The work of **James Tenney** (b. 1934) as a composer, theorist, performer, and teacher, is of singular importance in American music of the past four decades. He is by nature a quiet, almost publicity-shy musician, but his musical and theoretical works are steadily becoming widely known, despite the fact that few have been published and only a relatively small number, to this date, are readily available on recordings. *Meta + Hodos* once had the widest "underground" readership of any treatise of its kind until it became more readily available through Frog Peak in the late 1980s. The drum quartets, *For Ann (rising)*, and a few other works are also familiar, in a wide variety of contexts, to contemporary musicians. However, general knowledge of Tenney's total oeuvre, and of the *integrities* found therein (to borrow a term from Buckminster Fuller, in whose work Tenney has always been interested) is at best spotty. To some, he is the pianist who plays the *Concord Sonata* so wonderfully from memory, and who, as a conductor and pianist, has long been a courageous pioneer and advocate of contemporary music, particularly American. To others, Tenney is known as one of the first composers to successfully make use of the digital synthesis techniques developed by Max Mathews at Bell Labs, and to make these ideas known to the music world. He is also known for his groundbreaking work in the development of compositional algorithms. This is the period in his work that is documented on this recording.

This CD is a reissue of the Frog Peak/Artifact recording, *James Tenney: Selected Works 1961–1969*, the first recorded collection of James Tenney's music of the 1960s. Many of the pieces on this disc were realized at Bell Telephone Laboratories from 1961 to 1969, where Tenney used Max Mathews's digital synthesis program, which eventually became Music IV. This software became the model for many of the common computer music environments of the past forty years, and was the first system of its kind available to composers.

Tenney's pieces from 1961 to 1964 constitute the first significant and developed body of computer-composed and synthesized music by an American composer. Prior to Tenney's arrival at Bell Labs, Mathews and John Pierce had each made a few musical studies with the program, and the composer David Lewin had realized some short pieces by sending scores to Mathews to enter into the computer. However, according to Mathews, Tenney was the first composer to come to Bell Labs and work directly with the program on an extended basis.

Tenney was a very young composer when he wrote these pieces. He was working with a new medium, a technology that was still being developed, and a new aesthetic. It is perhaps easy to overlook the importance of the latter in the light of the tremendous technical and historical importance of these pieces—but it is characteristic of Tenney that he was not content just to explore the sonic and technical capabilities of a new technology. To this day, his work from this period remains an important example for composers who work with new technologies: The new world of "computer music" needed a radically new definition of music itself.

Note: The following liner notes are adapted from my *Soundings #13* book-length essay, "The Early Works of James Tenney," published in 1984, Soundings Press, Peter Garland, ed. They were later shortened (and edited by Lauren Pratt) to become the liner notes for the 1992 Frog Peak/Artifact CD of James Tenney's computer and electronic music. Certain of Tenney's pieces from this period (*Four Stochastic Studies*, *Stochastic String Quartet*, and *Ergodos I*) were described in detail in that article but are not included on this CD. —*Larry Polansky*

Larry Polansky is a composer, performer, theorist, programmer, editor, and writer who teaches at Dartmouth College. He is the co-founder and co-director of Frog Peak Music (A Composers' Collective).

*Collage #1 ("Blue Suede")* (1961)

*Collage #1 ("Blue Suede")* was written in 1961 during Tenney's stay at the University of Illinois, which he attended, he says, because it was one of the few places where electronic music facilities were available at the time. This is a work for analog electronics (tape techniques) written prior to Tenney's tenure at Bell Labs. Perhaps the corn belt had its own kind of cultural influence on him, for in *Collage…* there is a definite departure from the more European style of some of his earlier work (like the Varèse-ian chamber work *Seeds*) and a new use of an indigenous element: the music of Elvis Presley.

*Collage #1 ("Blue Suede"),* a tape collage of Elvis Presley's "Blue Suede Shoes" (by guitarist/singer Carl Perkins), has become an American electronic music classic, and one of Tenney's better-known works. It is short (a little over three minutes) and with respect to techniques available today, uses a very simple set of technological resources. Most of the "classical" tape manipulations are used: speed changes, reversal, tape head echo, multi-tracking, splicing, and some filtering. *Collage…* is a virtuosic example of these ideas. Particularly impressive is the editing, which in its rapid, arhythmic but pulsating effect resembles a hyperactive version of Tenney's later collage *Viet Flakes* (1966). There is a sense of *time* here—in the way that jazz players use the word, an intuitive playing with a kind of implicit pulse—that is uncommon in tape music. The edited phrases seem to fall right around the perceived, implied beats, in much the same way in which a jazz rhythm section and soloist interact around a steady pulse. The overall effect is that the piece swings. Tenney is sensitive to the music to which he pays homage (R&B, or perhaps rockabilly), in which the concept of the backbeat is crucial. *Collage…* never sacrifices the backbeat to its transformations, and it resembles early rock 'n' roll in its rhythmic drive. Yet, intentionally, it never quite finds the "groove" (of steady time divisions)—it is always frustrated by quick silences, aborted beats, and unexpected returns to the beginnings of phrases. It is perhaps Elvis's physical and musical gyrations and expressions taken to their perceptual extreme, an attempt by Tenney to capture some *essence* of the music.

> "I had been deeply moved by Varèse's *Déserts* and *Poème électronique*, and by his vision of the new musical possibilities realizable through electronic technologies. In 1959 I began graduate work at the University of Illinois, attracted there by the fact that courses were being offered in electronic music (perhaps for the first time anywhere). Under the generous tutelage of Lejaren Hiller, I began to work in the new medium, but with absolutely no success at first. In spite of all my earlier expectations, the synthetic character of the electronically produced sounds seemed to resist my every effort to use them in a way that was musically satisfying to me. *Collage #1 ("Blue Suede")* arose, initially, as an act of desperation in the face of these difficulties, but once begun, it was completed in one feverish week in the studio. I consider it a celebration of Elvis Presley, and I like to think it would have pleased him."
>
> (from Tenney's "In Retrospect," notes to the Steve Reich Foundation concerts of Tenney's music in New York City, December 1978)

*Collage…* is in four short sections. The first (25–30 seconds long) comprises almost exclusively slowed-down tape transformations of the instrumental background, particularly the drums, omitting the voice. It is not obvious at this point what the sound source is, although the "feel" suggests rock 'n' roll. Tenney uses tape head echo to produce a rich, sustained, phase-shifted processing on the low, complex sonorities. The quick splicing and primarily monaural texture clarifies the rhythmic movement. The second section (about 45 seconds long) introduces some beautiful higher-pitched timbres over the low bass. These sounds seem to be the results of various filterings, reversals, editings, and speed increases (in various combinations) of the higher-pitched sounds on the recording (although it is hard to tell, I think the voice, lead guitar, and higher-pitched drums are used). They have a grainy quality that might suggest that they are actually lower-pitched sounds played at a higher speed, maybe even those of the first section. There is a complex contrapuntal relationship (high/low) developed during this section, and it is developed for about 15 seconds longer than the first. Near the end (the last ten seconds or so), a marked increase in density and tempo occurs, as well as an obvious crescendo, leading into the third section (now about 1:15 into the piece). Suddenly, all that is heard are quick splices of more or less unadulterated voice, but the transition is mediated by the crescendo and by the fact that the accompanying instrumental sounds are spliced, of course, in conjunction with the voice. Many of the quick splices, it seems, are slightly dovetailed (on separate tracks) and so the effect is one of quick, seamless shifts of attention. From my experience in playing this piece for students and friends over the years, I can say that when this section begins the recognition of Elvis's voice is rather sudden, and quite wonderful, as is the realization that we've been listening to him all along! This section is also about 45 seconds long, and at about 1:58 through the piece, the low sounds from the first section, and shortly after, the higher sounds from the second, join in. The last minute and a quarter or so of the piece is a three part contrapuntal "jam" of the three textures, and it may well be that the material used in this section is identical to all the "component" material used previously, giving the piece a characteristically economical and transparent form (like its source!).

A few other things about this piece are worth noting. First, like much of Ives's music (as in the "Emerson" movement of the *Concord Sonata*, which Tenney is famous for playing), the development scheme is "backwards." The source material is not heard until the third section, unrecognizable and highly transmogrified material presented first. This is not specific to the music of Ives and Tenney, but I think it is unusually common in American music. It reminds me very much of the way traditional fiddlers will play highly ornamented versions of a fiddle tune, and then, somewhere in the middle of a performance, play the tune in a straightforward manner, almost as a way of taking a breath, allowing the listener to rest in the simple beauty of the revealed "pure" version.

The choice of material was, I think, unusual for the period. Composer/violinist Malcolm Goldstein told me that "a lot of people were doing collages at the time, but Jim was the only one who used rock 'n' roll." Whether Tenney was the only one or not is not so important, but it *is* important that he treated it with a sensitivity and love that is singular to this day. He has since used several "indigenous" musics, primarily, I think, because he simply likes them, and in some way wants to contribute to the tradition itself.

Technical note: *Collage #1* was first released on *Musicworks* cassette #36. The recording on this CD is a new digital remastering of the original analog master.

## Computer Music

During the years 1961–64, Tenney worked at Bell Laboratories in New Jersey, and was one of the first composers (if not the first) to utilize the music synthesis programs (usually called "MUSIC N") that Max Mathews had been developing. It is curious that even though Tenney's articles (such as "Sound Generation by Means of a Digital Computer," *(Yale) Journal of Music Theory*, 7/1, 1963) were the first technical explanations of digital synthesis procedures available to composers, for a long time he was unrecognized as one of the pioneers of the field, perhaps because he was not closely connected to an academic "computer music facility." Only two of his computer pieces, *Noise Study* and the *Stochastic String Quartet*, were ever released on (obscure) records (the former on Decca DL9103, *Music from Mathematics)*. For a great many years after he made these pieces, many composers knew his stature in the field without actually knowing the music itself (which, until the Frog Peak/Artifact release in 1992, was completely unavailable).

These pieces are, if not the first American computer-generated works, at least among the first, and it is astonishing that in terms of compositional intelligence, they are still advanced. The tremendous advances made by Tenney's music in the early sixties are still awaiting their appropriate recognition and appreciation.

Tenney wrote at length about his work at Bell Labs ("Computer Music Experiences: 1961–64," *Electronic Music Reports* #1, Institute of Sonology, Utrecht, 1969), and in the late 1980s a group of composers (including myself, John Oswald, Gordon Monahan, John Bischoff, Tom Erbe and Chris Brown) undertook to digitally transfer and remaster the pieces (culminating in the recordings reissued on this CD). In this regard, it is perhaps unnecessary to analyse these pieces in any detail, for Tenney has already done so in the above-mentioned paper (required reading for anyone interested in computer music). However, I will offer some reactions to the work in general and say a few words about each piece.

There are several philosophical currents flowing through this music. One is Tenney's belief that the computer should be used to show him new things about music, perception, and the nature of composition, rather than to execute a set of pre-composed musical-dramatical ideas. In this respect, these pieces are, like much of his later music, tasks for the listener given a set of *known* compositional criteria. The computer provided Tenney with a means to create perceptual domains whose detail, and even middle-level characteristics could in turn *teach* him about his own perceptual processes. Tenney was not primarily interested in the computer as a powerful synthesizer, although his many experiments with timbre made full use of that exciting technical domain. Rather, he deeply felt Cage's influence, and the way in which these compositional programs respond to Cage's ideas is fascinating. In these pieces, for the first time in his music, Tenney chooses to relinquish control over various aspects of the music, and by doing so opens up a rich new area for musical experiment.

Another somewhat unusual aspect of Tenney's music that surfaces in these pieces is his love of all things noisy. This is evident not only in the *Noise Study,* but in the particular timbres and structures he chose to experiment with—structures which would produce, and did result in, ungainly, dense, and noisily unpredictable sonorities. Even in his experiments with vibrato, he came to the conclusion that random elements should be introduced into several parameters of the timbral synthesis, to produce "more natural" sounds. Tenney has often sought to emulate extra-musical phenomena in his forms and timbres, believing, I think, that many interesting manifestations of various musical parameters (rhythm, timbre, pitch, and even structure) occur not by human design, but as part of some natural process. He has, in particular, always been interested in the human voice and in speech, and many of his compositions show this directly (like the *Three Indigenous Songs*). Noise, in either its simplest timbral connotation or in its more abstract one involving the ordering and transmission of information, is omnipresent in our environment, but its occurrence there is often the last thing we imitate when we imitate nature. For Tenney, it has usually been one of the first.

A third idea of importance in this music is the sophisticated use of *stochastic processes* to structure the pieces. Tenney had already written *Meta + Hodos* at this time, and had his own rich and complex theory of musical form that lent itself naturally to the use of stochastic methods in composition. The full ramifications of that paper, and of the later ones in the "series" *(META Meta + Hodos;* both works were published by Frog Peak Music in 1995, but originally written much earlier) and "Hierarchical Gestalt Perception in Music: A Metric Space Model," with Larry Polansky, *Journal of Music Theory*, 1980) have yet to be realized compositionally, though many composers have felt their influence (the music and ideas of Charles Ames are an important and, unfortunately, almost completely overlooked, example).

Briefly, the concept of a stochastic process is one in which certain parameters of a random distribution are specified, and these parameters can be shifted to affect the general shape (or color) of the random events. Tenney found that by specifying the *mean* and *range* of various parametric levels over given time intervals, he could create large and complex forms whose overall structures were determinate, but whose microstructures were not. Tenney implemented this hierarchically: Large-scale means were used to randomly select smaller-scale means within them. All of his pieces from Bell Labs use these ideas, and along with Iannis Xenakis (who was exploring somewhat similar ideas in Europe at about the same time) and Lejaren Hiller, with whom Tenney had studied at Illinois (but who used the notion of stochastic distributions in a completely different way), Tenney is one of the first composers to seriously deal with these techniques in a formal compositional setting. They have since become, more through the influence of Xenakis than anyone else, part of the common parlance of contemporary composition, but at the time they were revolutionary, radical concepts, no less so than Cage's aleatoric ones.

Tenney describes the context of his work at Bell Labs in the following excerpt from "Computer Music Experiences":

> "I arrived at the Bell Telephone Laboratories in September, 1961, with the following musical and intellectual baggage:
>
> 1. numerous instrumental compositions reflecting the influence of Webern and Varèse;
> 2. two tape pieces, produced in the Electronic Music Laboratory at the University of Illinois—both employing familiar, 'concrete' sounds, modified in various ways;
> 3. a long paper ("Meta + Hodos, A Phenomenology of 20th Century Music and an Approach to the Study of Form", June, 1961), in which a descriptive terminology and certain structural principles were developed, borrowing heavily from Gestalt psychology. The central point of the paper involves the *clang*, or primary aural Gestalt, and basic laws of perceptual organization of clangs, clang-elements, and sequences (a high-order Gestalt-unit consisting of several clangs).
> 4. A dissatisfaction with all the purely synthetic electronic music that I had heard up to that time, particularly with respect to *timbre;*
> 5. ideas stemming from my studies of acoustics, electronics and—especially—information theory, begun in Hiller's class at the University of Illinois; and finally
> 6. a growing interest in the work and ideas of John Cage.
>
> I leave in March, 1964, with:
>
> 1. six tape-compositions of computer-generated sounds—of which all but the first were also composed by means of the computer, and several instrumental pieces whose composition involved the computer in one way or another;
> 2. a far better understanding of the physical basis of *timbre*, and a sense of having achieved a significant extension of the range of timbres possible by synthetic means;
> 3. a curious history of renunciations of one after another of the traditional attitudes about music, due primarily to a gradually more thorough assimilation of the insights of John Cage.
>
> In my two-and-a-half years here I have begun many more compositions than I have completed, asked more questions than I could find answers for, and perhaps failed more often than I have succeeded. But I think it could not have been much different. The medium is new and requires new ways of thinking and feeling. Two years are hardly enough to have become thoroughly acclimated to it, but the process has at least been begun."
>
> ("Computer Music Experiences", pp. 23–24)

In my discussion of Tenney's computer music which follows, I quote freely from the above paper (citing page numbers for direct quotes).

*Analog #1 (Noise Study)* (1961)

This was Tenney's first piece at Bell Labs, and he describes its genesis below:

> "For several months I had been driving to New York City in the evening, returning to the Labs the next morning by way of the heavily traveled Route 22 and the Holland Tunnel. This circuit was made as often as three times every week, and the drive was always an exhausting, nerve-wracking experience, fast and furious, … The sounds of the traffic—especially in the tunnel—were usually so loud and continuous that, for example, it was impossible to maintain a conversation with a companion. It is an experience that is familiar to many people, of course. But then something happened, which is perhaps not so familiar to others. One day I found myself *listening* to these sounds, instead of trying to ignore them as usual. The activity of listening, attentively, to 'non-musical,' environmental sounds was not new to me—my esthetic attitude for several years had been that these were potential musical materials—but in this particular context I had not yet done this. When I did, finally, begin to listen, the sounds of the traffic became so interesting that the trip was no longer a thing to be dreaded and gotten through as quickly as possible. From then on, I actually looked forward to it as a source of new perceptual insights. Gradually, I learned to hear these sounds more acutely, to follow the evolution of single elements within the total sonorous 'mass,' to feel, kinesthetically, the characteristic rhythmic articulations of the various elements in combination, etc. Then I began to try to analyze the sounds, aurally, to estimate what their physical properties might be—drawing upon what I already knew of acoustics and the correlation of the physical and subjective attributes of sound.
>
> From this image, then, of traffic noises—and especially those heard in the tunnel, where the overall sonority is richer, denser, and the changes are mostly very gradual—I began to conceive a musical composition that not only used sound elements similar to these, but manifested similarly gradual changes in sonority. I thought also of the sound of the ocean surf—in many ways like the traffic sounds—and some of the qualities of this did ultimately manifest themselves in the *Noise Study*. I did not want the quasi-periodic nature of the sea sounds in the piece however, and this was carefully avoided in the composition process. Instead, I wanted the aperiodic, 'asymmetrical' kind of rhythmic flow that was characteristic of the traffic sounds."
>
> (pp. 24–25)

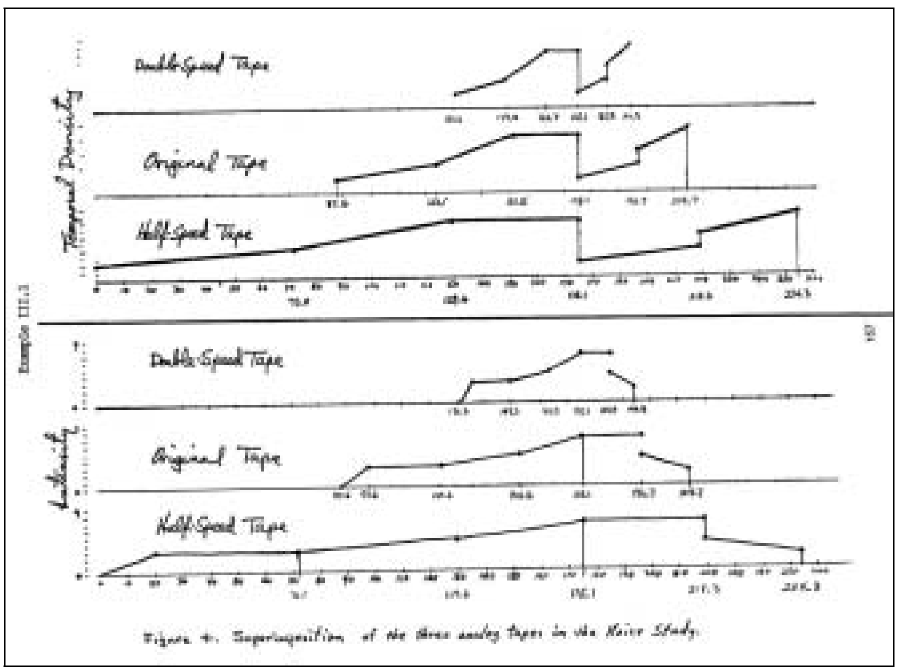
How similar this is to Varèse's love for the noises of the city (as in *Amériques*, *Déserts*, *Ionisation*, …) and to so many of the ideas implicit in Cage's use of noise. It is interesting that the very first "instrument" Tenney constructed at Bell Labs was the very thing that much of electronic music has since tried to eliminate: a complex noise generator. The instrument itself uses amplitude modulation, with the ability to select a center frequency, amplitude, and bandwidth, and to interpolate over a given duration between selected initial and final values for these parameters. The piece uses up to fifteen of these instruments at some points, though this is a result of the combination of three different speeds of an initial tape (on which only five instruments are used). Tenney describes the large-scale structure as follows:

"The piece is divided into five sections, the durations of the sections decreasing, progressively, from the first to the fifth. The piece begins slowly, with relatively wide noise-bands whose center frequencies are distributed evenly throughout the pitch range, approximating a white noise. As the average intensity and temporal density increase (in the second and third sections) the noise bandwidths decrease, until the sounds of each instrument are heard as tones with amplitude fluctuations, rather than as noise-bands. The beginning of section 4 is marked by a sudden change to a lower temporal density (i.e., longer note-durations), wider bandwidths, and a new amplitude envelope is introduced, with percussive attack followed by a decreasing—then increasing—amplitude. During this fourth section the average intensity is maintained at a high level. The fifth section begins at a lower intensity, which decreases steadily to the end of the piece. This return to the conditions of the beginning of the piece is manifested in the other parameters also, except for the temporal density, which increases during the last two sections from a minimum (like the beginning) to a maximum at the end. Thus, except for this note-duration parameter, the over-all shape of the piece is a kind of arch."

(p. 28)

*Temporal density* is, in Tenney's usage, roughly equivalent to tempo. More precisely, the temporal density of a given "temporal gestalt unit" is the number of lowest level ("element") events it contains "per unit time," so that, for example, a phrase that contains ten notes over ten seconds has a higher temporal density than one which contains eight over the same duration.

The following chart shows the way in which the three tapes were timed and mixed together to form *Noise Study*.




*Noise Study* began the aesthetic direction that Tenney would later develop in pieces like *Phases.*

Technical note: *Noise Study* was originally released on Decca DL9103, *Music from Mathematics.* This version is digitally reconstructed and remastered from the original analog tapes.

*Dialogue* (1963)

> "If I had to name a single attribute of music that has been more essential to my esthetic than any other, it would be variety. It was to achieve greater variety that I began to use random selection procedures in the *Noise Study* (more than from any philosophical interest in indeterminacy for its own sake), and the very frequent use of random number generation in all my composing programs has been to this same end. I have tried to increase this variety at every Gestalt 'level'—from that of small-scale fluctuations of amplitude and frequency in each sound (affecting timbre), to that of extended sequences of sounds—and in as many different parameters of sound as possible (and/or practicable). The concept of *entropy* has been extremely useful as a descriptive 'measure' of variety, and several important laws of musical structure have been derived in terms of entropy relations (see the memo "On Certain Entropy Relations in Musical Structure" included with my articles). The composing programs described below represent various attempts to combine the clang concept developed in *Meta + Hodos* with more recent ideas about these entropy relations and stochastic processes in general."
>
> (p. 40)

Tenney's computer programs for *Dialogue* and an earlier set of pieces (*Four Stochastic Studies*) utilize, for the first time, the model for gestalt formation processes outlined in *Meta + Hodos*. This motivated the first facility to write compositional subroutines in the MUSIC IV context, an idea with important ramifications for composers of the next forty years. MUSIC IV and most subsequent sound synthesis programs of its genre (until very recently) were primarily "performers"—their main function was to generate sound given certain parameters according to a "score/orchestra" paradigm. The composer specifies detailed values for musical parameters (pitch, duration, loudness, timbral values, etc.) of software-constructed computer *instruments* (of the composer's design)—each set of values constitutes a *note* (or perhaps, an *event*). While this procedure affords the composer a type of control similar to the traditional manner of writing a score, it does not take into account the use of the computer as an aid to *compositional intelligence*. Tenney very quickly saw the need for this, and with Max Matthews developed the necessary software for incorporating compositional subroutines written in high-level languages (at the time, FORTRAN) into the MUSIC IV system. The synthesis program would then get the data it needed from the compositional program, where these data were "composed" by composer-written algorithms.

Tenney was interested in specifying mean and range values for certain parameters (in this case note duration, amplitude, and frequency), and programming the computer to select probabilistic values around these fixed ones. Given a fixed (or variable) begin-time and end-time, such a statistical specification creates what Tenney calls *temporal gestalt units* (TGs). The means and ranges would of course vary from TG to TG, and this specified progression of values in a sense determines the piece. He called a TG comprised of small level (*element*) values a *clang*. He also specified that at least one of the three parameters in any clang should "be variable over its entire range, whereas the other parameters might be varying (temporarily) over a narrower range" (page 42). Tenney also specified the total number of clangs to be generated, along with extreme values for their durations (an overall duration range), the number of voices to be generated per clang, the rest probability for each voice, and the FM range for each voice. By changing values for the above, four different pieces were generated, called the *Four Stochastic Studies.*

*Dialogue* represents certain improvements and extensions to the program used for the previous studies. One modification was the ability to superimpose *larger hierarchical forms* on the clang-by-clang chain of events. To do this, Tenney specified initial and final *mean* values for a given *sequence* (composed of clangs in the same way that clangs are composed of elements). The computer used interpolated values (from the clang starting times) to stochastically compute means for the clangs. This in a sense replicates the choice process within the clangs themselves, and ensures "that some sense of 'direction' could be given to longer sequences, while still allowing the smaller details to vary randomly" (page 44). The actual instruments used in *Dialogue* were of a different sort as well, in that they either produced noise bands or tones in response to a given probability input. Additional parameters are also added to the instruments' repertoire:

> "These are amplitude-modulation *rate* (which becomes noise *bandwidth* for faster rates), and amplitude-envelope function-number. The two types of stored functions are arranged in arbitrary 'scales' and controlled in essentially the same way the other parameters are. (The arrangement of the function-number scales is not entirely arbitrary: for wave-form, the spectra with more energy in the lower harmonics were given the lower scale-values, and for amplitude-envelope, those with the shorter rise-time were given the lower values. Thus, a sequence could change, gradually, from less to more 'penetrating' and/or 'percussive' timbres, for example.)"
>
> (p. 44)

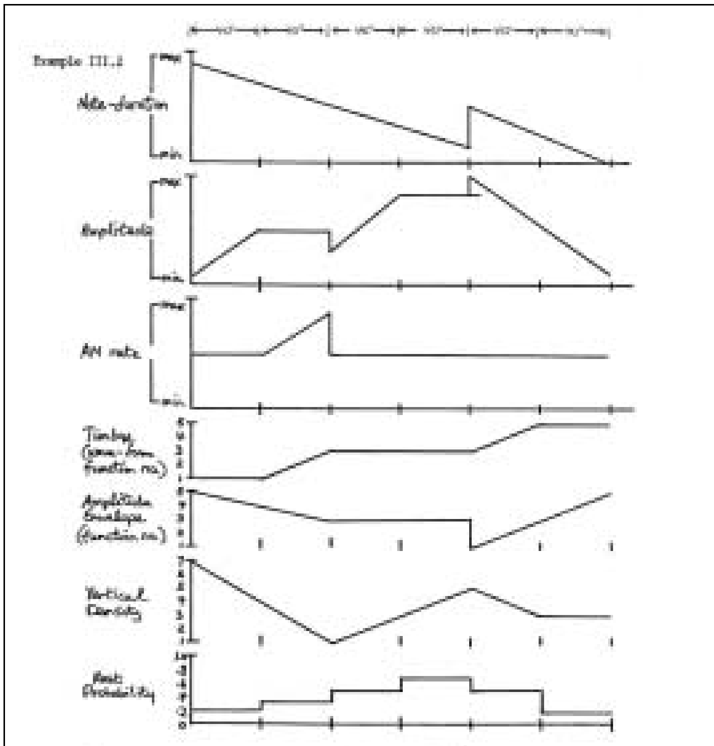



Figure IIa. Parametric Means for "Dialogue" (tonal stratum).

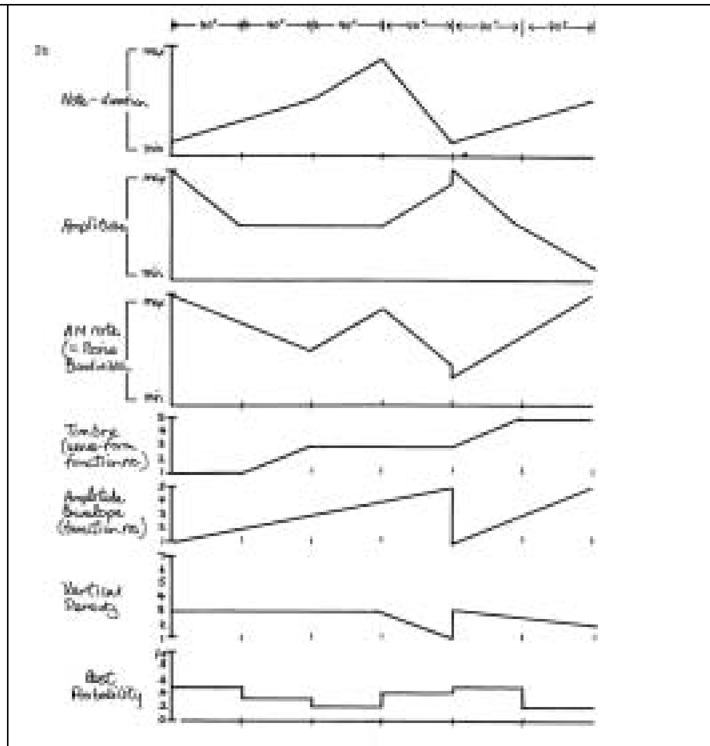



Figure IIb. Parametric Means for "Dialogue" (noise stratum)

*Dialogue* is, formally, a dialogue between noise-bands and pure tones. The diagram shows the complete form, and accurately reflects the input to the computer program. The first diagram shows the graphs for the mean values of tonal parameters, and the second shows similar parameters for the "noise-tones." Noteworthy is this program's early use of what has become an important technique in modern digital sound synthesis, the use of wave-tables—preset data-sets (functions) that a composer can call up to use in a variety of ways. Intelligent structuring of systems of these functions, that is, how to order them perceptually, remains an interesting question—Tenney's ordering of the timbral space is quite ingenious, still interesting to those of us who deal with these same questions today.

Technical note: The version on this CD was digitally remixed and remastered from the original analog tapes.

*Phases (for Edgard Varèse)* (1963)

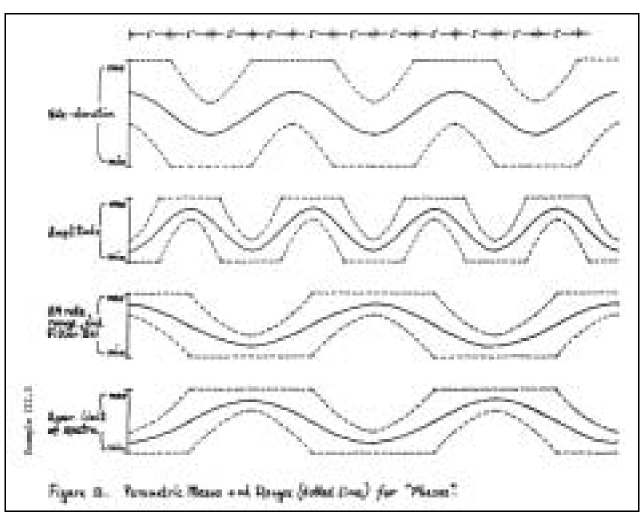
To me, *Phases* is the most beautiful and interesting of these works. It is difficult to describe its ungainly, almost otherworldly effect—as if it were not composed by either man or machine, but some goblin-hybrid of the two. It remains, as well, one of the least accessible of Tenney's compositions, seeming to exist for its own purposes entirely. Listening to it often seems like eavesdropping on a silkenly beautiful alien conversation. It is, not surprisingly, little known, as it makes few compromises to any of the criteria usually posited for "good" music. Its coherence occurs on a larger level than we are yet able to easily perceive. I think that in this piece, and also perhaps in *Ergodos II* (which followed it), Tenney realized his goal at Bell Labs, to have the computer-produced work do things that he could not foresee, and transform his own musical thinking.

The sound quality of *Phases*, though, is exciting. It's funky. The subtle use of noise, pitches just on the level of audibility, minuscule glissandi that remind one of the inner patterns in rice paper, are all in their own ethereal way quite moving. It is as if *Phases* is a surreptitious window on an ongoing perceptual and sonic communication from another dimension.

A lot of this has to do with the further extensions Tenney made to his instrumental repertoire in *Phases:*

> "One of the most obvious aspects of many of these environmental sounds was their frequency instability—'glissandi' and 'portamenti,' as well as faster modulations. The sounds in *Dialogue* and *Ergodos I* had some frequency 'enveloping,' and this now seemed a necessary extension of the list of variables. Filling in the gap between tones and noise-bands was achieved simply by allowing intermediate values to occur in the parameters affecting the noise—the range and rate of random amplitude modulation. In addition, it seemed desirable to envelope the AM rate so that the bandwidth of the noise could vary within each sound."
>
> (pp. 55–56)

Another important factor in the generation of more complex and varied tones was the use of a rather complex *amplitude compensating band pass filter* in the stored functions, to produce an enormous range of spectral variation on a limited set of basic waveforms. The complexities of this filter have more to do with the mechanics of digital sampling than anything else (and indeed seems quite simple when compared with the digital filters in use today) but what is important is that its *bandwidth* and *center frequency* could be modified continuously in time, independent of the fundamental frequency, creating a powerful instrument for spectral shaping and manipulation. (Tenney refers to it as a *formant filter*). Tenney was searching out each timbral parameter and more or less applying the same idea: Their functions should be controllable by the stochastic processes that govern TG formation.



Formally, the *Phases* program incorporates still one higher level of TG determination, what Tenney calls the *section*. Now, not only parametric means of clangs are determined by the machine, but also the parametric means and ranges of sequences, which previously had to be input by the composer. This extends the hierarchical process to four levels (element, clang, sequence, section). Tenney's graph shows the shapes of the parametric functions in several of what he considers to be the most important parameters. One can see both the elegant form and the genesis of the title—the functions are each sinusoids of varying wavelengths, and as such change phase relative to each other. These slow-moving sinusoids create the perceptual effect of a clear overall movement but imperceptible change, and only if the listener focuses attention on a given parameter (and this is difficult to do!) can the direction and nature of the parametric evolutions be perceived.

*Music for Player Piano* (1963–1964)

Tenney was one of the first composers to actively champion the player-piano music of Conlon Nancarrow, and wrote the first extended critical study of Nancarrow's work. However, his computer-composed *Music for Player Piano* preceded any real knowledge of Nancarrow's music. In this piece, which is actually one short piece realized in four "orientations," Tenney made use of the same types of computer-generated stochastic decision-making processes used in such pieces as *Dialogue, Phases,* and so on. Like *Ergodos I* and *II,* geometric orientations of the medium itself (in this case player-piano rolls, instead of analog tape) are physically responsible for the different versions of the piece. In *Music for Player Piano,* the computer only specifies values for pitch, duration, and event density. The result of the computer's compositional process was then punched onto a piano roll (not by Nancarrow, as was Tenney's later *Spectral CANON for CONLON Nancarrow,* but in New York City), to be played in four orientations: forward, backward (retrograde), upside-down (inversion), and upside-down and backward (retrograde inversion). The order on this recording is: original, retrograde inversion, inversion, retrograde, so that the complete set is a palindrome, or mirror image of itself.

Technical note: This recording was made from the rolls themselves by John Oswald and Marvin Green in the early 1980s, in Toronto, using PCM digital recording technology. We are grateful to these two composers for the use of their extraordinary recording.

*Ergodos II (for John Cage)* (1964)

The concept of an ergodic information domain, one in which (put rather simply) any given slice of the material is equivalent statistically to any other slice, has been of great importance to contemporary composers since the early work of people like John Cage, Philip Corner, Iannis Xenakis, and Tenney. The effects of such an environment on our perception, and the choice of how to create this auditory phenomenon has remained an idea of tremendous interest. In a way, the music from the 1960s that is often called *minimalism* is a special case of music whose large form is ateleological, but in which intricate (or even simple) microstructure is of sonic importance. Composers (and listeners) have been fascinated by such works, and have experimented both with the concepts of apparent change along specific parametric axes (like Cage's pioneering *Music of Changes*), or with very slow and steady modification along *one* parametric axis. Tenney's characteristic response to this idea was to first try to more or less scientifically explain it to himself, and then to create music which utilized that property of ergodicity, trying to remove traces of "dramatic intent."

> "Both the *String Quartet* and *Dialogue* made use of programming facilities enabling me to shape the large-scale form of a piece in terms of changing means and ranges in the various parameters in time. Now my thoughts took a different turn—an apparent reversal—as I began to consider what this process of 'shaping' a piece really involved. Both the intention and the effect here were involved in one way or another with 'drama' (as in Beethoven, say)—a kind of dramatic "development" that inevitably reflected ('expressed') a guiding hand (mine), directing the course of things now here, now there, etc.

> What seemed of more interest than this was to give free rein to the sounds themselves, allowing anything to happen, within as broad a field of possibilities as could be set up. One question still remained as to the possible usefulness of my controls over the course of parametric means and ranges: are there ways in which the full extent and character of the 'field' may be made more perceptible—more palpable—by careful adjustments of these values?"
>
> (p. 52)

*Ergodos II* was the last work Tenney completed at Bell Labs, and is a fitting, Zen-like conclusion to his formal and aesthetic investigations. Eighteen minutes long, the analog tape may be played in either direction. The tape "might be subdivided into two or more segments of approximately equal length, and these segments played simultaneously (over one to N pair of loudspeakers, for N segments)." Tenney later used *Ergodos II* with the Tone Roads ensemble in conjunction with the set of pieces referred to as *Instrumental Responses* (1964). In addition, *Ergodos II* is the first piece to use the stereo facilities that had recently been added into Matthews's program. Predictably, Tenney adds the spatial distribution of the sounds into the list of parametric variables that are subject to stochastic distribution. The instruments and algorithms are almost identical to *Phases*—it has the same rich texture, but the piece has, by any reasonable definition, no form. The musical effect is startling. *Ergodos II* seems to have been an almost *required* piece, the final step in a series of investigations into the perceptual unknown. In this regard, I had always been curious about the last sentence in Tenney's paper, where he cryptically states:

> "Another piece was begun after its completion, but abandoned when my dissatisfaction with the early test results made it clear that I would not have time to complete it before leaving."
>
> (p. 60)

The reader might wonder, as I did, what could possibly follow *Ergodos II,* and Tenney later informed me that it eventually became the tape work *Fabric for Ché* (1967).

Technical note: The version on this CD was digitally remastered from the original analog master.

*Fabric for Ché* (1967)

*Fabric for Ché* is both beautiful and ugly, a relentlessly noisy evocation of the revolutionary political energy of its time—an angry, poetic shout. (The work's composition is contemporary with Guevara's ill-fated attempt to establish a continent-wide revolutionary movement in Central Bolivia.) Tenney explains it as an attempt to create a continuous sonic event with no beginning and no end. Like much of his other music—"the whole piece conceived as consisting of but *a single sound,* more or less complexly 'modulated'." The individual microscopic sonic events are "noisy" and like *Ergodos I* and *II,* the texture, intensity, and overall timbre are static.

*Fabric for Ché* was realized at the Brooklyn Polytechnic Institute (where Tenney taught for a while), using taped sequences originally generated at Bell Labs. It is somewhat surprising to hear it today, with its many-faceted sonic relationships: to the music of Xenakis, to works of composers using techniques like granular synthesis and, even more appropriate perhaps, to industrial noise music of the 1970s and 1980s. The piece is, like *Music for Player Piano,* a palindrome (like some of the music of Carl Ruggles, which has been so influential for Tenney): The second half is the reverse of the first.

*For Ann (rising)* (1969)

*For Ann (rising)* is to many people Tenney's signature piece, archetypical of his aesthetic. Its genesis lies in what has now become known as a *Shepard-tone* (named for the great experimental psychologist R. N. Shepard, a pioneer of multi-dimensional scaling and an associate of Tenney's at Bell Labs. There are, however, some subtle differences between Tenney's sound and what is usually meant by Shepard-tone). The phenomenon has also been associated closely with the work of Jean-Claude Risset, another important early computer music pioneer. This now-classic auditory illusion, like an Escher woodcut, seems to continuously rise.

Tenney's piece is about twelve minutes long, and consists of smoothly rising glissandi, each at an interval of a minor sixth from its upper and lower neighbors. The glissandi begin in the infrasonic (below our sense of pitch) range and gradually, over the course of about half a minute, climb into the ultrasonic (over around 20 kHz). Each glissando has a fade in/fade out amplitude envelope on it, so that its entrance and exit are imperceptible. The composite effect is of a complex, almost contrapuntal gestalt. The listener's attention constantly shifts, both between various bands of the spectrum and the various levels of her own perception, in an often breathtaking and disorienting way. At any given point, there are between 12 and 15 glissandi present—the continual overlapping is what creates the illusion.

I have heard Tenney speculate on a possible modification of this piece which would, I think, be an interesting exploration. He suggests that each glissando be related to the one on either side by the value (often denoted as $\phi$ or phi) which is the limit of the ratios of successive Fibonacci terms (2:1, 3:2, 5:3, 8:5, 13:8, 21:13…), or about 1.618033988749894 (etc.), a minor sixth. This interval is about 833 cents [¢: where 100¢ = 1 equal-tempered semitone], as compared to 813.7¢ for the common just minor-sixth of 8/5, 840.5¢ for the harmonic-series minor/major-sixth of 13/8, and 800¢ for the 12-tone equal-tempered. The current version of the piece only approximates $\phi$, but a more exact tuning would result in the surprising result that all *first-order difference-tones* of any given glissando pair would already be present in some lower glissando. That is, all *resultant* tones would replicate existing ones, and the piece might conceivably be smoother, or more "perfect," and even more illusory (a classic "Shepard-tone" uses the octave as a similar "trick," but with the octave). This rather simple yet surprising result of the Fibonacci numbers, or more accurately of the *golden mean*, can be seen visually in the common representations of it as a sequence of inscribed rectangles with sides proportioned in this fashion. What Tenney describes is an important acoustic ramification of this very popular concept. A "fine tuning" of the piece with today's digital technology would be relatively simple, and an interesting worthwhile experiment.

Technical note: The original analog recording of *For Ann (rising)* was first released on *Musicworks* cassette #27. It was later remastered by Tom Erbe, and appeared on *Ear* magazine's Absolut Music CD #3. The version on this recording was regenerated by Tom Erbe using Barry Vercoe's CSound composition and synthesis language, according to Tenney's specifications.

**James Tenney** was born in Silver City, New Mexico, and grew up in Arizona and Colorado, where he received his early training as a pianist and composer. He attended the University of Denver, The Juilliard School of Music, Bennington College, and the University of Illinois. His teachers and mentors have included Eduard Steuermann, Chou Wen-Chung, Lionel Nowak, Carl Ruggles, Lejaren Hiller, Kenneth Gaburo, Edgard Varèse, Harry Partch, and John Cage. A performer as well as a composer and theorist, he was co-founder and conductor of the Tone Roads Chamber Ensemble in New York City (1963–70). He was a pioneer in the field of electronic and computer music, working with Max Mathews and others at the Bell Telephone Laboratories in the early 1960s to develop programs for computer sound-generation and composition. He has written works for a variety of media, both instrumental and electronic, many of them using alternative tuning systems. He is the author of several articles on musical acoustics, computer music, and musical form and perception, as well as two books: *Meta + Hodos: A Phenomenology of 20th-Century Musical*

*Materials and an Approach to the Study of Form* (1961; Frog Peak, 1988) and *A History of 'Consonance' and 'Dissonance'* (Excelsior, 1988). He has received grants and awards from the National Science Foundation, the National Endowment for the Arts, the Ontario Arts Council, the Canada Council, the American Academy and Institute of Arts and Letters, the Fromm Foundation, the Deutscher Akademischer Austauschdienst, and the Jean A. Chalmers Foundation. He has taught at the Polytechnic Institute of Brooklyn, the University of California, and at York University in Toronto, where he was named Distinguished Research Professor in 1994. He now holds the Roy E. Disney Family Chair in Musical Composition at the California Institute of the Arts. His music is published by Sonic Art Editions and the Canadian Music Centre, and is distributed by them and by Frog Peak. Recordings of his works are available on the Artifact, Col Legno, CRI, hat[now]ART, Koch International, Mode, Musicworks, Nexus, OO Discs, SYR, and Toshiba EMI labels, among others.

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*Bridge & Flocking*. T. Bächli, G. Schneider, E. Radermacher, M. Werder, pianos. hat ART 6193.
*Critical Band*. Relâche Ensemble. Mode 22.
*Forms 1–4*. MusikFabrik. hat[now]ART 2-127.
*Music for Violin and Piano*. M. Sabat, violin; S. Clarke, piano. hat[now]ART 120.
*Saxony*. U. Krieger, saxophone. OO Discs 32.
*The Solo Works for Percussion*. M. Kaul, percussion. hat[now]ART 111.
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**JAMES TENNEY** (b. 1934)
**SELECTED WORKS 1961–1969**
80570-2

1. *Collage #1 ("Blue Suede")* (1961) 3:22
2. *Analog #1 (Noise Study)* (1961) 4:23
3. *Dialogue* (1963) 4:08
4. *Phases (for Edgard Varèse)* (1963) 12:20
5. *Music for Player Piano* (1963–64) 5:48
6. *Ergodos II (for John Cage)* (1964) 18:24
7. *Fabric for Ché* (1967) 9:50
8. *For Ann (rising)* (1969) 11:47

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