XENAKIS AND STOCHASTIC PROCESSES

We encountered the Greek composer Iannis Xenakis in Chapter 11 in connection with Varèse's *Poème électronique* and the design of the Philips Pavilion at the 1958 Brussels World's Fair. Working with the architect Le Corbusier, Xenakis (1922–2001) used mathematical formulas for saddle-like shapes known as hyperbolic paraboloids to design the building's sweeping forms. He used the same formulas four years earlier to organize the surging masses of glissandi in his orchestral piece *Metastaseis* (Dialectical Transformations, 1954)—further evidence of his interest in fusing music, math, and architecture.

Trained as a civil engineer in Athens, Xenakis was active in the Greek resistance movement and fled to France after the war, where he worked in Le Corbusier's studio while studying composition with Darius Milhaud, Messiaen, and Pierre Schaeffer. Like Ligeti, Xenakis believed that Integral Serialism had opened up ways of hearing in terms of textures created by masses of notes. In his book *Formalized Music* (1963), he explained his conception of an integrated musical "space-time," which involved modeling mathematical probabilities for ongoing interactions of many indeterminate details. Xenakis compared such "stochastic" processes to "natural events such as the collision of hail or rain with surfaces, or the song of cicadas in a summer field" (SR 183:1374; 7/14:104). Thus his *Pithoprakta* (Actions by Probabilities, 1956), for two trombones, percussion, and strings, begins with scattered percussive sounds that gradually coalesce into complex textures. He was particularly interested in sonic phenomena, such as the sounds of a political demonstration involving hundreds of thousands of people, which could produce a "mass event" with a clearly articulated shape and form moving through time and space.

In the 1960s Xenakis began composing with computers. In addition to founding centers for "Mathematical and Automated Music" in Paris and at Indiana University, he developed a computer system in 1977 that converted drawings directly into sound, as with the score for *Mycenae-Alpha* (1978; Fig. 12.2). As the shifting shapes scroll past, they are translated into pitches in thin bands or clusters, complex mutating textures, and bursts of noise. Xenakis intended the system to make the act of composition accessible even to those without formal training; indeed, a free version known as HighC is currently available online. His software anticipated by many decades today's inexpensive graphic musical interfaces like Singing Fingers, developed at the MIT Media Lab, which enables children to finger-paint with sound.

SPECTRALISM AND ITS RESONANCES

In the 1970s a group of composers who became known as Spectralists began integrating mathematical models of timbre with principles of psychoacoustics to create luminous sound masses that surge through time and space. As with the

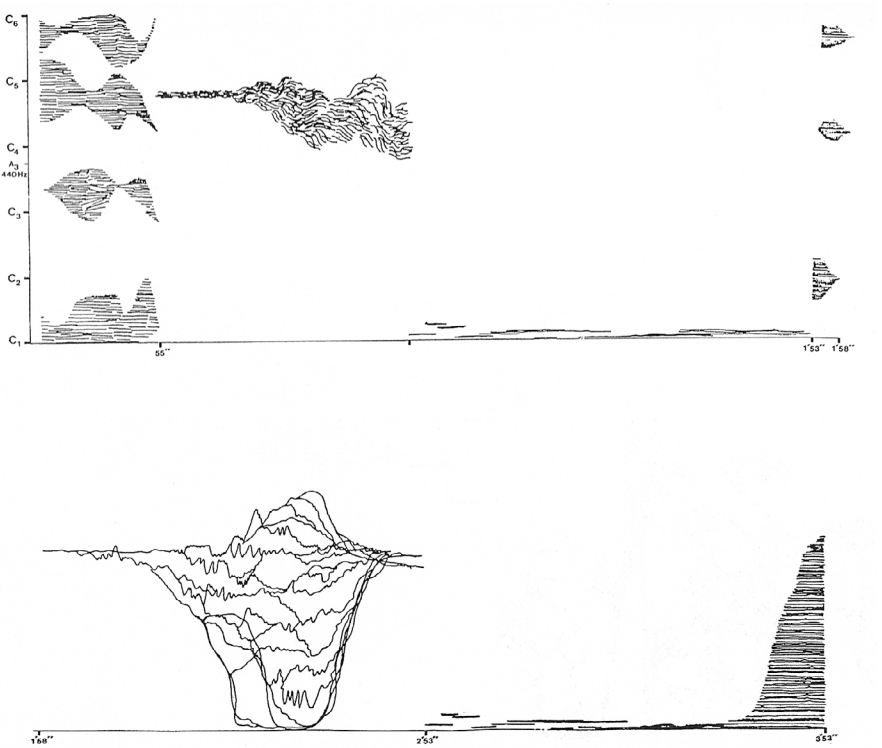


Figure 12.2: *Iannis Xenakis,* Mycenae-Alpha, *excerpt*

approaches to textural composition discussed earlier, Spectralism also emerged in part as a rejection of Integral Serialism and the various techniques that had been developed for controlling the individual musical parameters. As the British composer Julian Anderson has written, alluding to the creative process of Boulez's *Structures*: "the serial obsession with devising separate or related charts for pitch, duration, intensity, dynamics and timbre is replaced with a fondness for attempting to abolish the distinctions between these phenomena."

The Spectralists also differentiated themselves from both Integral Serialism and Indeterminacy by focusing on issues of the perceptibility of structure. The French-born composer and Messiaen student Tristan Murail (b. 1947), for example, has drawn on research in psychoacoustics and psychology to inform his compositions: "my material is neither the musical note nor musical sounds, but the sensation (sensation in a very general sense: that which is felt, in other words, perceived and interpreted) that is created by the note or sound."

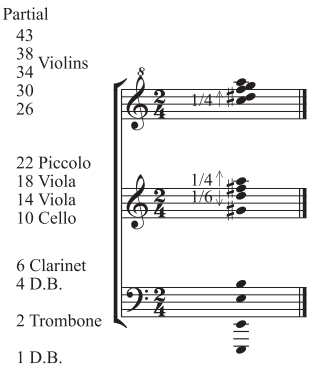
As suggested by the emphasis on spectra, which could refer either to sound and timbre or to light and color, there are connections between the Spectralists and Impressionism (see Chapter 2). This is clear in Murail's *Vues aériennes*

(Aerial Views, 1986) for French horn, violin, cello, and piano. Inspired by Monet's paintings of Rouen Cathedral, capturing the play of light and shadow at different times of day, Murail "paints" four versions of the same musical object, the first seen in "morning light (clear light, very obtuse angles, maximum distortion)," the second as if through "light in the rain (soft-focus effect, sharper angles, slighter distortion)," and so on.

The often-noted quality of "acoustic glow" associated with many Spectralist works results from the close coordination of harmony (produced by the combination of individual pitches) and timbre (produced by the weighting and combination of overtones). This glow stands out vividly in *Partiels* (Partials, 1975), a piece for chamber orchestra by the French composer Gérard Grisey (1946–1998), who studied with Xenakis and Ligeti as well as Messiaen. Part of a cycle of works entitled *Les espaces acoustiques* (Acoustic Spaces, 1974–85), *Partiels* simulates the rich field of harmonics revealed through a spectrographic analysis of a low E played on a trombone (Ex. 12.2). The dramatic opening sonority and rhythmic motive are slowly destabilized over the course of the 22-minute-long piece as we experience the depths and variety hidden in a single sound.

Many Spectralist composers have been deeply involved with electronic music. Murail developed software at IRCAM for analyzing instrumental timbres and using the results to synthesize new sounds or modify live instruments. He also explored the inverse, that is the idea of imitating electronic effects with acoustic instruments: His orchestral work *Gondwana* (1980) re-creates the rich and shimmering bell sound of the analog ring modulator and some of the characteristic timbres of computer music synthesis. Murail's *Mémoire/Erosion* (Memory/Erosion, 1976), for horn and a small ensemble of strings, winds, and Ondes Martenot, imitates the increasingly chaotic effects of an analog tape-delay system (which creates echoes by sending the output of a tape machine back

Example 12.2: *Trombone harmonic series used for Gérard Grisey's* Partiels. *Arrows indicate microtonal intervals. As presented by François Rose.*



into the input). Beginning with a single note and its echoes, a complex cloud of sounds builds up gradually until it spins out of control, only to come to an abrupt stop, as if the composer had suddenly turned off the tape machine.

Other Spectralists have pursued different pathways. The Finnish composer Magnus Lindberg (b. 1958), a pupil of Grisey, began focusing on textures and the acoustic properties of harmonies as a result of his work at IRCAM in the 1980s. Lindberg also studied the works of Jean Sibelius (see Chapter 4), whose harmonies he describes as having a resonant, "almost spectral quality." Lindberg's music illustrates the connections between texture music and other recent trends. His virtuosic solo cello piece *Stroke* (1984) uses a host of extended techniques in playfully "decomposing" its dramatic opening gesture. The pervasive loops and layers in *Corrente* (1992) for chamber orchestra can be linked to Minimalism (see Chapter 14), while its quotations of Purcell, and Lindberg's use of passages from Mahler and Debussy in *Cantigas* (1999) for orchestra, exemplify the collage techniques discussed in Chapter 13.

Another Ligeti pupil, the Korean-born and Berlin-based Unsuk Chin (b. 1961), has employed Spectral ideas in pieces like *Xi* (Nucleus, 1998) for large ensemble and tape. Its soft opening sighs, synthesized at IRCAM from heavily manipulated piano pitches, gradually evolve into a richly textured haze of sound. Chin's opera *Alice in Wonderland* (2007) integrates textural approaches with more traditional techniques of melodic development. Chin has written of her works in terms of "a play of light and colours floating through the room and at the same time forming a fluid sound sculpture."

TIMBRE AND EXTENDED TECHNIQUES

PENDERECKI'S *THRENODY*

As timbre has taken center stage in textural composition, composers have begun to explore untraditional or "extended" performance techniques for instruments as well as the voice. Among the most influential works of texture music is *Threnody: To the Victims of Hiroshima* (1960) by the Polish composer Krzysztof Penderecki (b. 1933). Written for a 52-piece string orchestra, it opens with a series of shrieking clusters created by overlapping entrances of groups of instruments sounding their highest notes as loudly as possible. With a nod to Cage, Penderecki originally named the piece *8′ 37″*, the length of the work as specified through its precise temporal graphic notation. After the first performances, he changed the title to *Threnody* (song of lament) for the victims of the American atomic bomb dropped on Japan in 1945, thus putting it in the category of Britten's *War Requiem* and other postwar memorial pieces. The change also reflects Penderecki's interest in connecting his music to political and social issues, an increasingly important factor over his long and prolific career.