# Letters

## On Spatialization

Every epoch in the history of Western music has made its defining contributions to the art. We have seen the growth and elaboration of tonality in a variety of definitive styles, the emergence of the orchestra to the point of its becoming as important a dimension in advanced tonal music as the pitch structure itself, the revolutionary discoveries of the various modes of composing without relying on the resources of tonality, the advanced instrumental techniques that take advantage of expanded orchestral textures as the primary musical resource, and finally the development of electronic instruments to manipulate traditional sounds or generate completely new ones as the fundamental musical material.

Each of these developments evolved out of the preceding ones. It is my conviction that our epoch's contribution to the ongoing sea changes in Western music is an evolution of electronic music (in all its forms) that opens up a dimension that has always been a part of music performance but now, with the development of highly sophisticated software and the ever more common use of multi-channel amplifications systems in concert halls, is available to the composer as a structural and expressive resource. This dimension is, of course, space and the spatialization of musical sound.

I'm not referring to the commercial/cinematic use of "surround" sound, most of which merely adds rear-channel ambience to basically front stereo sources (and sometimes not even stereo). From what I read in the so-called "pro audio" magazines, the commercial musical scene is only just now beginning to wake up to the possibilities of using space in a more structural/organic manner, something that many of us have been doing for decades. The result, however, is that we are finally getting some first-class software that allows us to pursue ideas or invent entirely new concepts that were difficult or impossible to realize in the earlier years. An excellent example is software called AudioStage by a French group, Longcat; the user can not only move musical events around in a 3D space (assuming there is a sufficient number of physical audio outputs), but any number of differently sized spaces can be designed each of which with its own acoustic characteristics, and all of these are continuously available, including the possibility of utilizing several spaces simultaneously. (Other, more traditional spatial movement software, but developed to very high levels of precision and flexibility, are by Iosono and Flux IRCAM Tools. One of the genuine pioneers of spatialization software is Jean-Marc Duchenne [AcousMod-ules] who provides a wide variety of conventional and, especially, unconventional modules that encourage experimentation and discovery.) This means that space, its changing acoustic characteristics and expressive potential, can become a fundamental part of musical structure.

What I refer to especially is the use of space in music as an expressive device. Space moves us. Finding ourselves in or directly observing huge spaces is often an overwhelming experience. We hear from mountain-climbers and sky-divers, or we know from such experiences as the classic "room with a view" or simply looking out over a vast panorama from a plateau, that in one way or another experiencing enormous spaces is breathtaking or overwhelming or humbling or whatever. We are moved, and often profoundly. A few years ago, I had the extraordinary experience of flying in a helicopter over the Grand Canyon, without doubt a high point of my life. You never forget things like that. So it is with any encounter with vast spaces. At the other end of the scale, we are moved negatively by small, tight spaces, and some people are so sensitive that they experience claustrophobia—elevators are not for them.

Spatialization techniques in electronic music allow us to mobilize those deep emotions in the service of musical thought. Or one can equally say the reverse: musical thought can be in the service of mobilizing the deep emotions aroused by space. We accomplish this by creating or generating the illusion of space for the listener. We can statically define different kinds of spaces by placing sound events at fixed specific points around the listener, orchestrated with other audio cues such as reverberation. And we can evoke spatial responses by the illusion of motion of sound events, undoubtedly the most powerful and musically dynamic way of generating a sense of physical space. There are, I have found, two principal ways of generating audio motion: movement *in* space; and movement *of* space.

Movement *in* space is the more or less standard perceived motion of a sound event through a specific trajectory or in a particular configuration. The sound event is made to move around, through, above, or below the listener; several events in motion simultaneously along different trajectories add a physical (directly experienced) sense of counterpoint to the ensemble of events that is occurring. Following the trajectories of two or more sound sequences that move through perceptual space produces a fresh kind of contrapuntal awareness: you have the sense of musical linear interactions, but now physically transcribed in such a way that the musical lines moving around you define space—or, better, make

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you aware of space (and the effect of counterpoint) in an entirely new sense. Timbral transformations in synchronization with movement *in* space can endow the musical events with a vitality that static articulation is unable to achieve. And, again, if several such transformations are taking place simultaneously, even contrapuntally, an extraordinarily rich sense of space occurs that is pure magic, and deeply expressive.

Equally interesting is the creation of more than one kind of space at the same time. Several kinds of space can co-exist with the appropriate musical events that create interesting tensions that seem physically present to the listener. Timbral transformation of sound that is accompanied by a transformation of the space it is in—either by moving from one area of the hall to another (one side seems as big as a canyon, the other seems as small as a telephone booth, for example) or by a static transformation where the sound remains in place, but the place itself changes characteristics—can all add tremendous vitality to a musical passage.

But of even greater expressive potential to my ears is the possibility of movement *of* space, or creating the illusion that a kind of space, not just a musical event, is moving or transforming around or through the listener. This kind of illusion is extremely difficult to achieve; I myself have only managed it a few times, and what works in my studio doesn't always work in concert, although sometimes to my great surprise the reverse happens: a movement *in* space produces a movement *of* space in a specific acoustic environment and a particular set of loudspeakers. When it happens, it is, as they say, simply awesome.

What that "it" is, is difficult to describe without having experienced it. The effect plays on your spatial awareness: you are made to perceive a kind of space, be it of huge or small dimensions, and that space is passing around in front of, behind, or through you. It might be, given the dictates of relativity, that you feel as if you are doing the moving in that space, or moving along with a particular kind of space, rather than space moving through you. One way to think of it is by re-adapting the "spatial" conception of time as moving along a line from the future through you in the present and becoming past: either future time is moving toward you or you are moving towards future time, the effect is the same. So with movement *of* space: an awareness of a finite three-dimensional volume moves on a line passing around or through you; you are aware of it being over there, then of it moving and finally ending up over here, an object that is simply space.

Movement *of* space, then, involves finding those sounds and their characteristics that induce the listener to be just as aware of the spatial dimension(s) as he or she is of the timbral, pitch, rhythmic, and phrasal dimensions, and maintaining those characteristics while panning the sounds on a desired trajectory. Clearly, much of the illusion has to do with a highly refined and specialized use of reverberation: that's where much of the work is. And again, several kinds of space can be made to move simultaneously in what can only be described as *spatial counterpoint*, where the listener is at the focal point of awareness of several spaces moving around and through him or her. Technically this would require a large number of loudspeakers; otherwise, the illusions would be easily destroyed by phase interferences between the various audio signals producing the effects. The acoustics of the concert venue often already cause phase problems; no need to add to these difficulties with too few speakers. But there is no doubt that the transformation of a space while it is moving produces a significant emotional response, and the synchronization of these kinds of transformation with other musical dimensions yields a new expressivity in musical discourse. Movement *of* space is, then, using space "for itself," analogous in other musical contexts to using certain kinds of chords or harmonies "for themselves" rather than being functional in the traditional sense, or to using orchestral timbre "for itself" rather than as support for pitch structures.

As an independent musical dimension, space offers a variety of opportunities for structural development and elaboration. Spatial phrasing is one such notion. Transformations of a spatial zone or zones can be done with specific velocities, rhythms and durations that contribute to the overall rhythmic shaping of a piece. Still to be explored are such notions as: the dispersion of events to particular points in space at different times or within different dynamic and rhythmic schemes that are synchronized (or "associated with") other musical dimensions, particularly with timbre; the designing of motion trajectories (the "choreography" of a piece), again in synchronization with other audio elements; the rhythms and durations of kinds of spaces and their movements around the listener; varying perceived acoustics so that they are "in tune" (resonate) with particular frequencies occurring at specific times and in different parts of the listener's perceptive field; and so forth.

I have had highly accomplished colleagues and friends tell me, upon hearing stereo mixdowns of my multichannel works, that they can imagine what the spatial effects would be like. No, they can't, any more than they can get an idea of what

the Grand Canyon is like by watching a TV documentary. You have to experience it, all of it, to perceive the spatial-structural dimension and to truly feel the expressive power of space.

Musical spatialization opens up wholly new kinds of experience; when are we ever in the presence of, or feel, space that is moving through us and qualitatively transforming? When do we ever feel the presence of different kinds of spaces that interact and modify each other? We just might even learn to be more intuitively sensitive to the quality of space around us in our everyday lives, just as our predecessors have taught us to listen to the musicality of the sounds that surround us. And perhaps of equal importance is the social aspect of a successful spatialization installation: this is something that can only be realized in a public arena of some sort, a small auditorium, a planetarium, a large concert hall; that is to say, it is not something for home consumption, and especially not on the tiny loudspeaker(s) found on computers or i-This and i-That. People once again will return to the concert hall—after all, who can afford or has the room for twelve or more channels of audio?—for that extra dimension of human participation that has been gradually eroded by high-quality recordings and, in some parts of the world, by TV channels dedicated entirely to concert music and opera. IMAX is a clear indicator of such a development in the video world.

Spatialization is already changing the way music is conceived. One could say that up to now, musical composition has been largely a question of "what happens when." With spatialization, composition now becomes "what happens when and where." As more work is done to refine spatialization concepts and discover new modes of musical thinking in terms of space, it becomes clear that spatialization is *our* genuinely new contribution to musical art.

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