

Steve Reich

Writings about Music

Music as a Gradual Process
1968

I do not mean the process of composition, but rather pieces of music that are, literally, processes.

The distinctive thing about musical processes is that they determine all the note-to-note (sound-to-sound) details and the over all form simultaneously. (Think of a round or infinite canon.)

I am interested in perceptible processes. I want to be able to hear the process happening throughout the sounding music.

To facilitate closely detailed listening a musical process should happen extremely gradually.

Performing and listening to a gradual musical process resembles:

pulling back a swing, releasing it, and observing it gradually
come to rest;
turning over an hour glass and watching the sand slowly
run through to the bottom;
placing your feet in the sand by the ocean's edge and
watching, feeling, and listening to the waves gradually bury
them.

Though I may have the pleasure of discovering musical processes and composing the musical material to run through them, once the process is set up and loaded it runs by itself.

Material may suggest what sort of process it should be run through (content suggests form), and processes may suggest what sort of material should be run through them (form suggests content). If the shoe fits, wear it.

As to whether a musical process is realized through live human performance or through some electro-mechanical means is not finally the main issue. One of the most beautiful concerts I ever heard consisted of four composers playing their tapes in a dark hall. (A tape is interesting when it's an interesting tape.)

It is quite natural to think about musical processes if one is frequently working with electro-mechanical sound equipment. All music turns out to be ethnic music.

Musical processes can give one a direct contact with the impersonal and also a kind of complete control, and one doesn't always think of the impersonal and complete control as going together. By "a kind" of complete control I mean that by running this material through this process I completely control all that results, but also that I accept all that results without changes.

John Cage has used processes and has certainly accepted their results, but the processes he used were compositional ones that could not be heard when the piece was performed. The process of using the *I Ching* or imperfections in a sheet of paper to determine musical parameters can't be heard when listening to music composed that way. The compositional processes and the sounding music have no audible connection. Similarly in serial music, the series itself is seldom audible. (This is a basic difference between serial (basically European) music and serial (basically American) art, where the perceived series is usually the focal point of the work.)

What I'm interested in is a compositional process and a sounding music that are one and the same thing.

James Tenney said in conversation, "then the composer isn't privy to anything". I don't know any secrets of structure that you can't hear. We all listen to the process together since it's quite audible, and one of the reasons it's quite audible is, because it's happening extremely gradually.

The use of hidden structural devices in music never appealed to me. Even when all the cards are on the table and everyone hears what is gradually happening in a musical process, there are still enough mysteries to satisfy all. These mysteries are the impersonal, unintended, psycho-acoustic by-products of the intended process. These might include sub-melodies heard within repeated melodic patterns, stereo-

phonic effects due to listener location, slight irregularities in performance, harmonics, difference tones, etc.

Listening to an extremely gradual musical process opens my ears to *it*, but *it* always extends farther than I can hear, and that makes it interesting to listen to that musical process again. That area of every gradual (completely controlled) musical process, where one hears the details of the sound moving out away from intentions, occurring for their own acoustic reasons, is *it*.

I begin to perceive these minute details when I can sustain close attention and a gradual process invites my sustained attention. By “gradual” I mean extremely gradual; a process happening so slowly and gradually that listening to it resembles watching a minute hand on a watch – you can perceive it moving after you stay with it a little while.

Several currently popular modal musics like Indian classical and drug oriented rock and roll may make us aware of minute sound details because in being modal (constant key center, hypnotically droning and repetitious) they naturally focus on these details rather than on key modulation, counterpoint and other peculiarly Western devices. Nevertheless, these modal musics remain more or less strict frameworks for improvisation. They are not processes.

The distinctive thing about musical processes is that they determine all the note-to-note details and the over all form simultaneously. One can't improvise in a musical process – the concepts are mutually exclusive.

While performing and listening to gradual musical processes one can participate in a particular liberating and impersonal kind of ritual. Focusing in on the musical process makes possible that shift of attention away from *he* and *she* and *you* and *me* outwards towards *it*.

The Phase Shifting Pulse Gate
Four Organs
(1968 – 1970)
An end to Electronics

“Each drum is capable of producing two sounds differing in pitch, one from each end of the drum. Each player creates a different rhythmic pattern through irregular alternation of left hand with right hand; the drums, however, are interdependent and their patterns dovetail into each other to create an unbroken succession of tones.”

Ankloeng Gamelans in Bali, Colin McPhee, 1937

“Hocket. In medieval music, a peculiar technique of composition characterised by the quick alternation of two voice parts with single notes or short groups of notes, one part having a rest where the other has notes.”

The Harvard Brief Dictionary of Music, 1961

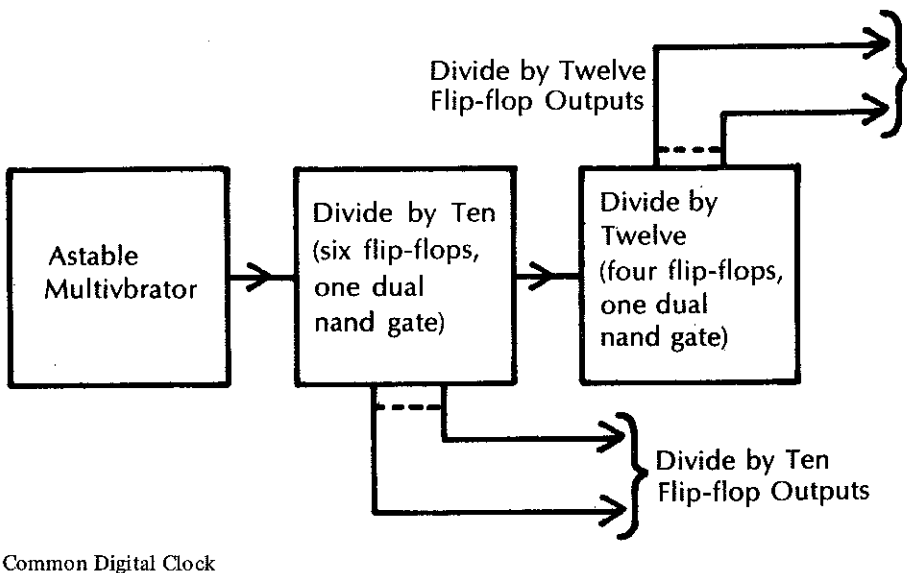
On Lincoln's birthday in 1968 I had the idea that if a number of single tones were all pulsing at the same tempo, but with gradually shifting phase relations, a great number of musical patterns would result. If the tones were all in phase (struck at the same instant), a pulsing chord would be heard. If the tones were slowly shifted just a bit out of phase, a sort of rippling broken chord would be heard which would gradually change into a melodic pattern, then another, and so on. If the process of phase shifting were gradual enough, then minute rhythmic differences would become clearly audible. A given musical pattern would then be heard to change into another with no alteration of pitch, timbre, or loudness, and one would become involved in a music which worked exclusively with gradual changes in time.

In terms of performance this meant that each performer could play two notes (one hand, one note), pause, play two notes, pause, and so on. Depending on when performers played and paused (their phase relation), various interlocking melodic patterns would occur. This would be in contrast to the Western and generally non-Western practice of creating melodies that one person can play or

sing by himself, but would resemble the interlocking figuration of the Balinese Gamelan and the hocketing procedures in medieval music. Performing such interlocking music would not be too hard to do, but to play, pause, and also very gradually shift one's phase relationship to the other players would be almost impossible. Clearly an electronic device was needed that would be both an instrument in itself, and also a sort of phase variable metronome enabling several performers to play together.

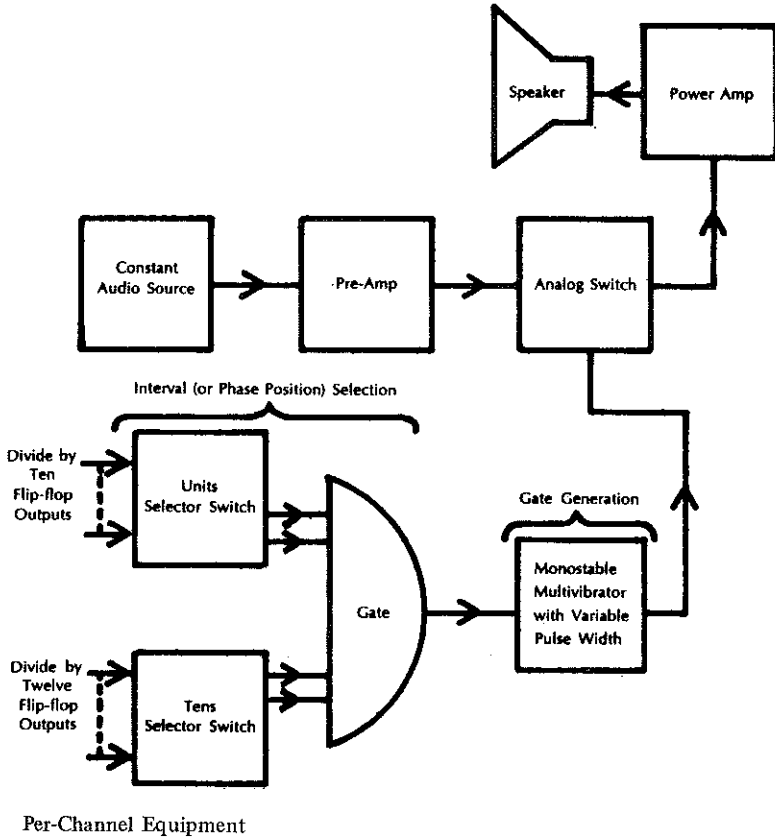
Later, in February of 1968, I visited Larry Owens, an electronic engineer at the Bell Laboratories in Holmdel, New Jersey, and, after several months, the following block diagrams and descriptions resulted.

Technical Description of Device



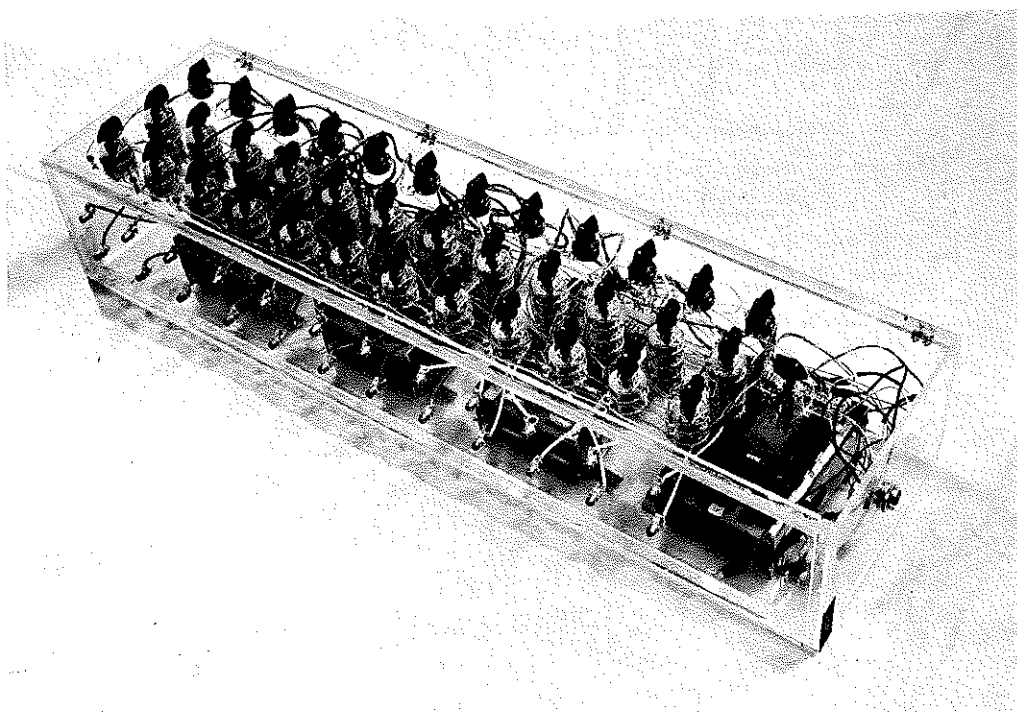
Each of the 12 channels must concern itself with periodically gating an analog signal for a programmable length of time, and then must be capable of being programmed to shift phase position so that this gating occurs at any one of 120 subdivisions of the constant time period.

The digital clock, common to all channels, is shown on the previous page. The constant time period for all channels is determined by the period of the astable multivibrator divided by the counting ratio of 120. The period of the astable multivibrator can be varied over a specified range. The constant time period is thus divided into 120 equal intervals, or counts, any one of which may be selected by simple digital logic.



The per-channel equipment shown above must select one of the 120 intervals or counts (phase positions) from the common clock, develop the gate, and gate the incoming analog signal. The choice of one of the 120 counts is made by 2 selector switches (one with 10 positions and the other with 12) in tandem. The digital outputs of these selector switches are logically combined to select the desired interval or phase position. The gate is then derived from the selected interval with a pulse width determined by the adjustable time constant of a monostable multivibrator. This gate waveform is then applied to an analog switch which, when gated, allows the analog signal to pass through it.

From a more musical viewpoint one could describe each channel as capable of dividing a repeating time period or "measure" into 120 equal parts or "120th-notes". Thus, if all channel selectors switches are set to 1, and one channel is moved one unit ahead of the other, that pulse will be heard one "120th-note" before the others, or one "120th-note" out of phase. Since even at very slow tempos the rhythmic movement from one "120th note" to the next is barely perceptible, each channel becomes, on a perceptual level, continuously phase variable in relation to all the others.



The Phase Shifting Pulse Gate. The knob at extreme right controls the tempo of the astable multivibrator in the digital clock, common to all channels. The socket at extreme right is the power input. The upper row of 12 RCA jacks is for patching in 12 audio signals while the lower row is for patching the audio output pulses into amplifiers. The upper row of 12 knobs (closest to input and output jacks) control the 10 position rotary switches that count by units while the middle row of knobs control the 12 position rotary switches that count by tens. The bottom row of knobs control the potentiometers that gradually vary the pulse width for each channel from one fifteenth to one half second.

The device is purely rhythmic in nature and produces no sound of its own. Provision is made to patch in any 12 constant sounds one wishes. These sounds may be either acoustical via microphone (droning violins, voices, or one's finger constantly rotating on the moistened lip of a thin vibrating wine glass), or electronic (oscillators). When one of the gates opens, a short pulse, varying from one fifteenth to one half second in width, is passed through the gate, into a power amp, and out to a loudspeaker. When the gate is closed, there is no sound, or simply the acoustical sound of the instrument if an acoustical source is used.

More than a year after my first visit to Bell Labs the Phase Shifting Pulse Gate was completed. I constructed it myself with a good deal of help from Larry Owens and David Flooke. All the crucial Fairchild Integrated Circuits were generously donated by Mr. Seymour Schweber of Schweber Electronics.

Musical Applications

In April of 1969 I first performed *Pulse Music* on the Phase Shifting Pulse Gate at a concert at The New School in New York. On May 27, 1969, I gave the second performance of Pulse Music in a more elaborated form at the Whitney Museum of American Art. For that performance eight oscillators were patched into the gate and tuned to the same natural minor scale as four log drums used earlier in that same concert. Though only eight different pitches were used, four of them were patched into two channels each, so that a total of twelve oscillator tones were actually used. In bars 13 through 16 on the following page one can see this separation of the doubled tones into two separate phase positions. All the dotted lines between bars indicate the gradual 120th-note-by-120th-note phase shifting. The small numbers in parenthesis indicate the position of the rotary selector switches. If (1) is the first eighth-note in a measure of 12/8 divided into 120 equal divisions, then (11) will be the second eighth-note, (21) the third, and so on. These numbers helped me correlate the musical notation with the actual movements of the rotary selector switches during performance. At bar 21 the final pattern is very gradually accelerated to more than twice its original tempo, creating a sound better described as a blur of color than as a series of discrete pulses. After bar 21 the long dotted lines indicate the final gradual phase shifting of this blur into a fast pulsing chord at bar 22.



S. R. performing *Pulse Music* (5/69) at the Whitney Museum of American Art in New York on May 27, 1969.

Pulse Music (5/69) – (for Phase Shifting Pulse Gate)

Preceding the performance of *Pulse Music* at the Whitney Museum was the first and only performance of *Four Log Drums* where the gate functioned as a programming device for 4 performers each playing a two-note wooden log drum. The pulses from the gate were transmitted to each performer via headphone, and each performer played his log drum in exact synchronism with the pulses that I sent them from the gate. Since the earphones only somewhat softened the sounds going on in the room, the performers could and did listen to each other. It was found during rehearsals that although performers tried to follow their pulses exactly, they could only create the musically correct overall pattern when they listened to each other as well. It will be noted that not only are the pitches the same as in *Pulse Music*, but the tempo as well. *Pulse Music* began directly and without pause from the end of bar 14 of *Four Log Drums*.



Four Log Drums (5/69) performed at the Whitney Museum of American Art in New York on May 27, 1969. From L. to R.: Richard Landry, Art Murphy, S.R., Phil Glass, Jon Gibson.

① $\text{♩} = 112$

Log Drum 1
 Log Drum 2
 Log Drum 3
 Log Drum 4

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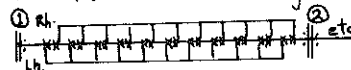
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Four Log Drums (5/69)

Four Organs – An end to Electronics

After the performance at the Whitney Museum I brought the Phase Shifting Pulse Gate back to my studio in its fibre case, and didn't immediately unpack it. The pressure of performing with a device that was essentially a prototype, and could easily have ceased functioning at any time, was one of the reasons. Another, and more serious, was that the 'perfection' of rhythmic execution of the gate (or any electronic sequencer or rhythmic device) was stiff and un-musical. In any music which depends on a steady pulse, as my music does, it is actually tiny micro-variations of that pulse created by human beings, playing instruments or singing, that gives life to the music. Lastly, the experience of performing by simply twisting dials instead of using my hands and body to actively create the music was not satisfying. All in all, I felt that the basic musical ideas underlying the gate were sound, but that they were not properly realized in an electronic device.

Three months later, in August of 1969, I had the idea that if a group of tones were all pulsing together in a repeating chord, as at the beginning of *Pulse Music*, one tone at a time could gradually get longer and longer in *duration* until the gradual augmentation (lengthening) of durations produced a sort of slow motion music. This would simply be using the variable pulse width aspect of the gate (which I hadn't used in the Whitney Museum version at all) exclusively, and to enormous proportions. The tones would simply begin in unison in a pulsing chord, and then gradually extend out like a sort of horizontal bar graph in time. Instead of loading my pulse width control with more and more capacitors, I thought about playing a repeated chord on an organ, and then holding one and then several of the notes down longer. Instead of the common digital clock, I thought of a musician playing a steady pulse with a rattle (maracas) that would enable the organists to count together as they held their notes down longer and longer. Since I was unable to start work on this piece for several months, it took until January of 1970 to see *Four Organs* for four electric organs and maracas completed.

The Maraca part consists of steady unbroken eighth notes played throughout the piece thus:  Since the Maracas must be clearly heard over the 4 organs in each hand. It is suggested that 2 pairs be used, one pair

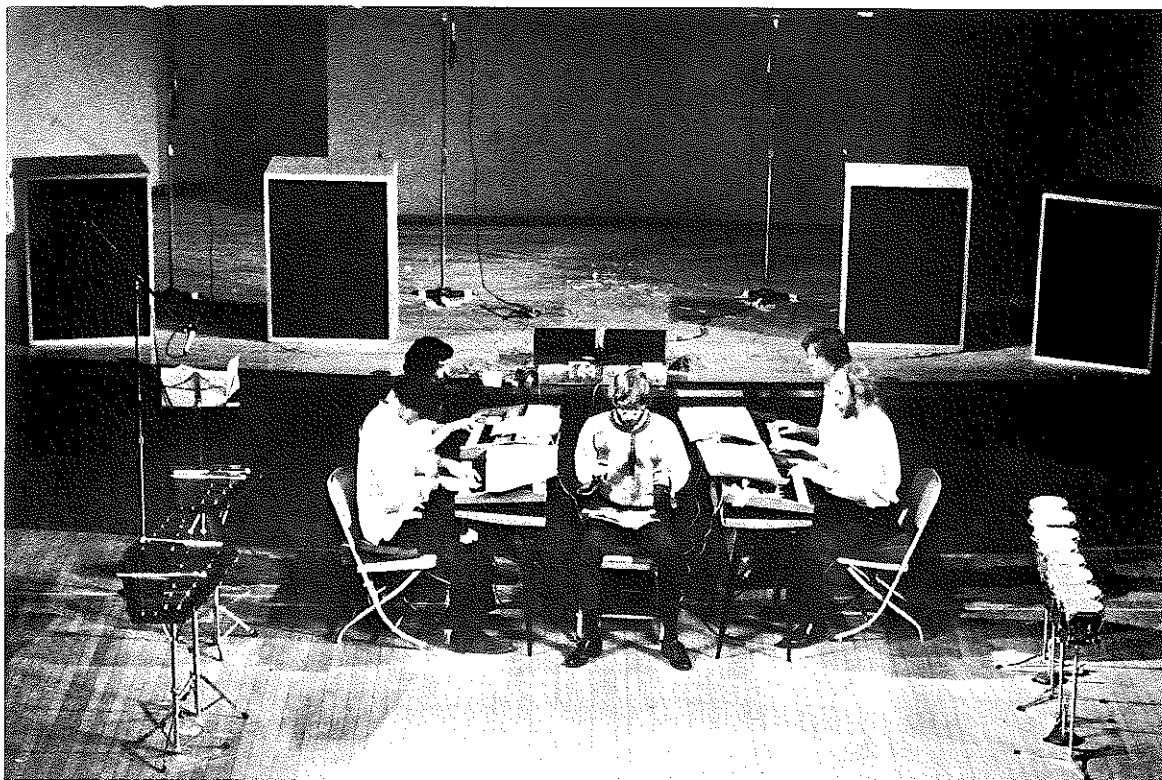
Four Organs (1/70); first paragraph of score



Four Organs (1/70); bars 1 - 4



Four Organs (1/70); bar 42



Four Organs (1/70) performed at the Loeb Student Center of New York University on November 14, 1971.

Art Murphy
S. R.

James Preiss

Steve Chambers
Russ Hartenberger

It was my intention to resume work with the Phase Shifting Pulse Gate after I finished *Four Organs*, but the experience of composing and then rehearsing with my ensemble was so positive, after more than a year of preoccupation with electronics, that another piece for four organs, *Phase Patterns*, happened very spontaneously a month later in February of 1970. In this piece the four of us were literally drumming on our keyboards in what is called a 'paradiddle' pattern in Western rudimental drumming. This piece proved to be as positive an experience as *Four Organs* and led, together with other factors, to a trip to Africa to study drumming.

The Phase Shifting Pulse Gate is still in its fibre case on top of the closet in my bedroom. I haven't unpacked it yet.

Some Optimistic Predictions
(1970)
about the Future of Music

Electronic music as such will gradually die and be absorbed into the ongoing music of people singing and playing instruments.

Non-Western music in general and African, Indonesian and Indian music in particular will serve as new structural models for Western musicians. Not as new models of sound. (That's the old exoticism trip.) Those of us who love the sounds will hopefully just go and learn how to play these musics.

Music schools will be resurrected through offering instruction in the practice and theory of all the world's music. Young composer/performers will form all sorts of new ensembles growing out of one or several of the world's musical traditions.

Serious dancers who now perform with pulseless music or with no music at all will be replaced by young musicians and dancers who will re-unite rhythmic music and dance as a high art form.

The pulse and the concept of clear tonal center will re-emerge as basic sources of new music.