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Musica instrumentalis of the Merciless Cosmos: *La légende d'Eer*

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The idea of a *musica instrumentalis*, forming a link between the human and the heavenly, has continued over the centuries to be a strand of musical thinking. *La légende d'Eer* is a 46-minute, 8-channel electroacoustic composition which Xenakis created in 1977–78 for playback in Le Diatope, a curvaceous architectural construction designed by the composer together with a visual component. The sound materials of *La légende d'Eer* stem from three sources: "instrumental sounds," "noises," and electronically generated sounds. The form of *La légende d'Eer* could be described as roughly circular. It also carries a strong suggestion of an initial departure, a journey of some sort, and a final return. Xenakis surrounds the work with a compilation of five (pre-existent) texts, reflecting or reacting upon each other across the distances in time, space, and culture which separate them.

KEYWORDS: *musica instrumentalis, musica humana, musica mundana, La légende d'Eer*

I.

The principal reason why the (theoretical) study of music was so central to scholars and philosophers in the Middle Ages and the Renaissance, forming one of the components of the *quadrivium* of higher learning, was that it was imagined to form a link between the human and the heavenly. Specifically, *musica instrumentalis* (the music we perform and hear) mediated between *musica humana* (the harmony of the humors or temperaments within the human body) and *musica mundana* (the harmony of the spheres), between what we might call the biological and the cosmological scales. The cosmos of those days, however, was a relatively compact and cozy place, where the stars were equidistant from the earth on a sphere just outside the solar system, and the entire celestial mechanism constituted the innermost few concentric elements in a system which extended further out to complex hierarchies of angels and the divine presence. That the universe might be infinite in extent and contain many planets like the earth was the idea of the wayward monk Giordano Bruno in the late sixteenth century, although of course he had no scientific reasons for believing this, and it was one of the many heresies for which the Church eventually burned him at the stake. *Musica instrumentalis* was further divided into two: *musica speculativa*, music theory, a mathematical discipline dealing with such matters as the relationship between intervals and the proportion of string lengths; and *musica practica*, music as composed and performed. The latter, more modest in its philosophical ambition, could nevertheless achieve a more exalted status by

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the use of structural proportions which in some way emulated those of God's harmonious universe (cf. Curtis 1992).

More recently it has become apparent that our solar system is indeed one of many such systems, in a corner of one of the many galaxies in our "local" cluster, many of which are grouped into one of many superclusters. And each time the innocuous word "many" is used, it stands for an amount at or beyond the limits of any number we can comfortably grasp, let alone count. Moreover, to quote the astronomer Martin Rees,

> The entities that conventional astronomers [as opposed to radio astronomers] observe and call "galaxies" are no more than traces of sediment trapped in the centers of vast swarms of invisible objects of quite unknown nature. The gravity of this dark matter holds galaxies together and moulds their structures. (Rees 1997)

And, as the physicist Steven Weinberg concludes, "[t]he more the universe seems comprehensible, the more it also seems pointless" (Weinberg 1988). So much for those harmonious spheres, set in perfect motion by God and kept perfectly maintained by his angels. It has even been suggested that there might be no physical laws at all in the deepest sense, since no mathematical connection can be found between the twenty or so dimensionless parameters that relate the forces and masses of the universe together; their values could just be a random selection among many others, but one which happens to generate a universe with the characteristics we can observe.

The idea of a *musica instrumentalis* linking humanity with heaven has nevertheless continued over the centuries to be a strand of musical thinking, from the encyclopedic late works of Bach (the Goldberg Variations or the B minor Mass, for example) to the symphonies of Mahler, and the astrologico-serialism of Karlheinz Stockhausen's work since the 1970s. With the subsequent radical change in our view of reality, which has gradually come about as science has supplanted superstition in more and more of our thinking, one would naturally expect that the terror and wonder of the merciless and perhaps pointless cosmos would itself inspire a shift in musical thinking. Nevertheless, superstition is still rife. So is nostalgia for the comfortingly small and benign (or at least not indifferent) "universe" dreamt up in ancient times by astrologers and priests, as if there were a "god-shaped hole" in human consciousness since the insights of Darwin, Einstein, and the quantum physicists (to name only these). But as the quantum physicist David Deutsch puts it, "there is little difference between having an X-shaped gap in one's scheme of things and believing in X" (Deutsch 1997: 143). We might provisionally conclude, therefore, that any kind of consolation is simply not to be found, only the illusory consolation of wishful thinking.

Iannis Xenakis is one of the first composers to have taken this situation seriously, and part of the reason for this must surely be his background in the exact thinking of mathematics, engineering, and architecture. If architects were to use the kind of ill-defined thinking in their calculation which is characteristic of most artists (even the most integral of serial composers), their buildings would fall down. This is not to say that music composed by architects therefore "stands up", or even that it should or can do so; the issue is one of general rigor and lucidity. The converse of such an approach, taken to its logical extreme, implies letting go of superstition and imprecise thinking. It leads directly to a contem-

plation of the immensity of the "modern" cosmos and its relation (or the unanswered question as to whether it has any) to human existence, and to the conception of a new kind of *musica instrumentalis* which arises from this confrontation. Xenakis effectively announces this as his goal in the first chapter of *Formalized Music*:

> Art, and above all, music . . . must aim . . . to draw towards a total exaltation in which the individual mingles, losing his consciousness in a truth immediate, rare, enormous, and perfect. If a work of art succeeds in this undertaking even for a single moment, it attains its goal. [. . .] This is why art can lead to realms that religion still occupies for some people. (Xenakis 1971: 1)

Such a statement should not be misinterpreted as mysticism, or as trying to fill the aforementioned "hole." Its implication is rather that in leading to the realms of *ekstasis* the proposed music would be embodying a perception of the human/cosmos relationship in a comparable way to that in which "divine order" is embodied in, for example, the mass settings of Ockeghem, but from a point of view inspired by science rather than religion. That is to say, inspired by informed speculation rather than credulity. This, surely, is the only authentic standpoint to take given the current state of our knowledge, notwithstanding the puzzling fact that some "contemporary" composers seem content to ignore the (musical/scientific) findings of the intervening centuries, as well as the fact that the music of such as Ockeghem (partly, I believe, because it embodies an authentic response to the "whole world" as it was understood at that time) will inevitably expose their work for the superficial *ersatz* that it is. Which is not to say, of course, that Xenakis's music has no contact with the past or with tradition: it merely (and rightly) views them from a distance, with respect but without sentimentality, and certainly without the delusion that any kind of "going back" is either desirable or possible, unless the intended result is to "entertain" a passive audience by reinforcing their conditioned preferences.

This might be an apposite point at which to make a brief comment on the important difference between the deepening of knowledge and "progress," lest the foregoing give rise to misinterpretation. While it is obviously true that in our era we know such things as that the earth is not flat, and (thanks to Xenakis) what the application of the principle of Brownian motion to the activity of a string orchestra sounds like, and to this extent our knowledge of both the physical world and the "world" of music is constantly expanding, the means by which that knowledge is put to (philosophical/musical) use could not so easily be said to have "progressed." This, I believe, is because the cognitive apparatus by which we apprehend the knowledge available to us has not been in what one might term a "primitive" state since long before the dawn of recorded history. Everywhere we can look, both historically and geographically, we find it in a fully formed state. It is well known that no spoken language has yet been discovered, however "primitive" the society under study, which is not just as well-adapted and flexible a means of communication, within its own context, as, for example, is English in a context such as this article. Thus, I am not claiming that Xenakis is in any way less "primitive" than Ockeghem; but I am claiming that the music of both of these composers is more authentic, more truthful, than that of, say, Arvo Pärt. Readers of this particular journal might need no convincing on this point, but you are in a very small minority; outside the comfort of academia these

arguments have some importance, and they are being lost to the persuasive machinery of the entertainment industry.

II.

La légende d'Eer is a forty-six-minute, eight-channel electroacoustic composition which Xenakis created in 1977–1978 at the electronic studios of the Westdeutscher Rundfunk (WDR) in Cologne. It was commissioned by the WDR in connection with the opening of the Centre Georges Pompidou in Paris, and was conceived for playback in Le Diatope, a typically curvaceous architectural construction designed by the composer together with a visual component (running independently of the music) produced by 1600 flashing lights together with four lasers whose paths were controlled by 400 adjustable mirrors. The work therefore takes its place in the long series of "polytopes," site-specific combinations of sound, light, and architecture which have appeared regularly in Xenakis's output since the 1960s. In so far as its architectural and musical elements were conceived and produced as mutually complementary, *La légende d'Eer* represents (to date) the fullest realization of the "polytope" concept, whose origins clearly date back to 1958 and the combination of Varèse's *Poème électronique* with the Xenakis-designed Philips Pavilion at the World Fair in Brussels. Nevertheless, the inexorable grandeur of the music is quite capable of engendering a disturbingly intense experience on its own, even in the two-channel version which has been released on disc (Auvidis Montaigne: 1992),[1] which in any case makes perfect sense as a mix in its own right.

The "polytopes" might be seen as an attempt to address what might be called the "acousmatic" problem, that is, the problem of how to present to an audience music that has no necessary visual component such as live performers. My own feeling is that the crux of the issue lies in this necessity, and not in the presence or absence of visual stimuli to accompany a public musical event. In other words, since a visual component is not required by the music (except the rotating reels of a tape machine, but more recently these too have vanished), any such component will inevitably raise the question of whether it has been merely thrown in for cosmetic reasons. Not having witnessed *La légende d'Eer* in its original context, I would hesitate to criticize it in these terms, especially given that Xenakis is the last composer who could credibly be accused of falling prey to the temptation of cosmetic presentation. Nevertheless, the issue remains stubbornly alive: since there are musical possibilities in the "tape" medium that are not available in any other, there must be some way to present it in public. Some would presumably be of the opinion that public presentation is unnecessary and any attempt to do so is quixotic, but this kind of atomization of audiences into solitary listeners at home (even were they all to have adequate if not optimal listening equipment and conditions) is, I think, a dangerous path to contemplate. At the same time as affording an inward experience, music is also part of society, it is an arena of participation, and this fact (how ever attenuated by the way we are presently compelled to live) is an essential component of music's power as an art form. Unless, that is, one takes the view, famously espoused by Margaret Thatcher, that society no longer exists, in which case one must take on the full horrific implications of such a view. Fortunately (or not?), this standpoint is clearly based on ideology rather than reality.

So what is the answer for electroacoustic music? Let us not forget that the technological advances that have made such a thing possible are relatively recent, that the music itself is more recent still, that it implies a shift in musical thinking at least as fundamental as any in history, and that there is an inevitable inertia to any process where people are adapting to changes in their technological and sociological environment. On the other hand, most people in the Western world are already quite accustomed to public musical events (in the context of dancing), which involve little or no "live" performance. In other words, I expect the "problem" not to be solved but eventually to dissolve. At that point, music such as *La légende d'Eer* will come into its own, with or without the light-show. In my opinion this is one of Xenakis' most profound and involving compositions, which is to say that if there is any meaning to the term "masterpiece," I would unhesitatingly attach it to this work.

III.

The sound materials of *La légende d'Eer* stem from three sources: "instrumental sounds," "noises," and electronically generated sounds. Obviously, this could be said of a great many electroacoustic compositions; the sonorous identity of *La légende d'Eer* is the result of Xenakis' somewhat idiosyncratic "tastes" in these areas, as well as its position within his musical evolution on the cusp between *musique concrète* and computer music, as will be apparent on a further examination of the three aforementioned categories.

Instrumental Sounds

Xenakis mentions African and Japanese instruments in this connection: the use of materials deriving from non-Western musics is also a feature of other electroacoustic compositions by Xenakis, such as the brief *Orient-Occident* (1960), and the more extended *Bohor* (1962), and *Persepolis* (1971). Taking these works in chronological order, there is an obvious development away from the "anecdotal" use of such sounds in *Orient-Occident* (more characteristic of Parisian *musique concrète* in general) through *Persepolis*, some of whose materials are closely related (in origin, context, and morphology) to their counterparts in *La légende d'Eer*.

Xenakis begins his written introduction to *La légende d'Eer* in typically forthright fashion:

> Music is not a language. Each piece of music is a sort of boulder of complex shape with scratches and patterns carved upon and within it, which people may decipher in a thousand diverse ways, none of which is the best or most truthful. (Xenakis 1995: 11)[2]

While, for the most part, the "instrumental" sounds of *La légende d'Eer* display their provenance rather more clearly than the other categories, they do not come packaged with quotation marks or other pseudo-linguistic pointers. They are indeed incisions on or in the musical fabric, whose interpretation as carriers of "meaning" or connotation is certainly not encouraged by their context. At the same time it is quite clear that the desired rough-edged quality of these incisions is enhanced by eschewing the more "manicured" sounds of Western instruments.

Noises

Two examples mentioned by the composer are "specially chosen stones" and the scraping of cardboard. Again, the use of such (in every sense) "raw" materials was a frequent feature of almost all Xenakis' electroacoustic music up to and including *La légende d'Eer*. In particular, the complex sonorous results of friction between objects constitute an *idée fixe* for Xenakis, from the extended grating sounds which occupy most of *Persepolis* (1971), to the "exaggerated bow-pressure" which he employs in instrumental compositions to transform string instruments into noise generators. (I am reminded here of the Homeric epigraph to the score of *Charisma* for clarinet and cello: "then the soul like smoke moved into the earth, grinding.") The ability of string instruments to make transitions between pitched and unpitched sounds (that is, to vary the degree of periodicity or randomness in the air pressure/time function of those sounds), and the expressive potential of such transitions, are precious qualities for Xenakis, and no doubt had their influence on the third category of sounds, as we shall see.

Electronic Sounds

Most of these were produced at the Paris studio of CEMAMu (Centre d'Etudes Mathématiques et Automatique Musicales), which Xenakis had set up in the 1960s. In this connection, *La légende d'Eer* stands at a turning point in Xenakis' electroacoustic oeuvre. At the time of its composition, the processing power of computers was beginning to reach the level demanded by Xenakis' ideas on the methodology of electronic sound generation. This development led soon afterwards to the creation of UPIC (Unité Polygogique et Informatique du CEMAMu) and a continuing series of compositions, beginning with *Mycenae alpha* (1978), which have more or less abandoned the use of pre-recorded sound objects in favor of computer-generated materials. Here too, his approach is both distant from and dismissive of more "typical" practitioners:

> Mathematics is not to be trifled with. It is extremely hard, naked, like a smooth endless wall, which traditionally minded musicians will ruin their fingernails on rather than grasp. A more considered approach is necessary. It is only possible via the shaping of the air pressure/time curve which ends at the eardrum, and not via abstract and cold sine-tones. [. . .] From the outset, therefore, away with sines and cosines and their superimposition into "harmonic sounds" and "partials." This is why I have employed probability functions to generate the pressure/time curve. (Xenakis 1995: 12)

Naturally enough, waveforms generated by such means are likely to have a somewhat "noisy" quality as a result of the inevitable aperiodicities that result from their statistically defined structure. This is indeed the case in *La légende d'Eer*, although the types of functions used also enable resolution into more or less stable pitches, as a "special case," in much the same way as static pitches are often a special case of *glissandi* (where the "temperature" of pitch-motion is zero) in Xenakis' instrumental writing. His accustomed intransigence notwithstanding, Xenakis also understands how important it is in compositional practice to work from an awareness of the nature of our perceptual apparatus. Our sensitivity to stable frequencies, therefore (even though our experience of harmonic spectra is emphatically not an experience of mental Fourier transforms), is a fact of aural perception, which cannot be dismissed as easily as can the most wishful excesses of "spectral" thinking. Hence, the accommodation of stable pitches (not to mention their often modal organization) in his vocal/instrumental music as

well as the emergence of (agitatedly unstable) pitches from barely differentiated noise which is a recurrent and memorable element over long stretches of *La légende d'Eer*.

The basic sounds were elaborated at the WDR studios using "classical" *musique concrète* techniques: filtering, tape-speed alteration, reversal, superimposition, and so forth. The result is an epic piece in which internally complex layers of sound interact, coalesce, grind against one another, and split apart over extended time-spans.

A technical description of the production of *La légende d'Eer* would give at best a misleading impression of what to expect from listening to the music. And why should it do more, one might ask? But the repertoire of electroacoustic music is literally littered with examples of works whose composers seem to believe that the quality of a musical composition is primarily a function of the elegance of its process of technical realization. This has never been true of Xenakis, either in the electroacoustic or vocal/instrumental sphere. It is often remarked that his instrumental music shows more "sophistication" than his electroacoustic pieces, in the use of statistical calculations instead of rattling a tray of beads (*Bohor*), for example. The results give the lie to such a simplification. The calculations that go into the construction of massive and intricate textures in an orchestral work (or, for that matter, the evolving waveforms of a computer-generated sound) serve primarily to generate, *ex nihilo*, an internal vitality and complexity which is already present in acoustical processes such as Xenakis might record for an electroacoustic piece. Conversely, the seeming sophistication of method in a notated work of stochastic music invariably leads, in his hands, to a result whose impact is viscerally immediate, whose structural points of articulation are typically angular and brutal rather than smooth and deft. While a note inscribed in a musical score is a relatively simple object, all of whose attributes can be precisely described (its pitch, dynamic level, duration, and so forth), the sounding result of that note when performed by a musician is an immeasurably more complex one. In computer music, that complexity cannot be called up by making a mark on a piece of paper, but must (at some stage) be calculated, or else brought in from the outside world. As we have seen, in *La légende d'Eer* Xenakis employs both methods, each of which has its own range of applicability within the work. However, whereas it is usually possible while listening to distinguish "concrete" and "electronic" sounds, this differentiation, like that between "instrumental" and "noise" materials within the "concrete" category, does not behave as a structural determinant, as it does in a great deal of electroacoustic music (beginning in the mid-1950s with Stockhausen's *Gesang der Jünglinge*, of course). As I hope to have made clear, there is an underlying unity of approach to both categories which overrides their procedural divergences.

While the various simultaneous layers of sound in *La légende d'Eer* are constantly undergoing slow metamorphoses rather than abrupt changes of direction, there is no sense of what would become known as "morphing" between clearly defined points of departure and arrival. Indeed, such points (moments when some particular thing begins to happen, or ends) are quite elusive in this work. Every instant along every metamorphosis presents itself as equally "important," the result of which is a peculiar kind of articulation of musical time in which the "passage" of time seems to disappear almost completely from one's perception. Time, as the saying goes, "seems to stand

still." This would imply that the music engenders a state of contemplative listening; but this is a different kind of contemplation than the current connotations of that word would suggest. One might imagine it to be related to the active contemplation which Gregorian chant was originally intended to instill, certainly in the singers, whatever its present misuse as a "relaxing" sonic ambience. (Whether *La légende d'Eer* will become suitable fodder for New Age consumers in a thousand years' time is another matter!) In any case, the nature of time and its effect upon consciousness (or should that be the other way around?) has become, subsequent to the development of relativity and quantum mechanics, a subject of intense speculation, since the implications of those theories are so strongly counterintuitive. Many contemporary scientists are convinced that current physics, however successful in an instrumentalist sense, cannot be complete without the inclusion of consciousness. Among these, the mathematician Roger Penrose is among the most eloquent:

> It seems to me that there are severe discrepancies between what we consciously feel, concerning the flow of time, and what our (marvellously accurate) theories assert about the reality of the physical world. These discrepancies must surely be telling us something deep about the physics that presumably must actually underlie our conscious perceptions. (Penrose 1989)

Perhaps a work such as *La légende d'Eer* could also be telling us something about such matters; if only music were a language, we might be able to describe that something.

IV.

The form of *La légende d'Eer* could be described as roughly circular, in so far as one can easily imagine the linking of its end back to the beginning in a continuous installation-based context such as Le Diatope. While this feature has its practical role in the exigencies of such a context, it also carries a strong suggestion of an initial departure, a journey of some sort (reaching at its furthest point a situation of sensory derangement and "lostness"), and a final return. This is why I have characterized the phases traversed by the music as "regions," although, as will be apparent by now, the arrival in a new region is generally a gradual matter during which a recognizably new musical element has gradually asserted itself, or an element already present has undergone a transformation or has gradually withdrawn from audibility. Along with this quasi-symmetrical movement is another more unidirectional tendency, wherein, beginning in the highest pitch-range, the music gradually extends itself downwards in register until the entire audible spectrum is filled, eventually concentrating on the lowest part of the range until the high sounds of the opening re-emerge. Another strikingly consistent feature is that the introduction of new sound materials (the passage from one region to another) usually takes place at the outside edges of the stereo panorama, the new materials then proliferating inwards and often compressing the spatial extension of the pre-existent materials into a persistent but waning presence at the center. Then there is the "time-dilating" effect I mentioned in the previous section, which makes the clock-timings below less relevant than they would be in many cases. The effect of these processes is a little like observing gradual changes in geography from the window of an aircraft (of whose speed one is not generally aware), with the crucial difference that one is

forcibly immersed in them rather than viewing them from a safe distance. The following is a rough guide to the terrain.

0'00". Extremely high whistling sounds at left and right (which I shall subsequently refer to as Material 1) begin sparsely, like signals being exchanged over a great distance, creating at the outset an impression of emptiness and desolation. At 2'06" the whistles of Material 1 begin to be chopped into more or less rapid irregular segments, sometimes becoming almost birdlike chirrups. Over the following minutes the number of layers (and spatial positions) of these sounds gradually increases towards a polyphony spread across the stereo panorama, also beginning the process of downward registral extension.

6'35". A sustained metallic resonance (Material 2), with variegated internal activity, enters by fading in at the spatial periphery. Eventually this too expands to fill the space and, as a result, its high-frequency components absorb those of Material 1. Relatively unprocessed concrete sounds (frictional squeaking, in this case) also enter sporadically toward the end of this region (Material 3).

9'19". The first event of Material 4 takes place unobtrusively at the extreme left. This is the sonority generated by stochastic waveform computations. Typically, it consists of sound-objects which begin with a "wall" of more or less colored noise, from which a wavering pitch emerges like an electronic scream, typically also wandering across the sound space. Alongside this, at 9'45" or so, a recognizable flute-like sound makes its presence felt, at 10'00" some clear scraping sounds, and at 10'25", an unmistakable African kalimba. For the remainder of this region, Materials 2 and 3 form a constantly shifting context for a series of increasingly paroxysmic bursts of Material 4. All of these materials still generally occupy a medium-to-high frequency range, so that the overall texture is extremely closely-woven. At 17'23" Material 4 appears in combination with itself for the first time, and rapidly reduces its "accompaniment" to insignificance, apart from a new element (at 18'25") reminiscent of a large metal object being dragged laboriously over concrete: Material 5.

19'20". Material 4 drops out to be supplanted by several layers of Material 5 (whose dynamic envelopes develop from smooth to "lumpy" during the traversal of this region), along with the kalimbas of Material 3, which occupy its interstices. At 21'05", after the "dragging" has developed a significant low-frequency component, the percussion instruments multiply to include several simultaneous irregular (mostly upwardly-transposed) drum-rhythms. A "surreal" kind of rhythmic interaction ensues between these drums and the random impulse-successions (bounces) of the dragging sounds. If two sound-sources such as these are treated by Xenakis as functionally "equal" in the composition, despite one being the result of an independent musical enactment and the other not, this serves further to emphasize that such differences are merely a question of perspective.

25'07". Once again, a transition between regions begins almost imperceptibly. A rhythmic pulsation (around 155 beats per minute), of electronic origin, gradually shifting in timbre and gradually sliding upwards in pitch, enters at the extreme right. Such sounds (Material 6) rapidly spread across the space and, simultaneously, across a range of different tempi, until a quiet, static scraping at the center is almost all that can be heard of the previous texture. The simultaneity of tempi produces at this point a highly disorienting effect like a combination of

sonic "stroboscopes," which additionally bear a striking resemblance to a passage in the orchestral *Jonchaies* (1977), more evidence of deep connections between Xenakis' electronic and instrumental music. One could imagine this region as being the "center" of the entire work, where we enter the musical analogue of a sub-microscopic world of particles and force-fields. At 27'45" these are joined by a highly pitch-unstable frictional texture (Material 5b), which in some of its appearances takes on the aspect of an enormous creaking door.

32'54". The disorientation is completed by the brutal re-entry of Material 4 from both sides simultaneously (but now in a virtually continuous slab instead of separate phrases: Material 4b), "causing" Material 6 to withdraw rapidly into inaudibility, and Material 3, in more or less its original form, also to re-enter. The return journey seems now to have begun. Material 5b also joins the by now spatially and registrally saturated soundscape at 35'11", soon taking over from Material 4b, although at 36'54" a much lower-pitched manifestation of Material 4b makes its appearance and, not unexpectedly by now, multiplies itself into an inferno of increasingly deep buzzing. The low bass region has by now become the site of an indistinct tangle of sound materials, accompanied by shards and flecks of equally indistinct higher sounds. At 40'15" the latter begin to resolve into pitched twitterings (Material 1b), and the former into a localized mass of distortion which drags itself around the space slowly before disappearing completely by 43'00". Material 1b is now left alone and becomes increasingly like the sparse calls of nocturnal insects (a recurrent and autobiographically significant sound-image for Xenakis), eventually smoothing out into the whistles with which the work began, and fading from audibility.

V.

Phenomena and their causes, both musical and cosmological, may be explained and thereby understood on various distinct levels, from the reductionist to the global, each of which throws light on a particular aspect of an overall reality. For example, *La légende d'Eer* might be approached from the standpoint of its microstructure: not only the computer-generated air pressure variations which produce the sounds of Material 4, but also the rhythmical structure of the drumming of Material 3, the frictional interactions between physical objects and substrates which produce Material 5, and so on. One might also examine the inter-reactions and interpenetrations of these materials on the "phrase" level, that which corresponds more closely with the articulation of more familiar and deep-rooted types of human communication such as speech and vocal/instrumental music – in short, with breath and body movement. Then there are the shifting perspectives, which make possible different "spaces" within which these inter-reactions take place; and then, the "epic" formal scheme, which provides the entire work with its overall shape and directs the "fate" of the materials. Note that these diverse levels of understanding are discontinuous with one another, perceptually and (presumably) conceptually. While it is true that a "rhythmic" train of impulses, accelerated sufficiently, produces a "pitched" sound, and decelerated produces "formal" divisions of time, the human sensory/cognitive apparatus carries out different operations to perceive these things. Note also that none of the levels is more "true" or "complete" than any other. To take a scientific analogy, no possible amount of knowledge concerning the nature of

subatomic forces will assist in the understanding of (still less predict the course of) organic evolution by natural selection, and vice versa. Is it possible to take our perspective on *La légende d'Eer* a stage even "further out" than the limits of the work itself, to perceive connections between it and phenomena outside it? Yes. Xenakis surrounds the work with a compilation of five (pre-existent) texts, to which we turn finally as our journey to the center of the composition heads back outwards.

The texts will be seen to reflect or react upon each other across the distances in time, space, and culture that separate them. In fact one could say that they reflect upon each other in the same way and to the same degree as they do upon the music. They provide a selection of possible points of departure from which to enter the music, but also might draw the listener outwards from the music to some fascinating manifestations of human thought. While Xenakis himself is not normally at his most eloquent when giving verbal expression to his ideas (nor, I am sure, would he claim to be), he does not appropriate these texts to speak for him: they speak for themselves, but in doing so illuminate the music – not what it consists of or how it came about, but why.

The first text is from Plato's *Republic* (from which it stands out rather incongruously) and is the "legend of Er" itself. Er is a warrior from the city of Pamphylia. He is killed in battle, and when his body is collected for burial ten days later it is found to be uncorrupted. After another two days, Er returns to life, a phenomenon he cannot explain, and tells of what he saw during his temporary sojourn in the "other world." The punishment of evildoers and rewards given to the pious are described in comparable terms to those Dante was later to use, particularly in so far as the punishments receive more detailed attention than the rewards. Nevertheless, the most arresting image, and the most obviously related to Xenakis' composition, is a structure that spans the universe:

> the spindle of Necessity, on which all the revolutions turn. [. . .] The spindle turns on the knees of Necessity; and on the upper surface of each circle is a siren, who goes round with them, hymning a single tone or note. The eight together form one harmony; and round about, at equal intervals, there is another band, three in number, each sitting upon her throne: these are the Fates, daughters of Necessity . . . who accompany with their voices the harmony of the sirens – Lachesis singing of the past, Clotho of the present, Atropos of the future.[3]

Xenakis' relationship to Platonic thought could form the subject of an essay in itself, but his use of this particular text is of a piece with his tendency to draw attention to Plato's more "immaterial" statements. Of course, Plato was also responsible for some of the most cogent statements of the Pythagorean idea of number in music being a reflection of the harmony of the spheres. When, in *Formalized Music*, Xenakis (1971: 178) draws together the justifications for his technical approach to composition, he first points out that his techniques, "although often rigorous in their internal structure, leave many openings through which the most complex and mysterious factors of the intelligence may penetrate," then that they afford "the placing of sonic art on a more universal plane . . . on the same level as the stars, the numbers, and the riches of the human brain," finally quoting Plato's *Timaeus* on divine harmony. Lest we think that Xenakis is in danger of vanishing into a fog of mysticism, he follows this two pages later with a statement which puts his "Platonism" in context:

I shall not say, with Aristotle, that the mean path is the best, for in music, as in politics, the middle means compromise. Rather lucidity and harshness of critical thought – in other words, action, reflection, and self-transformation by the sounds themselves – is the path to follow. (Xenakis 1971: 181)

The second text is from *Poemandres*, attributed in the Middle Ages and Renaissance to the sage Hermes Trismegistus. Hermes was supposed to have been an Egyptian priest/philosopher/king who lived at or before the time of Moses, and was revered by many Renaissance philosophers (Ficino, Pico, Bruno, Fludd, to name but a few) as a prophet who not only anticipated certain aspects of Christianity by thousands of years, but also combined what was seen as the ancient, pure, and magical religion of the Egyptians with a respect for the nature and capacities of humankind. This was seized upon by the Renaissance humanists as a justification for their attempts to emerge from theocentric medieval dogma. In 1614, the Swiss-born scholar Isaac Casaubon, in one of the first triumphs of analytical scholarship, proved that the Hermetic writings could not be as ancient as was claimed. For example, he considers that the correspondences between *Poemandres* and Plato's *Timaeus* (who for his part nowhere mentions Hermes) are more likely to have arisen from the former having been composed after the latter rather than being "prophetic" of it. The *Hermetica* turn out to have been compiled from gnostic sources in the early Christian era; but, by a strange coincidence (and no more than this!), they could now be interpreted as anticipating more recent theories concerning the origin of the universe. Poemandres is the name of the "Mind of the Supreme Power," who manifests him/herself to Hermes, the latter having entered into a state of visionary meditation:

immediately all things were disclosed to me in a moment; and I see a spectacle indefinable, all things having become light . . . and, after a little, darkness was brought down in part having become dreadful and horrible, sinuously terminated, so that I imagined myself having seen the darkness changed into a certain moist nature, unspeakably disturbed, and giving forth smoke as if from fire, and emitting a certain sound ineffable, mournful. Then a noise from it was inarticulately sent out, as I supposed the voice of Light.[4]

The obscure text of *Poemandres* (and it is by no means the most obscure in the *Corpus Hermeticum*) continues with a typically complicated gnostic vision of the creation of the world and ultimately of humanity. The violence as well as the weird incomprehensibility of the vision leads us once more to another angle on the music of *La légende d'Eer*. Xenakis describes this text as a "revelation through tone, light and abstraction," which condition of course was the implicit goal of Le Diatope and its music.

The following text comes from the *Pensées* of Blaise Pascal, and is an expression of the awe engendered by seeing oneself poised between the infinite and the infinitesimal (remember here Xenakis' concern to work directly with air pressure/time functions, in other words with the smallest perceptible "particles" of sound).

For, after all, what is man in nature? A nothing in comparison with the infinite, an absolute in comparison with nothing, a central point between nothing and all. Infinitely far from understanding these extremes, the end of things and their beginning are hopelessly hidden from him in an impenetrable secret. He is equally incapable of seeing the nothingness from which he came, and the infinite in which he is engulfed.[5]

Just before this, Pascal takes the reader on a journey from the human scale down to the infinitesimal, where he describes nested layers of complexity in an infinite regress, in a way which centuries later Benoît Mandelbrot would quantify and describe as the "fractal geometry of nature." Elsewhere (in 1989) Xenakis remarks, with reference to Mandelbrot's insights: "these results are rather novel aspects of the equivalent compositional problems which I started dealing with 35 years ago" (Varga 1996: 205). There are moments in *La légende d'Eer* where one is indeed disconcerted by being, as it were, dwarfed by something which could either be an enormous object or a minute one which appears enormous, either as a result of its being magnified or of one's own self being somehow greatly diminished in size. Nevertheless, the music is by no means "fractal" in structure: rather like the universe itself, as it appears in the light of recent deep-space observations, its structure on the largest (time- and space-) scale is considerably simpler than on smaller scales. The structure of galactic superclusters is less complex than that of single living cells. This is what gives astrophysicists a certain confidence that the universe might be "comprehensible;" in the present context, it gives the listener a vantage point from which to explore the teeming microstructure of this composition. Nevertheless, while "[t]he unfolding of the cosmos, it seems, is almost completely insensitive to the details of its contents," (Bucher and Spergel 1999) at least those contents of which we are presently aware, the progress of *La légende d'Eer* seems much more clearly "driven" by a pressure exerted by its materials as they (repeatedly) force their way from the spatial periphery to the center or (cumulatively) propagate throughout the audible frequency-spectrum.

Next we come to a passage from Jean-Paul Richter's novel *Siebenkäs*, which also appears in Xenakis' choral-orchestral work, *Nekuïa* (1981). The works of Jean-Paul (1763–1825) are widely known to have exerted a crucial influence on the young Robert Schumann, principally for their labyrinthine formal structures and their tendency to flower into hyper-romantic "purple passages" whose relationship to the surrounding narrative can be highly tangential. The passage chosen by Xenakis, which has become somewhat celebrated in its own right, is one of these digressive fantasies. A dream is recounted in which Christ announces to the souls of the dead that God does not exist:

> I traversed the worlds, I sped up to the suns, with the galaxies I flew across the deserted spaces of the heavens, but there is no God. I went down as far as existence can project its shadows, I cast my gaze into the abysses, and I cried 'Father, where are you?,' but all I heard was the eternal tempest, governed by no one. . . . And when I looked up to the infinite heavens, seeking the eye of God, the universe observed me from its empty, bottomless socket; and eternity, reclining on chaos, gnawed and regurgitated it.[6]

Again, images of a violent and pitiless universe, the symbolic figure of Christ standing for suffering humanity, with the twist that the suffering has neither cause nor respite. The four texts considered so far have in common a concern with religious experience in one form or another, which throws Xenakis' uncompromisingly atheistic viewpoint into sharp relief. It is significant (also relative to his seemingly paradoxical relationship with Plato, as mentioned above) that Xenakis refers to "abstraction" in relation to the Hermetic text, whose obscurity is in fact less the result of any such tendency than that of a typically gnostic veiling of "holy truths" from the understanding of the

uninitiated. What seems above all to interest Xenakis is the response of the human imagination (the human capacity to form "virtual" images of a perceived reality) to coming face to face with the limitless void, whether in a mystical, philosophical, or fictional context, which applies as much to the myth-making of Plato or Hermes Trismegistus as to Jean-Paul's fantastical reverie or Pascal's awed speculations. I would go so far as to say that Xenakis, in placing these texts around *La légende d'Eer*, rather than around the many others of his works, to which one or more of them might also be related, implies that the present work has a special place within his oeuvre as a musical-philosophical nexus at the dark center of his musical universe.

Lastly there is an excerpt from a *Scientific American* article which discusses the unimaginable amounts of energy released by supernova explosions (Kirshner 1976). Since the 1970s, far more extensive observations of these phenomena in distant galaxies have been made, as supernovae of a certain class are so consistent in terms of the energy given out and their evolution over time that they can be used as "standard candles" to make unprecedentedly accurate measurements of distances (and therefore also distances in time) over a large proportion of the observable universe. The conclusion (made, as it happens, over the last year or so) seems to be that the rate of expansion of the universe is actually increasing, a finding for which there is as yet no theoretical explanation (cf. Hogan *et al.* 1999). Such an explanation would have to invoke forces which have so far never been observed, or a new view of the geometry of space-time itself. How ever this may be, it presently seems clear that the future evolution of the universe will probably be towards increasingly cold and diffuse conditions, which naturally will have drastic implications for any form of life which remains in that distant future, as Martin Rees speculates:

> As the background temperature falls [in an eternally expanding universe], any conceivable form of life or intelligence would have to keep cool, think progressively more slowly and hibernate for long intervals. (Rees 1997)

> If protons lasted for ever, hugely complex but tenuous networks could be fabricated. There are quite general limitations on the size and complexity of organisms (or, indeed, computers) because anything too heavy would be crushed by gravity, and its internal workings would generate too much power to be radiated away. But structures in the far future can transcend both these constraints. Gravity can be suppressed, however massive these constructions are, by making them distended enough. And they can have a large enough surface to radiate and stay almost as cool as the background radiation, whose temperature drops as the expansion proceeds; the minimum energy needed to transmit each item of information gets ever lower. Information-processing (or "thinking") would be very slow in a spread-out configuration: the rate is limited by how long a signal takes to cross it, moving at the speed of light . . . But what is the urgency when aeons stretch ahead? (Rees 1997)

> Evolution needn't come to an end, even when all the protons vanish. There could always be black holes, provided that they grew, by coalescence, fast enough to counteract their erosion by evaporation. . . . These holes may concentrate energy enough to create new matter. Even a dilute gas made of electrons and positrons could provide the basis for circuitry controlled by complex magnetic fields and currents pervading the medium. (Rees 1997)

These hypothetical scenarios for the continuation of intelligence in the universe would obviously be billions of years after anything resembling humanity had ceased to exist: compared with what lies "out there" we are almost infinitesimally small both spatially and temporally. And this I think is an appropriate point at which to end, having left Iannis Xenakis himself far behind (as I am sure

he would want) in the course of the imaginary voyage in to and outwards from *La légende d'Eer*. Some of the foregoing may have been unusually tangential, but to me that is merely a token of the resonances set in motion by one of the most thought-provoking musical statements of our time.

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Notes

1. All timings refer to this version of the work.
2. Translated by RB.
3. Plato, *The Republic*. Excerpt reprinted in liner notes (1995) Auvidis Montaigne. MO 782058.
4. Hermes Trismegistus, *Poemandres*. Excerpt reprinted in liner notes (1995) Auvidis Montaigne. MO 782058.
5. Pascal, *Pensées*. Excerpt reprinted in liner notes (1995) Auvidis Montaigne. MO 782058.
6. Jean-Paul, *Siebenkäs*. In liner notes (1995) Auvidis Montaigne. MO 782058.