

learn how to play; you really have to have your wits about you at all times!"⁴⁶ A full report on the development of this custom instrument can be found at the composer's personal web site (www.wendycarlos.com).

THE ART OF DRONES AND MINIMALISM

Terry Riley and La Monte Young (b. 1935) were classmates at the University of California at Berkeley in 1959. They knew of Cage's work, were immersed in the world of classical music, the German school of serialism, and *musique concrète*, and were highly aware of the tape music experiments taking place at the Columbia-Princeton Electronic Music Center. Even though they were both rooted in the new music scene of northern California, both Riley and Young split from the core community of composers at Berkeley and the San Francisco Tape Music Center to pursue their own individual musical missions. Electronic music played a role in the development of their approaches to composition, but the two are most widely recognized as being key influences on a style of music called **minimalism**, which has had its own powerful impact on new music.

In 1959, Young attended a summer music course in Darmstadt, Germany, where he studied with Karlheinz Stockhausen. While in Germany he also happened to experience the piano recitals of David Tudor and performances by John Cage, both of which greatly affected his musical direction. Tudor later featured one of Young's compositions—*X for Henry Flynt*—at one of his Darmstadt performances. Terry Riley was impressed by him, later saying, "La Monte was definitely the focal point of the class. He was so radical. I had never come across anyone like that in my life before."⁴⁷

Classmates of Young and Riley included Pauline Oliveros, Paul Epstein, Loren Rush, David Del Tredici, and Doug Lee. While Young and Riley were attending UC Berkeley, they were also working as co-musical directors for Ann Halprin's (b. 1920) *Dancer's Workshop*. There was a healthy rivalry growing between this group of composers. Riley remembers, "Everybody in that class was trying to out-do each other in being far-out and seeing what could be the most new and mind-blowing thing that somebody could do in music."⁴⁸

La Monte Young: Musical Reductionist

Prior to Darmstadt, La Monte Young had already begun to explore the possibilities of lengthening the duration of the notes in his music. His *Trio for Strings* (1958) was a serial piece requiring about an hour to perform because it was constructed of lengthy sustained tones and long silences. It has been called the work that established Young as the "father of minimalism."⁴⁹

After experiencing Cage for the first time in Darmstadt, Young boldly began to add chance elements to his work and to strip it of complexity altogether. There was also a touch of Zen, possibly inspired by Cage as well, in his newly developed reductionist point of view. One of his first works following Germany was *Vision* (1959), which Young calls his "assimilation of Darmstadt."⁵⁰ It prescribed a time frame of 13 minutes during which 11 precise sounds were made, the timing and spacing of which were governed by chance operations.⁵¹ Inspired by Cage, Young was clearly conscious of the differences in his work that would set him apart from the elder statesman of experimental music.

Cage's work from the early 1960s was imbued with a complexity mediated by chance operations. Cage's definition of modernism was that it consisted of "collage and juxtaposition."⁵² This was evidenced by works exhibiting an extraordinarily busy mingling of audiovisual events. It was as if Cage were dropping an asteroid in a reflecting pool: ripples became tidal waves that saturated one's perceptions. In contrast, Young only slowly submerged himself in a still lake, minimizing the ripples that could break the surface. His work was about concentrating on a single thing very intensely, be it a sound, a process, an action, a thought, an environment, or some other possible element of a performance.

In 1960, Young moved to New York and worked from a loft in Greenwich Village. He began to explore radical interactions with audiences. He established contact with George Maciunas and contributed some works to the Fluxus movement in the early 1960s, a forum for exploring the radical aspects of social interaction with the audience. Some of his works from the early 1960s were reduced to simple textual instructions, another innovation that followed Cage but also led to similar practices by Oliveros, Stockhausen, Yoko Ono, and others. *Composition #5 1960* (1960) consisted of a series of instructions, such as:

Turn a butterfly (or any number of butterflies) loose in the performance area.
When the composition is over, be sure to allow the butterfly to fly away outside.
The composition may be any length but if an unlimited amount of time is available,
the doors and windows may be opened before the butterfly is turned loose and
the composition may be considered finished when the butterfly flies away.⁵³

Young met Marian Zazeela in 1962 and the two have worked together ever since. While her expertise has been the creating of light environments for Young's performances, she is also one of the musicians who contributes to his work. From 1962 to 1965, Young's interest in extended sounds and drones led to the formation of a performance group that was eventually called the Theater of Eternal Music. Members included Young and Zazeela (vocal drones), Tony Conrad (violin), John Cale (viola), and Angus MacLise (percussion). (Cale and MacLise would go on to be founding members of the Velvet Underground.) Sine wave oscillators were used to create sustained electronic pitches, as was a small aquarium pump that vibrated with an audible hum. One of the extended works that they did was *The Tortoise, His Dreams and Journeys* (1964). Pitches to be performed were determined ahead of time by Young and consisted only of intervals that were multiples of seven, three, two, and one. The group would improvise around this predefined sound palette, mostly holding and allowing the tones to permute for as long as they could. It was played loudly so that the tones would intersect, producing new sidebands and beat frequencies. A performance could last four or five hours.

Young first encountered Indian musician Pandit Pran Nath (1918–96) in 1970. Learning about the art of the raga reinforced the kind of improvisation he had been practicing in the 1960s, but also suggested some subtle changes that became a part of his compositional thinking. Rather than begin a piece with a strong musical statement, as he was apt to do when playing the saxophone, he learned to let a work unfold slowly from the very first note, resulting in a more suspended, organically evolving sound. Around this time, he and Zazeela created the concept of the Dream House for expanded musical experiences. The Dream House was at once a physical location, a sound and

light environment, and a performance that lasted over an extended period of time. The couple did performances in various places. Some were a week long, others two weeks. One performance in Germany was for 90 days, where the performers played the piece every day for a week and then the electronic tones were left to continue sounding for the remaining days.⁵⁴ It was performed using voices and electronic drones.

Terry Riley: The Pulse of a New Sound

Riley wrote *String Quartet* (1960), which was influenced in part by Young's *Trio for Strings* with its long sustained tones, but also by the fog horns that he could hear from his home in San Francisco. He then became involved in tape composition for a time with Morton Subotnick at the San Francisco Tape Music Center. Riley was probably the first composer to experiment with extended tape delay and the accumulating effect of running a single loop of tape through several tape machines, recording and re-recording signals in real time during the course of a performance. Riley came to his music of repeating figures and pulse rhythms largely by way of the tape recorder:

My interest then was to have some good tape recorders and work with tape loops and tape-loop feedback. The electronics were opening up new ideas in music for me. But I had no money to obtain a tape recorder. So I always used my skills as a pianist playing in bars to try to finance that part of my career.⁵⁵

There was another aspect of Young's music that resonated with Riley. He recognized it as Young's tendency to repeat lines of notes many times and to strip the structure of a piece down to its bare essentials. By doing this, Young greatly reduced the motion and tension of a piece of music, so that it did not appear to move. It evolved slowly, through whatever process had been defined ahead of time.

In *C*, Riley's seminal work from this period, could not have existed without the influence of La Monte Young.⁵⁶ Riley knew that the key to *In C* was its static nature, its motionlessness even in the midst of a complex production involving many instruments and musicians. Like the complex and machine-made player piano music of Conlon Nancarrow (1912–97), *In C* was a conceptual precursor to the idea of programming and sequencing in electronic music. Not surprisingly, Riley went from the acoustic environment of *In C* to create electronic works for organ and other keyboards, including *A Rainbow in Curved Air* (1969) and the lovely *Shri Camel* (1980), which used a Yamaha synthesizer tuned for just intonation. He also became immersed in Indian music and has succeeded for many years in creating music with a tendency toward the transcendental listening experience.

PROCESS MUSIC

At the heart of many works of electronic music is a process. Sometimes the process itself becomes the piece of music.

A few minutes after a piece of **process music** begins, the perceptive listener is usually thinking, "Oh, I get it." The composer has made her or his intentions obvious as the work unfolds. The piece is a kind of game that evolves by its own natural rules.

Much of the minimalist instrumental music of Steve Reich and Philip Glass is clearly process music: rules are established by the composers for the instrumentalists to follow unwaveringly. The controls available for electronic musical instruments, old and new, encourage a composer to think in terms of a process, whether that process is a hardwired patch of cables, a virtual patch inside a computer, or the turning of dials to various increments that shape the development of a piece of music.

The tape recorder has inspired process music from the early days of its use. It can be used as a means for recording and composing electronic music, or, in the case of process music, the tape machine itself becomes an integral cog in the process. An early process piece that also served as an installation was *Music for the Stadler Gallery* (1964) by Earle Brown, in which four recordings of the same instrumental piece were continuously replayed on four separate tape recorders, with the four tracks becoming increasingly out of phase with one another. The total duration of this piece was 30 days. An even earlier experiment using tape as the crux of the process was *Improvisation préédictée et suivie de ses variations* (1954) by Paul Arma, in which a tape recording of an orchestra was played in reverse at the same time as the same orchestra was performing the work live.⁵⁷

Tape composition using tape loops is an example of process music. When Oliveros set up one tape loop running through two tape recorders for *I of IV* (1966), she was taking advantage of the phenomenon of tape delays that was made possible by using two tape recorders. This was the defining concept or process behind the piece. Another was that the realization had to be possible in real time—a requirement of much process music. Oliveros was committed to performance pieces that could be engineered in front of an audience. The sounds were recorded on the first tape recorder, and were then played back on the second tape machine after an eight-second delay. Once played, the sound was fed directly back to the record channels of the first tape recorder. With the addition of reverberation, the result was a barrage of slowly unfolding undulations that changed dynamically as sounds continued to be repeated. Oliveros played an active role during a performance of *I of IV* by continuously triggering new sounds to add to the evolving mix. Every sound that entered the loop was slowly transformed as other sounds were continuously layered on top.

Brian Eno also worked with tape delay much in the manner defined by Oliveros. However, he expressed a somewhat indifferent attitude toward the outcome. He described the realization of *Discreet Music* (1975):

Since I have always preferred making plans to executing them, I have gravitated toward situations and systems that, once set into operation, could create music with little or no intervention on my part. That is to say, I tend toward the roles of planner and programmer, and then become an audience to the results.⁵⁸

Eno's composition existed of a diagram of the devices used to generate the music. His approach was identical to that of Oliveros except that the sound material was specifically melodic and he did not modify or interact with the sound once the process was set in motion. The result in *Discreet Music* is the gradual transformation of a recognizable musical phrase that starts the process. Along with collaborator Robert Fripp, Eno continued to produce several works and performances using this process technique, but with the increasing involvement of the performer as a real-time wild card for throwing sonic monkey wrenches into the steadily turning wheels of tape-delayed sound.

Steve Reich has composed some of the purest forms of process music. His early tape compositions dating from 1965 and 1966 used tape loops to explore the process of phasing—identical segments of recorded sound were played synchronously using more than one tape recorder and then were allowed to drift out of phase as the speed of one of the players was increased or decreased. As the sounds went in and out of “phase” with one another, they created new combinations of timbres, beats, and harmonics. When the sound material had a natural cadence, the process of phasing often created continuously shifting changes to the rhythm as the sound drifted in and out of phase. Adding additional tracks and loops of the same source sound increased the possibilities for phasing relationships.

Reich's first tape works using this phasing process were based on recordings of the human voice. He discovered the phasing process by accident while playing tape loops of a Pentecostal street preacher he had recorded in San Francisco. The resulting work, *It's Gonna Rain* (1965), began with the simplest demonstration of phasing as two loops began in unison, moved completely out of phase with one another, and then gradually came back together in unison. The same process began again with two longer loops to which Reich added another two and then eventually eight to create a multilayered series of phasing sequences happening in parallel. *Come Out* (1966) was shorter and used a brief tape loop of a young man describing the aftermath of a beating he was given at a police station in New York City. In this case a short phrase of the young man's voice was first played using two loops going gradually out of phase. The natural rhythm and melody of the voice led to a kind of two-voice canon. Reich enriched the canon or “round” effect by then using four and finally eight tracks, the last consisting of a beautifully undulating pulse that sounds more like the reverberating sound of a ticking clock in a tunnel than the human voice.

Reich's use of the human voice as source material was a departure from the norm in electronic music of that time. He recalled why he made that choice in his first electronic music experiments:

I was interested in real sounds, what was called *musique concrète* in those days, but I wasn't really interested in the pieces that had been done. I thought that they were boring, partly because the composers had tried to mask the real sounds. I was interested in using understandable sounds, so that the documentary aspect would be a part of the piece.⁵⁹

Reich felt that by not altering the dynamics of the voice—its pitch and tone color—it retained its naturally emotive power. His phasing treatment then magnified the expression of the voice through rhythm and repetition.

After realizing *Come Out*, Reich moved on to compose music for live instrumentalists. His love of the phasing process was so strong that some of his first instrumental works from this period, such as *Piano Phase* (1967), recreated the effect with live musicians. He gradually applied a process approach to an entire canon of works, which placed him on the map as a leading proponent of minimalist music. *Four Organs* (1970), for four electric organs and maracas, was a tour de force of process composition. The piece was based on the augmentation of a single chord of music that was played, note by note, in a slowly unfolding sequence by four organists. Reich described the work in this way:

Four Organs is an example of music that is a “gradual process.” By that 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 overall form simultaneously. (Think of a round or an 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.⁶⁰

Four Organs is a 24-minute piece of music consisting of a single chord. The work had structure only because of the process through which the chord was disassembled and recombined.

A conceptual cousin to Reich's *Four Organs* music is *Points* (1973–74) by Ruth Anderson, which used only sine waves as the raw threads of the piece. Individual tones of different frequencies entered at intervals of five seconds, building up a multilayered fabric of sound that gradually began to thin again as the earlier threads of sound were pulled out. The process repeated several times but with different choices of pitches making up the threads.

Computer music is a particularly fertile field of possibilities for applying processes. This fact has been recognized by anyone working with any size or vintage of computer.

Figure in a Clearing (1977) by David Behrman used one of his homemade synthesizers based on the KIM-1 microcomputer. The process used in that work consisted of rules being carried out by the computer in real time during the performance. A live cellist responded to chord changes played by the computer, which employed 16 triangle wave oscillators. The computer could also choose those chord changes from any one of several preset tunings. The tempo of the chords was determined by an algorithm modeling the velocity of a satellite in a falling elliptical orbit around a planet. While the computer ran on its own using rules for making chord and tuning changes, the live cellist improvised using six pitches specified by the composer.

Alvin Lucier is the godfather of process music. He is widely known for works that begin with a process or idea that is then carried out according to written guidelines. The process in most of Lucier's works is often a physics lesson of some sort. In *Vespers* (1968), performers walked through a darkened space using handheld echo-location devices to find their way. In a version of *Clocker* (1978) that he produced with Nicolas Collins, Lucier wired himself to a galvanic skin response monitor that could measure the differences in skin resistance caused by mood changes. The electrical signal of the device was amplified and used as a control voltage to modify the speed of a ticking clock. The ticking was amplified and sent through a delay system, creating layers of ticking that Lucier could manipulate, much in the manner of Reich's phasing idea, but in real time rather than on tape: “I wanted to make a work in which a performer could speed up and slow down time, stopping it, if possible, simply by thinking.”⁶¹ *Clocker* was the literal implementation of this desire.

Lucier's list of process works is extensive, each one unique. *I Am Sitting in a Room* (1970) explored the process of sound filtering by the natural acoustics of a room by repeated playback and re-recording of successive generations of Lucier's voice reciting a short paragraph. *Music for Piano with One or More Snare Drums* (1990) picked up the sympathetically vibrating sounds of snare drums as “a pianist plays a series of notated