CASCANDO

REALIZATION OF SAMUEL BECKETT'S RADIO PLAY BY CHARLES DODGE

CAST OF CHARACTERS

Opener	John Nesci
Voice	Computer synthesis based on a reading by Steven Gilborn
Music	Computer synthesis based on Voice

Realization made at the computer centers of Columbia University and the City University of New York and the Center for Computer Music at Brooklyn College.

CHARLES DODGE

CASCANDO

realization made at the computer centers of Columbia University and the City University of New York and the Center for Computer Music at Brooklyn College

CHARLES DODGE (b. 1942, Ames, Iowa) has long been recognized as an accomplished composer of computer music. He was one of the first composers to use computer speech and speech music synthesis in composition. He studied composition at the University of Iowa, Aspen, Tanglewood and Columbia University. Among his teachers were Richard Hervig, Darius Milhaud, Arthur Berger, Gunther Schuller, Jack Beeson, Chou Wen-chung and Otto Luening. He studied electronic music with Vladimir Ussachevsky and computer music with Godfrey Winham and has done research in computer music at the Bell Telephone Laboratories. He was Visiting Research Musician at the University of California at San Diego, and he has been Visiting Composer-in-Residence at the M.I.T. summer course in computer music on several occasions. Most of his works since 1970 have been recorded, including those on CRI SD 300 and 348. In 1980, he became Professor of Music at Brooklyn College of the City University of New York where he is director of the Center for Computer Music and Coordinator of Undergraduate and Graduate Programs in Composition. CASCANDO is dedicated to his wife, Katharine Schlefer Dodge.

CASCANDO is Charles Dodge's realization of Samuel Beckett's radio play of 1963. Like Beckett's *Words and Music*, *Cascando* has three characters: Opener ("Dry as dust"), Voice ("low, panting"), and Music. "Music" is not characterized by Beckett, but he indicates very precisely in the published play (with rows of dots) where it is to "speak" alone, sound together with Voice, or be overlaid with a comment from Opener. Thus, as Vivian Mercer has remarked in her *Beckett/Beckett*, *Cascando* could be described as a kind of libretto, and it and *Words and Music* "inaugurate a new genre—invisible opera."

This "libretto" attracted Dodge when, finishing his *Speech Songs* (CRI SD 348) in 1972, he began looking for other material for his "pitched speech" composition. At first the Beckett play seemed too long for the purpose, but Dodge ended up using it entirely, word for word, (plus, of course, music for Music). He worked at it, off and on, for more than five years. Beckett gave Dodge permission to "musicalize" *Cascando*, but initially withheld rights to public presentation. However, on receiving a copy of the finished tape in the spring of 1978, he wrote, "Dear Mr. Dodge: Thank you for your letter of April with the tape of your CASCANDO. Okay for public performance." (Dodge finds the "your" flattering, and we shall see presently how accurate it is.)

There are about as many interpretations of the meaning of Beckett's drama as there have been interpreters of it. Perhaps the narrative Voice is that of Opener himself, the former trying desperately to tell the very last story—to "finish it...then sleep... no more stories... no more words."—while the latter (austere, confident, presiding) opens and closes the bits of story and music, aware (as Hugh Kenner says in *A Reader's Guide to Samuel Beckett*) that he is "incomprehensible to censorious folk called 'they'":

> They say, That is not his life, he does not live on that. They don't see me, they don't see what my life is, they don't see what I live on, and they say, That is not his life, he does not live on that.
> *Pause.*
> I have lived on it. . . pretty long.

The story that Voice tries to tell is about a man called Woburn, going out at night on a familiar search ("same old coat...same old stick"), who keeps falling (=*cascando*) "...on purpose or not...can't see...he's down...that's what counts," in mud, in sand, in stones, finally in the bilge of an oarless, tillerless boat "heading out...vast deep...no more land." Voice breathlessly follows Woburn, dying to end his story ("...to see him... say him"), hoping that "this time...it's the right one." Music is with Voice in this quest; Opener comments, perhaps with wonderment, "From one world to another, it's as though they drew together." But, at the close, although Woburn clings on (to the boat? to the narrating Voice which cries "come on...come on" together with Music?), there is only extinction. (The last word of the play, a direction, is "*Silence.*")

The three characters of the drama are realized by Dodge in three different ways: Opener is represented by a normal speaking voice (that of actor John Nesci); Voice is represented by synthesized pitched speech derived from a reading of the part by another actor (Steven Gilborn); Music is represented electronically, but it is derived from, and relates directly to, the opening speech of Voice. It may be useful to describe the various steps along the way to the final composition, partly to insist on the close relationship between computer-aided synthesis of sound (as Charles Dodge does it) and traditional ways of composing—to insist, that is, on the profound musicality of Dodge's CASCANDO.

Dodge began by composing the basic part for Voice, from start to finish. Both rhythm and pitch are notated conventionally, but separately. Both were arrived at empirically, not according to any "system." The rhythms are close to natural speech rhythms. The pitch-successions are freely chromatic but not twelve-tone; they were chosen, says Dodge, "to capture the spirit of what I thought the Voice was like." Also, Beckett's many repetitions of words and phrases—but in many different contexts—were taken into account: "I tried to use the same pitch-successions for the same words, when they recur. The problem became how to compose a pitch-pattern for a particular word that would be suitable in all of the contexts in which it occurs." The pitch-patterns of individual words, then, became recognizable musical motifs, and their recurrence is a significant factor in the integration of the work.

The separation of rhythm and pitch components facilitated things at the next stage of composition. Steven Gilborn recorded the Voice part, reading it in the rhythms Dodge had given it but not attempting to reproduce the pitch-patterns. That recording was run through a computer, programmed so as to convert it from analog to digital state—to a stream of numbers— and to analyze the material on the tape in infinitesimal detail: the computer analysis is of some 24 attributes of sound, of which four are printed out: (1) high frequency amplitude; (2) low frequency amplitude; (3) ERRN, a relationship between (1) and (2) which helps distinguish between voiced and unvoiced phonemes; and (4) the average pitch, expressed in cycles per second. The print-out consists of pages and pages of lines of "frame numbers," each line representing the four attributes at 1/120 of a second. The beginning (only) of the sound of the "c" in Voice's first line, ("if you could finish it"), for example, looks like this in the computer analysis of Gilborn's reading:

Fr. No.	High Fr. Amp.	Low Fr. Amp.	ERRN	Avge. Pitch
704	5.066860	38.038544	0.017743	214.285706
705	4.550298	46.835800	0.009439	98.684204
706	44.208771	195.746399	0.051007	98.684204

With the print-out of the computer analysis, Dodge had a finely detailed picture of the Voice part, with the rhythmic component more or less as he wished it. Next came a re-synthesis of Voice, based on the Gilborn reading as analyzed by the computer (and the analysis studied by Dodge) but now introducing the desired pitch-successions and the quality of the sound. The latter, Dodge had decided, was to have both pitch and noise components in about equal measure, "as though you made simultaneously a pitched voice and a whispered voice." This resulted

in the strained, rasping character of Voice—slightly repellent but poignant, too.

Now the synthesized Voice was re-converted to analog tape, and, with razor blade and splicing tape, Dodge went to work editing it, to make sure that all the timings were just the way he wanted them. This, then, was the Voice part.

In Dodge's realization of *Cascando*, Opener's part is left unmusicalized: it is simply a recording of an actual human voice. This was taped separately, the actor who read it going through the part a few times, Dodge choosing the best take of each passage. The parts for Voice and Music, however, *are* musicalized. There are eight "solos" for each, alternating as the piece unfolds, and at times they engage in "duets." Having finished the composition of the Voice, and the tape-editing of the Opener, Dodge turned to Music. How was it to relate to Voice (if at all), and how were the two to interrelate (if at all) during the duets?

Dodge decided to relate Music's quality of sound to that of Voice by having it, too, consist in equal-mixture pitch and noise, and he decided that the pitch-succession of the two would also be related:

> What I finally settled on was that the sound-quality of Music would be directly derived from the recording of Voice—by feeding the synthesized Voice back into the computer and doing further operations on it to eliminate its intelligibility but to magnify its pitch-and-noise quality—its musicality. It was to be almost as if you trained on the Voice a microscope so powerful that the larger patterns, forming words, would be imperceptible; only the microscopic details would be apparent. Or as if you took a magnifying glass to a photo in a newspaper and viewed the individual dots, all of varying shades of grey.
>
> Also, the pitch-patterns of Music, I decided, would be related directly to those of Voice's opening speech, but greatly elongated.

The latter relationship—between the pitch-patterns of Music and those of Voice—is based on an inversion of the latter. However, each of the pitches thus derived is greatly protracted, and there are many overlappings of pitches, so that, to the ear, the derivation of Music from the opening speech of Voice is hardly perceptible.

On the relationship between Voice and Music in their duets (of which there are five): Throughout the play, Voice is very fragmentary; it constantly starts and stops. Says Dodge:

> I wanted to capture something of that in the music, but not to have the music starting and stopping. So what I did was to "track," in the computer, the way Voice starts and stops. When the voice is "on"—that is when the computer, in "reading" the Voice parts, finds that there is sound—it emphasizes pitch qualities. When it finds that there is silence, it emphasizes noise qualities.

Another kind of relationship between Voice and Music in the duets was derived from the fact that speech has two kinds of syllables, voiced and unvoiced. The word "story," for example, consists of two voiced syllables ("o-ry") preceded by an unvoiced one ("st-"). The predominance of noise or pitch at any given moment in Music's part was partly determined by the nature of Voice's syllables at that moment, and by the order of voiced vs. unvoiced syllables. In short, Voice "triggers" Music, which is why in the duets Music often seems to well up shortly following Voice: there is a tiny time-lag.

The actual mixing of the Voice/Music duets was done in the computer, as the last pre-editing act. Then came the job of putting everything together: spoken voice (Opener), synthesized voice (Voice), synthesized music (Music), and the duets. By January 1983, Dodge's CASCANDO ("your" *Cascando*, said Beckett) was complete.

H. Wiley Hitchcock
Director, Institute for Studies
in American Music at
Brooklyn College

STEVEN GILBORN is a professional actor whose favorite medium is the stage. He has performed leading roles at regional theaters all around the country: among those roles are Prospero, Brutus, Malvolio, and Benedick. He has also worked extensively in radio, television and film, his most recent movie appearances being in *Enormous Changes at the Last Minute* and *Vamping*. CASCANDO is his third collaboration with Charles Dodge. JOHN NESCI has worked with Charles Dodge on recordings of Richard Kostelanetz's *He Met Her in the Park* and the radio serial *Lights from Below*. Nesci has appeared in films and on television and the stage. His work includes productions with Mabou Mines, La Mama Etc., Sam Shepard and Robert Wilson. Originally from Chicago, Nesci lives and works in New York City.

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CRI's Board of Trustees wishes to express its gratitude to the Mary Duke Biddle Foundation and the Norman and Rosita Winston Foundation for support during 1982-83.

This recording was made possible by grants from the Alice M. Ditson Fund of Columbia University.

CASCANDO—tape (BMI):32'15"

Liner: © 1983 Composers Recordings, Inc.
FOR CRI—
Producer: Carter Harman
Product Manager: Michael Bennett

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Printed in the U.S.A

CHARLES DODGE

FOLIA

Jeanne Benjamin, Michele Gallien, David Gilbert, Allen Blustine, George Haas, Donald Butterfield, Robert Miller, Raymond DesRoches, Richard Fitz; conducted by Jacques-Louis Monod

EXTENSIONS FOR TRUMPET AND TAPE

Ronald Anderson, trumpet; tape computed at the Columbia University Computer Center

BÜLENT AREL

MIMIANA II: FRIEZE

Realized at the Columbia-Princeton Electronic Music Center

BENJAMIN BORETZ

GROUP VARIATIONS (for Computer)

Realized at the Princeton University Computer Center

CHARLES DODGE (b. Ames, Iowa, 1942) studied composition at the University of Iowa, Aspen, Tanglewood and Columbia University. He numbers among his teachers Philip Bezanson, Darius Milhaud, Arthur Berger, Gunther Schuller, Chou Wen-chung, Jack Beeson and Otto Luening. He studied electronic music with Vladimir Ussachevsky and computer music with Godfrey Winham.

Mr. Dodge won his first (of four) BMI Student Composer Awards and his first (of two) Bearns Prizes while still an undergraduate. In 1970, with his mastery of computer music already well along, he became assistant professor of music at Columbia University, and the same year his *Changes* and *Earth's Magnetic Field* appeared on Nonesuch Records. In 1971, he began research in computer-synthesized speech and vocal sounds at the Bell Telephone Laboratories, and continued to work there in 1972-3 on a Guggenheim Fellowship. In February 1974 he was visiting research musician at the University of California (San Diego) Center for Music Experiment.

FOLIA was commissioned by the Fromm Music Foundation and was premiered under Melvin Strauss at the Berkshire Music Center in 1965; it is dedicated to Paul Fromm. It has also been conducted by Ralph Shapey with the Contemporary Chamber Players of the University of Chicago, and by Mr. Dodge with New York's Group for Contemporary Music.

Mr. Dodge writes:

"After an initial flurry of activity in the piano and percussion, FOLIA begins its evolution from a unified texture of sustained tones into extended solo and ensemble passages. In these, the possible diversities (of length-of-note, timbre, articulation, register and varieties of pitch and non- and almost-pitch) are balanced with the possible unities within these sonic dimensions. The title, meaning layers, refers to the resulting texture. The tracing of paths back and forth between unity and diversity results in a series of ever-heightened climaxes, and then in the music that leads from the final climax to the end of the work."

EXTENSIONS FOR TRUMPET AND TAPE was commissioned by and dedicated to Ronald Anderson, and was first performed by him at a concert of the Group for Contemporary Music in the spring of 1973. Mr. Dodge writes:

"The material for the trumpet and tape share a simple concept — equal interval divisions of pitch space — but diverge in their sonic surfaces. The trumpet part was freely composed with lyrical intent, using the pitch space of the octave and emphasizing its equal-interval divisions: tritones, thirds and seconds.

"The pitch space of the tape part is the continuum between 30 and 12,000 hz. The tape part, which consists entirely of sine-wave glissandos, begins with 16 equal-interval divisions of the pitch space. The sine-tones forming these divisions glissand to the intervallic mid-point of the pitch range, where the direction of the glissando is changed. With each change of direction, the number of tones (and thus the number of equal-interval divisions of the pitch-space) is doubled, until the last glissando, when the tape comprises 1024 tones.

"The trumpet and tape begin with successive solo statements of their respective materials. As the work evolves they overlap and the music ends as it began, with solo trumpet.

"The electronic portion was computed at the Columbia University Computer Center, using the Music 360 language, with digital-to-analogue conversion at the Nevis Laboratories."

JACQUES-LOUIS MONOD is widely respected as one of the finest conductors of today's music. He has conducted major orchestras in Europe and Britain and first recordings of important works by Berg, Webern, Carter and Schnabel. His most recent recording for CRI, Seymour Shifrin's THREE PIECES FOR ORCHESTRA, won the Koussevitzky Recording Award.

BÜLENT AREL (b. Istanbul, Turkey, 1919) graduated from the State Conservatory of Ankara, with a diploma in composition, piano, and conducting. He taught harmony and counterpoint in the same conservatory and piano and history of music at the Teacher's College in Ankara. He was one of the founders of the Helikon Society of Contemporary Arts, and was the regular conductor of the Helikon Chamber Orchestra for four years.

He studied sound engineering in Ankara under Joze Bernard and Willfried Garret of the *Radio Diffusion Française,* both members of the *Club d'Essai* of Paris. This collaboration marked the start of his interest in *musique concrète,* which later led him to electronic music. From 1951 until 1959 he worked at Radio Ankara as recording engineer and then as the Musical Director. In 1958 he pioneered in the field of electronic music combined with conventional instruments, with *Music for String Quartet and Oscillator.*

In 1959 he came to the United States as the recipient of a Rockefeller Research Grant for work at the Columbia-Princeton Electronic Music Center and in 1961 worked as an assistant to Vladimir Ussachevsky. The next year, he was lecturer at Yale University, where he installed an electronic music studio. Back in Turkey between 1963 and 1965, he composed the score for a musical which ran in Istanbul for over a year. In 1969 he was appointed Associate Professor and Director of the Electronic Music Studio at Yale and in September 1971, he became Professor of Music and Director of the Electronic Music Studio at the State University of New York at Stony Brook.

In 1974 he was completing a work for viols and electronic sounds commissioned by the New York Consort of Viols under a New York State Council of the Arts grant. He also received a National Endowment of the Arts grant in 1974, for completion of a large-scale piano work for pianist, Robert Miller.

He has composed symphonic works, chamber music, including *For Violin and Piano* (1966) recorded on CRI SD 264, and music for solo instruments. Of his many electronic works is *Stereo Electronic Music No. 2* recorded on CRI SD 268.

The composer writes:

"*Mimiana II: Frieze* was commissioned by the Mimi Garrard Dance Company. The choreography was completed some time before the musical score was composed. My general impression of the dance was of early Egyptian reliefs in which the human faces are seen in profile, while their torsos are facing outward. The dance gave me the feeling of a completely ritualistic procession consisting of slow and deliberate dancers' movements. Except for a few contrasting short bursts of fast, active sequences, the dance never lost its hypnotic character.

"In the musical score, all the sounds are electronically produced. Coincidently, the composition reflects some tonal feelings. From the middle part of the score, where the 'pure sounds' or sine waves are used, micro-tones are introduced and begin to give a descending character to the previously existing pitches by very gradually shifting the pitch structure downward — creating an intentionally blurred pitch relation.

"I restricted my sound colors and articulations only to those which would reflect the feeling of the dance. The MIMIANA II: FRIEZE musical score was composed and realized at the Columbia-Princeton Electronic Music Center in 1969."

BENJAMIN BORETZ (b. Brooklyn, 1934) began piano playing and composing in preschool years; was involved in writing and philosophy as well as music in high school and college; studied composition as a graduate student at Brandeis with Irving Fine and Arthur Berger; at Aspen with Darius Milhaud; at UCLA with Lukas Foss; and at Princeton with Roger Sessions and Milton Babbitt. He wrote articles for seven years as music critic for *The Nation*

(1962-1969); founded and has edited, first with Arthur Berger, then with Edward T. Cone, and most recently with Elaine Barkin, the semi-annual review called *Perspectives of New Music;* was a founder of the American Society of University Composers; has taught music since 1954; and is currently (1974) teaching at Bard College in Annandale-on-Hudson, New York.

While composing and teaching, he has also thought about music-theoretical, music-philosophical, and music-analytic matters, sometimes in literary form, and most conspicuously in a long essay entitled *Meta-Variations,* which has been published serially in *Perspectives,* and for which GROUP VARIATIONS was starting and focal point. Since completing the two versions of GROUP VARIATIONS (one for chamber orchestra, the other for computer), he has been working on a piece for chamber ensemble.

Mr. Boretz writes:

"The first (chamber orchestra) version of GROUP VARIATIONS was performed in 1967 and 1968 by the Group for Contemporary Music, under the direction of Charles Wuorinen. The computer version was begun in 1969, went through several intermediate versions, some of which were performed, and attained its present (presumably final) condition in 1973. During that time, the sound-synthesizing resources primarily used were those of Princeton University and Bell Telephone Laboratories; and the technical and auditory resources of Barry Vercoe, Hubert Howe, Richard L. Cann, Godfrey Winham, and J. K. Randall, among other musical habitués of the Princeton University Computer Center, were persistently exploited.

"For those whose auditory way into GROUP VARIATIONS might be improved by some extra-intuitive assistance, the following leads are offered: first, no matter what the prospect of computer-electronic performance tends to prepare you for, listen to GROUP VARIATIONS as polyphonic ensemble music, whose sonic surfaces are the fused images of networks of musical qualities, the *sounds of* such qualities rather than 'sounds' in some isolated, exotic, sense. A pervasive shaping focus for these images, amounting to a conceit of the piece, is that every sizable passage of GROUP VARIATIONS — including the 'passage' consisting of the whole piece — begins as if suddenly tuning into the middle of something, and ends as if suddenly tuning out of something new that had just previously begun. And, as each image is registered in the form of a phrase — or tune-stretch, give particular notice to what it subsequently *becomes,* as it merges, as a component part, into a still larger, single, complex image.

"Here another conceit of GROUP VARIATIONS, the musical resonance of an idea of complex congruence, may emerge: images of progressively larger time dimensions always fuse, in increasingly elaborate senses, into the same quality-network shape, so that wholes constantly retrieve and reincarnate the shapes of their component parts, and are subsequently themselves so retrieved and reincarnated. If, for a start, you listened to the image-chunks consisting first of the first four-attack stretch, then, of the first two such stretches, then, of the first two distinct stretch-type passages, and so on, you might get the feel of the process by which each trajectory 'arrives' at the same 'place' relative to its predecessors. Moreover, if you happened to identify the two stretch-types mentioned as complementary landscapes, the first conspicuously including places where several sounds attack together, and the second, places where single sounds attack several times in succession, many of the characteristics of the passages that ensue may come into sharper focus.

"Those interested in further guidance toward the specific depths of these particular surfaces (to paraphrase a phrase of Jim Randall's) are referred to the final chapter of *Meta-Variations,* and the score."

This recording of FOLIA was made possible by grants from the Martha Baird Rockefeller Fund for Music, Inc., the Fromm Music Foundation, the Contemporary Music Society and Joseph Machlis. The recordings of EXTENSIONS, MIMIANA II and GROUP VARIATIONS were made possible by grants from the American Composers Alliance.
Produced by Carter Harman
Cover uses computer art by Lou Katz. Art direction: Judith Lerner.
FOLIA and EXTENSIONS recorded by David Hancock
FOLIA — 11'45"
EXTENSIONS — 8'05"
MIMIANA II — 13 min.
GROUP VARIATIONS — 11'45"
ALL ACA (BMI)
LC#'s: Dodge 74-750093; Arel 74-750094; Boretz 74-750095
THIS IS A COMPOSER-SUPERVISED RECORDING

Printed in the USA

Digital computers have been employed in various aspects of music since the late 1950s. While some interest has been generated by the question, "Can computers compose?," most of the computer work by composers already experienced in the instrumental and electronic media has exploited the computer as an instrument of musical performance and particularly the great flexibility and accuracy which it provides. Using a computer, it is realistically possible for a composer to structure all elements of his composition (e.g., tempo, timbre, rate and shape of attack and decay, register, etc.) to the same degree as pitch and rhythm. Further, since compositions are coded onto computer cards, the composer can create different performances of his composition on successive computer runs by simply changing a few cards. Thus, computer sound synthesis reintroduces into the electronic medium a distinction between a composition and its performance.

It is through simulating the operations of an ideal electronic music studio with an unlimited amount of equipment that a digital computer synthesizes sound. The first computer sound synthesis program that was truly general purpose (*i.e.*, one that could, in theory, produce any sound) was created at the Bell Telephone Laboratories in the late 1950s. A composer using such a program must typically provide: (1) *Stored functions* which will reside in the computer's memory representing waveforms to be used by the *unit generators* of the program. (2) "Instruments" of his own design which logically interconnect these *unit generators*. (*Unit generators* are subprograms that simulate all the sound generation, modification, and storage devices of the ideal electronic music studio.) The computer "instruments" play the *notes* of the composition. (3) *Notes* may correspond to the familiar "pitch in time" or, alternatively, may represent some convenient way of dividing the time continuum.

The results of a computer run of a composition are stored on a computer tape in digital form (*i.e.*, as a succession of numbers) and are made audible through a special device called a digital-to-analog converter which transforms the digital information into continuous fluctuations in magnetism on audio tape.

Four different sound-synthesis programs were used to perform the works on this record: MUSIC IV (written by Max V. Mathews and Joan Miller at the Bell Telephone Laboratories) for *Quartets in Pairs;* MUSIC IVB (a greatly revised and expanded version of MUSIC IV by Godfrey Winham and Hubert S. Howe at Princeton) for *Mudgett;* a FORTRAN-language version of MUSIC IVB (written by Godfrey Winham) for *Quartersines* and *Changes;* and MUSIC 360 (an assembly-language program for IBM/360

computers written by Barry Vercoe) for *Synthesism*. All of the works used a digital-to-analog converter at the Bell Telephone Laboratories, and all were computed at the Princeton Computer Center with the exception of *Changes*, which made use of the Columbia Computer Center as well. The vocal parts for *Mudgett* were recorded at the Herbert H. Hagens studio in Princeton.

CHARLES DODGE

author of the MUSIC 360 programming language. Mr. Vercoe writes the following about his work: "*Synthesism* is a study in the less-typical aspects of computer-generated sound. Much of its material is either derived from or modified by the totally patternless output of a random-number generator. The structural base of the work is an ordered set of sixteen numbers that comprise a geometric series from 1 to 2. This set is projected onto various domains as a compositional determinant — for example, onto the octave to form an equal-tempered sixteen-note series and into the time domain to determine durations or to control successions of varying attack rates. *Synthesism* was computed using MUSIC 360, a special-purpose acoustical language designed specifically for synthesizing sound on IBM/360 computers. The language was conceived to enable the composer to code his 'instruments' in a clear and concise format which would facilitate extremely high-speed sound simulation on standard machines. *Synthesism* is an early product of that idea."

* * *

Charles Dodge received his early musical training in Ames, Iowa, where he was born in 1942. During his years as a composition student (at the University of Iowa with Philip Bezanson and Richard Hervig, at Tanglewood with Gunther Schuller and Arthur Berger, and at Columbia University with Jack Beeson, Chou Wen-chung, and Otto Luening), many of his works were awarded composition prizes. Since then, in addition to teaching in the music departments of Columbia and Princeton Universities, he has conducted research in computer sound synthesis at the IBM Thomas J. Watson Research Center and lectured on the subject for musicians, scientists, and engineers at various colleges and universities. Concerning his work, Mr. Dodge writes: "*Changes* was commissioned by the Serge Koussevitzky Music Foundation for performance at the Library of Congress. The texture of the composition comprises the same three elements throughout: lines, chords, and percussion; and each textural element delineates a different aspect of the composition's pitch structure. The chords play segments (3 to 6 notes) of the twelve-tone set that forms the basis of the work. In the course of the work the chords sound all 48 forms of the set. The lines play six-note segments of the set which are related to the original by rotation. The percussion duplicates the pitch-class content of the chords (*i.e.*, the percussion linearizes the pitches of the chords).

"For the computer performance I designed an 'orchestra' of 'instruments' that emphasize the different types of pitch-delineation. For the lines, a family of registral instruments was created which consist of a pulse generator (of the type used in speech synthesis) which is fed into multiple banks of filters in series. As the amplitude of the banks of filters is varied, the timbre of the note changes. Further, the center-frequency settings of the filters are changed with each chord change, so that the timbre-change itself changes as a function of the chord changes, which are themselves a function of the rate at which the lines sound all twelve tones. As the work progresses, each note in the lines incorporates more and more timbre-changes, so that at the end each note changes timbre six times. All of the 'percussion' sounds entail a timbre-change which is the result of different components decaying at different rates."