The vision is not clear enough because the vision is so clouded with an old vision, an anachronistic vision. But I was trying to answer your other question and I kind of got off on a tangent. In those primal cultures, many of the activities that we from the outside call 'art,' 'music' or whatever, they have a sacred quality to them. There's an importance attached to them. Now there is something about these important manifestations of art in the twentieth century that is like our version of the sacred in an almost completely secularized world and an almost completely trivialized world. These people represent, to me, those that somehow stood apart from that trivialization and pursued something that I can't help but relate to the sacred.

Tina: So do you think that perhaps the development of western religion had . . .

Jim: Western religion is a virtually dead issue in my mind, it's not any longer, it doesn't represent the sacred to me.

Tina: Yeah, I know, but I was thinking about the medieval and Renaissance, the whole development of that notion of the sacred in western religion and the parallels with the musical developments.

Jim: Yes, think about what I said before, that starting at about 1600, music took as its model the human condition, whereas before that it had been about much more things outside — God, the cosmos,



Anasazi (navajo, "the ancient ones") petroglyphs from the Painted Desert in Arizona. (slide by Ann Holloway).

the universe, **reality!** . . . that's what the important art and music and literature of the twentieth century has been about. And this is a manifestation of the sacred. So here's what they have in common with whoever the cultural agents are in non-western cultures, in any culture.

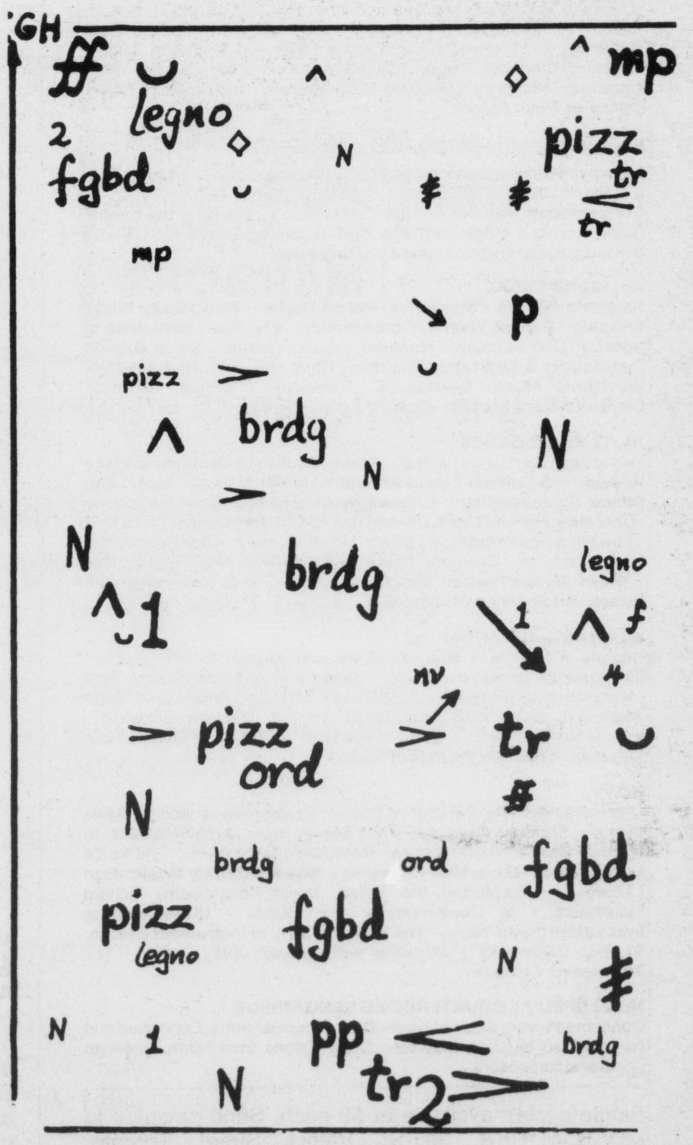
Udo: Of course in our time people have lost the understanding of the sacred.

Jim: They have. But one of the important things in my mind is the motivation of a person doing whatever it is they do. There are people, say amateurs, sort of on the fringes of the professional world of the arts who, even though all they write is some kind of little piece that's not going to go very far for one reason or another, they wrote it for the purest of motives, which is why I would not hesitate to include them in this category of the sacred. And in that world, there are gradations of value, But they are two very different worlds, the sacred and non-sacred, that have to keep relating to each other and keep maintaining some kind of common connection.

Udo: I've been into Fuller heavily these days, and time and again he uses the word 'god.' He also says, I don't believe in god, but he clarifies what god is: that unexplainable order that is still in this universe, that somehow it all works perfectly. That is god, you see. So in that sense, there's a kind of sacredness that you are talking about in the kind of work that those people are doing, and all those people we've been talking about. In some peoples' ears, that's also a cliche — seeking truth. But that's what those sacred people are doing.

Jim: Right. Sacred originally meant some kind of vision of reality . . . on the assumption that reality is mysterious, that it isn't obvious!

Udo: Of course, of course.



Detail from *Response*, 1964, (string part).