

META-XENAKIS

NEW PERSPECTIVES ON IANNIS XENAKIS'S LIFE, WORK,
AND LEGACIES

EDITED BY SHARON KANACH AND PETER NELSON





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Introduction: Meta-Xenakis

Peter Nelson and Sharon Kanach

One hundred years (more or less) since the birth of Iannis Xenakis (1922–2001) and we are still getting to grips with the legacy of one of the key creative figures of the twentieth century, a figure who not only sprang indelibly from the traumas and energies of that century but also put its foundational concepts into question.¹ In his central account of the wartime experiences that defined the trajectory of his life, as well as through his own representation of himself as an “ancient” rather than a “modern,” Xenakis encountered history as a crucial and exemplary element within his creative thought and artistic process: both his own, personal history, and the history which places Greek thought and culture at the center of European identity.² Xenakis’s concern with modernity—with the modernism that represents the core energies that drove the century’s preoccupations, from world wars to millennium—is clear in his work for the architect Le Corbusier (1887–1965), and in his ground-breaking researches with computers and digital technologies, and yet: the questioning that lies behind his creative impulse comes from another source, an ancient source as he himself expressed it, and that questioning blows apart the notion of the modern, and its Eurological orientation, in unique ways that are still being assessed.³

This volume is an attempt to register the impact of the questions Xenakis posed as much as the impact of the work he achieved. In that sense, it is not so much a celebration as a progress report. If the scale and ambition of the projects he inaugurated seem modern in their all-embracing vision and intransigent surfaces, the core of their conception has weathered in the realities of the current era to reveal a complexity and intricacy that speak to many different concerns and situations, across cultures,

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- 1 In the recent exhibition at the Philharmonie de Paris, “Révolutions Xenakis,” two passports were showcased: one dating from 1933 indicating his year of birth as 1921, and another one, dating from 1937 indicating 1922. See also Solomos, 2022, p. 34.
 - 2 In an interview with Richard Steinitz at the Huddersfield Festival in 1987, Xenakis stated quite clearly: “I brought myself up into the ancient Greek tradition, that’s for sure,” Huddersfield Festival, 21st November 1987 at 2:15 PM. Transcribed by PN. For Xenakis’s account of his wartime experience, see Xenakis, 1992, p. 8–9.
 - 3 In a published interview with Bálint András Varga he says, “I felt I was born too late—I had missed two millennia” (Varga, 1996, p. 15). For an account of the concepts of the Eurological and the Afrological, see Lewis, 2002.

and across disciplines. As the notion of our planet as the locus of an inter-planetary, exploratory, and fundamentally acquisitive human enterprise has given way to the sense of a planet that is fragile, lonely, and in danger precisely from that human acquisitiveness, so the overarching ambition of all-encompassing schemas has evolved to the recognition that actions are fraught and uncertain, local and situated, even as they have global consequences. And Xenakis's own, explicit vision attempted to navigate the consequences and uncertainties inherent in the forces of existence, with a concern for both the local and the global.

One clear example of this vision is Xenakis's first project intended to celebrate the inauguration of the Centre Pompidou in Paris (the Beaubourg Center, inaugurated in 1977 as the pinnacle of the cultural legacy of President Georges Pompidou (1911–74)). This was a plan for a *Polytope Mondial*, envisioned as a worldwide, planetary celebration. Xenakis boldly stated:

The time has come to bridge the arts across oceans, between continents and among countries. Why not weave together the population of the earth through the arts, by establishing a new, direct contact that overcomes the barriers of language, politics, parochialism, racism, chauvinism?

Today this “weaving together” is possible, though Xenakis's vision of “the arts” is remote from the populist notions of digital Neoliberalism. Penned in March 1974, the project specification seems like an encapsulation of Modernist ambition:

Within such a project, the most advanced scientific research can be combined with the most prophetic artistic forms. Yet both can remain powerful abstractions closely related to cosmic phenomena with immediate effect on the imagination of the most humble man and child of all races and religions.⁴

And yet, in Xenakis's own work, “cosmic phenomena” and “imagination” are the twin poles of a view of art that transgresses cultural boundaries, while acknowledging culture as a phenomenon like any other; as both physical and metaphysical.⁵ For him, the physical phenomena, that can be penetrated by scientific imagination, are entwined with cultural phenomena, that can be penetrated by the creative imagination, within a context of forces both elemental and political. As a work like *Evryali* for piano (1973) draws on ancient Greek thought and imagery to reflect on the human encounter with the abstract forces of creation, so works like *À l'île de Gorée* for harpsichord and ensemble (1986), with its harpsichord reflecting the music of the kora, and *Okho* for three djembes and large drum (1989) face up to the political and cultural forces

⁴ Xenakis, 2008, p. 247–8.

⁵ Xenakis writes, “The universes of music—classical, contemporary, pop, folk, traditional, avant-garde, etc.—seem to form units in themselves, sometimes closed, sometimes interpenetrating. They present amazing diversities, rich in new creations but also fossilizations, ruins, wastes, all in continuous formation and transformation like the clouds, so differentiated and ephemeral.” Xenakis, 1985b, p. 172.

that shaped the Afrodiasporic experience that haunts Europe.⁶ Xenakis, always a political radical under the surface, reflected similarly on other cultural formations, understanding, from his “ancient” perspective, that the power struggles of life—in all its forms—and the substances and forces that create and support that life, are deeply implicated in one another. This meta-view of culture and science allowed him to form a vast series of works that totally confounded the Eurological, Enlightened perspectives which formed the basis of the “avant-garde” art-worlds around him.

To mark the centenary of Xenakis’s birth, the Centre Iannis Xenakis (CIX), an independent not-for-profit association hosted at the Université de Rouen Normandie (France), initiated a unique, international consortium, mainly composed of his former students, performers, dedicatees, and collaborators, from five countries and three continents: France, Greece, Japan, New York, and Mexico: META-XENAKIS.⁷ The team’s shared goal was to create a truly transcontinental celebration of his life and work, as well as initiating a reassessment of his artistic and philosophical legacy. In all, around eighty events (concerts, exhibitions, workshops, public lectures, masterclasses, composition competitions) took place around the globe under the Meta-Xenakis banner, culminating in a forty-one-hour non-stop marathon symposium (see Appendix). This volume consists of both written texts and digital resources of various sorts, including audio, visual images, videos, computer software, and a virtual exhibition, as well as a selection of our marathon’s papers, reconstituted as considered contributions to Xenakis scholarship. Its aim is not only to shed new light on the life and work of Xenakis, as an exemplar of a particular sort of creative spirit, but also to report on new work inspired by his legacy, and to support the interdisciplinary impetus of the insights and initiatives by which Xenakis set in train a host of creative and investigative projects. Each of the eight Sections presents a pole in a constellation of viewpoints that supports a broad and inclusive view of creativity as lived by Xenakis himself, and as it lives on in the projects that continue to take the example of his work, the questions that he formulated, and the insights that he conceptualized as foundational. Throughout the book, beginning with its cover, between Sections, and occasionally as part of individual author’s Figures, the reader’s experience will gain human insight on Xenakis, through the thoughtful lens of Henning Lohner (b. 1961). From their initial meeting in 1985 until Xenakis’s passing in 2001, the two cultivated

6 The island of Gorée, off the coast of Senegal, was the largest collection and embarkation center for the slave trade between the fifteenth and nineteenth centuries. Xenakis dedicates this work to those “who, forcibly taken from their lands into appalling slavery, have managed to win for themselves leading positions in some of the ‘civilised’ countries to which they had been deported. It is homage also to the black heroes and victims of apartheid in South-Africa, last bastion of a hysterical racism” (Xenakis, 1988, title page). *Okho* was “a commission from the Festival d’automne à Paris and the Caisse des Dépôts et Consignations, with the support of the Government of France on the occasion of the celebration of the bicentenary of the French Revolution,” a circumstance in which this instrumentation, as well as the actual musical materials, could be seen as at least a challenge to received views. See Xenakis, 1989, title page.

7 Centre Iannis Xenakis, <https://www.centre-iannis-xenakis.org/>; Meta-Xenakis, <https://meta-xenakis.org>

a deep complicity and bond which is documented in this selection of photos. In 2013, Lohner generously bequeathed his entire collection of his unique photos and footage of their friendship to the CIX, and we are grateful to Henning for graciously allowing us to include these images here.

To begin the volume, James Harley, one of the key figures in contemporary Xenakis scholarship, reflects on meta-materiality as an emblem of the diversity and interdisciplinarity of Xenakis's worldview. This short introductory essay surveys the life, work, and legacy of Xenakis, pointing out key aspects of Xenakis's thought and creative motivation, as an initial focus for those already familiar with Xenakis, and as a compact introduction for those who are not.

The first Section, *Xenakis before Xenakis*, presents new information and insights on the early years of Xenakis's life. As personal history, this period was not only formative for Xenakis in the usual sense, but also inflicted an indelible mark physically, politically, emotionally, and intellectually that radically informed the whole of his later existence. And yet, beside the traumas of war, injury, and exile, a life was lived whose richness and focus equally informed the course of what was to come. Thus, Nikos Ioakeim examines Xenakis's rarely mentioned theater studies during the years of the Nazi Occupation of Greece during the early 1940s. He traces some of the composer's friendships from that time and the ways in which political affinities—cemented by those friendships—intersected with a notion of ancient Greece based on her dramas and theater, and raised the thorny question of Greek language, so pivotal to Greece's identity as a modern nation. In particular, Ioakeim provides new insights through his documentary investigation of the contact between Xenakis and the philologist, writer, and man of the theater Vassilis Rotas (1889–1977) and his Theatriko Spoudastirio (Theater Studio). By uncovering the evidence of Xenakis's early engagement with theater, conceived by Rotas as a political focus for the critical reinvention of Greek culture, this text sheds important light on a hitherto underexplored aspect of the composer's early life.

Stella Kourmpa, the archivist of the Athens Conservatoire, and a member of the board of the Contemporary Music Research Center, KSYME (Κέντρο Σύγχρονης Μουσικής Έρευνας) in Athens, provides context for the presentation of the text, from the KSYME archive, of a crucial letter that Xenakis sent to the first president of the new Greek state, Konstantinos Karamanlis (1907–98), after the fall of the military dictatorship in 1974. Kourmpa explores briefly the feelings of loss and exile experienced by Greeks, like Xenakis, who were banished during the post-war years, and presents for the first time, both in its original and in translation, the letter Xenakis wrote to Karamanlis offering his services to the new Greece, and proposing KSYME, founded in association with his friends Stefanos Vassiliades (1933–2004) and John G. Papaioannou (1915–2000), as an international center for music research. The text of the letter shows both the plans and the emotions of a man whose relationship with his country and his culture was both deep and problematic.

The next Section, *Xenakis without Borders*, examines the reception of Xenakis's work and ideas internationally, and as a response to his own travels to Germany, Japan, and Indonesia. As a Greek brought up in the radically multicultural environment of Braïla, a Danube port in a historically contested region of Romania, and steeped by inclination in the pre-Christian ethos of ancient Greek culture, Xenakis's instincts were fundamentally open and inclusive: this is what makes the planetary vision of the *Polytipe Mondial* affirmative rather than imperialist in its implications, and what makes his musical vision so communicative, despite its radical dimensions.

Marko Slaviček considers the experience of Xenakis as an occasional participant in the cultural life of Cold-War Berlin, particularly as a Deutscher Akademischer Austauschdienst (DAAD) visiting composer from 1963–4. Perceived as an artist at the leading edge of the Modernist avant-garde, Xenakis caught the attention of the Congress for Cultural Freedom, a Cold War enterprise inspired and funded by the US Central Intelligence Agency (CIA) and Slaviček traces the institutional and personal connections that led to the invitation from the DAAD, as well as the impact that Xenakis's presence and work had on the cultural life of the city.⁸ He also traces the personal effects of an exile within an exile, as Xenakis's solitary visit to the city was experienced.

Jelena Janković-Beguš documents the reception of Xenakis's music in Serbia, a country that occupied a sort of liminal space in post-war Europe. She also demonstrates the central role of broadcasting in the formation of cultural perspective, through the efforts of Radio Belgrade Third Programme to disseminate a broad and international range of contemporary music that regularly included the work of Xenakis. Janković-Beguš surveys the generally negative critical response to broadcasts and performances of Xenakis's work, exposing the cultural politics that play out a set of tensions between the national and the international within the collective psyche of a culture that perceives itself as being on the peripheries of larger forces.

Finally, Mikako Mizuno presents a historical account of those Japanese musicians who have established a performance tradition for the work of Xenakis. In particular, the pianists Yuji Takahashi (b. 1938) and Aki Takahashi (b. 1944) are pioneers who worked with many of the key figures of the European and American avant-garde. Their advocacy of the music of Xenakis was important because their cultural background allowed them to approach Xenakis's radical style without the barriers encountered by European performers. Mizuno relates how the engagement with Xenakis's music that they established has continued into the present, particularly among pianists and percussionists. Her account of the performances by percussionist Yasuko Miyamoto shows the creativity engendered by an intercultural approach to works that are, in their conception, partly outside culture.

8 See Saunders, 1999.

In the Section *New Contexts for Understanding Xenakis*, we develop a theme, already evident in Xenakis's own work from the earliest period, concerned with fundamental research into the philosophical, scientific, and technological underpinnings of music and sound, within a holistic understanding of art as an encounter with the cosmos. This theme connects deeply with Xenakis's study of ancient Greek culture, and with his sense that his own work continued, in some way, to view the world with the same preoccupations and priorities as the ancients. Xenakis imagined this theme as concerning an "alloy" of art and science, where the re-mixing of these two is in some sense a putting-back-together of strands of thought that already existed together in ancient times, and only really became separated out as a consequence of the project of Enlightenment.⁹ Nevertheless, Xenakis's own research made use of modern technologies of computing and computer modeling, not just as a method of shortcutting tedious calculations but as a method of exploring the phenomenological foundations of the physical occurrence of sound as much as the signifying processes of art.

Ronald Squibbs investigates the history and operation of Xenakis's Free Stochastic Music program, his first attempt at a generalized method of calculating the probabilistic processes that underpinned individual, experimental musical works, in a series created between 1956 and 1962 and labelled with the prefix ST. Squibbs probes the mechanisms of the program in order to show the tendencies and tolerances of the calculations, and he recalculates some of Xenakis's data in order to show the connection between the output of the program and the finished score. This allows a view of the experimental nature of Xenakis's original insight, that events in the world are probabilistic by nature, and that the processes of change are meaningful. It also demonstrates how Xenakis's experimental approach is capable of generating further insights, concerning both his own works and the processes of change in general.

Pierre Albert Castanet considers these same probabilistic processes from a philosophical perspective, as Xenakis also did. If the calculations of actual probabilities result in data, useful in the process of artistic creation, the initial insights relate to pre-Socratic notions of flux and evolution, of continuity and discontinuity that underpin our encounter with existence itself. Castanet traces the creative struggle that Xenakis experienced in trying to theorize an artistic process from these philosophical beginnings, as a way to make things clearer, rather than as some hermetic origin for artistic inspiration.

Ramón del Buey Cañas and Oswaldo Emiddio Vasquez Hadjilyra delve deeply into the discussion of materialism, taking Xenakis's own theoretical writings as a starting point. What becomes apparent here, if it was not apparent already, is that the philosophical and theoretical aspects of Xenakis's thought are themselves real and profound strands of research, with their own implications and discoveries, not merely emblems of an artistic concern with ancient culture. Xenakis's rejection of certain

9 See Xenakis, 1985a.

conceptual frames, such as the analysis of waveforms based on the theories of Jean-Baptiste Joseph Fourier (1768–1830), for example, speaks to a radical project of building from first principles. Del Buey Cañas and Vasquez Hadjilyra investigate the notion of “pedesis,” as “partly unpredictable motion in matter,” in order to demonstrate how real-time computing, as implemented in the UPIC (Unité Polyagogique et Informatique de CEMAMu (Centre d’Études de Mathématique et Automatique Musicales)) system, is not simply a trick of convenience, enabled by technical advance, but a principled outcome of dialectical thinking.¹⁰

Just as del Buey Cañas and Vasquez Hadjilyra show Xenakis’s thought prefiguring certain critical strands in current Science and Technology Studies, in dialogue with the writings of Abraham Moles (1920–92) and Isabelle Stengers (b. 1949), so Nathan Friedman pursues Xenakis’s aesthetic stance through the analysis proposed by Jean-François Lyotard (1924–98) in his exploration of the postmodern sublime. In his self-avowed stance of being an “ancient” rather than a “modern” Xenakis has always been an outlier in the narratives of modernism. Friedman explores Lyotard’s invocation of the “inhuman,” a notion that critiques the Enlightenment project of the intelligent individual, tracing its resonances in ancient thought, in order to uncover the radical ethics of Xenakis’s art: an ethics that produces an art, in the words of Milan Kundera (1929–2023), “washed clean of affective filth, stripped of sentimental barbarity.”¹¹

Judith Romero Porras continues the theme of “building from first principles” in her consideration of microtonality. Through the figure of Jean-Étienne Marie (1917–89), she also documents the connection between Xenakis and the culture of Mexico which is, incidentally, one of the important strands of this publication. Marie, as a composer influenced by the work of the Mexican Julián Carillo (1875–1965), and as a technologist and collaborator for performances of Xenakis’s work, was ideally placed to effect a cross-fertilization between Xenakis’s formulation of non-standard scales through the theory of sieves (*cribles*) and the microtonal practice that arose in Carillo’s music. Romero Porras shows how Marie’s analysis places culturally specific scalic practices as exemplars within the principled theoretical constructions of Xenakis.

Pablo Araya explores the meaningfulness of the statistical processes at the heart of Xenakis’s work through a detailed consideration of the nature of analogy. This goes to the center of the art-science “alloy,” which proposes, as a foundational insight, that the trajectories of natural events, as described by the paradigms of science, are susceptible to creative manifestation. Can metaphoric or analogical processes effect some solid amalgam of perceptual forces, effectively combining different views of a phenomenon? Or can art only ever hope to resemble phenomena as a copy? Araya

10 Computerized Polyagogic Compendium of the CEMAMu—where “polyagogic” is a sort of plural of pedagogic (cf. Varga, 1996, p. 121). The Center for Studies in Mathematics and Automation of Music was founded in 1972 at CNET—Centre de Recherche et Développement de France Télécom (Center for Research and Development of France Telecom), Issy-les-Moulineaux, France, with grants from the French Ministry of Culture.

11 Kundera, 2010, p. 78.

considers a number of theoretical foundations for analogy, comparing them to Xenakis's own theoretical writing, and showing how analogy can be the engine of a "creative-constructive" perception.

Mauricio García de la Torre continues the investigation of the apprehension of the meaningful processes at the heart of Xenakis's work by considering the phenomenology of perception. This is, above all, a phenomenology of energy. García de la Torre investigates acoustic energy in particular, as theorized by Julio Estrada in terms of what he calls "macrotimbre." As García de la Torre shows, the energetic quality of Xenakis's work is evident, not just in its statistical trajectories, but also in its use of the *glissando*/diagonal as a primary material, and he demonstrates this by taking analytical examples from a selection of Xenakis's key early works. This exposes the physicality of Xenakis's music, as structures formed by "the regulation of energetic factors of change and conflict."

Ambrosio Salvador Rodríguez Lara concludes this Section by extending the discussion of energetic processes to consider the use of spatial trajectories in music, using Xenakis's work *Persephassa* for six percussion (1969) as an example. Rodríguez Lara connects Xenakis's theoretical discussions with work by Henry Cowell (1897–1965) and Conlon Nancarrow (1912–97), showing how space projects out of the geometrical configuration of pitch on specific instruments. He shows the continuing power and relevance of these concepts by discussing their practical application and development in his own work, arguing that the expressive potential of the inclusion of space within the gamut of musical materials is ripe for further research and exploration.

The Section *New Perspectives on Xenakis's Works* concentrates its focus on individual examples from Xenakis's output, taking different approaches to uncover significant insights into the history, provenance, and implications of Xenakis's heterogeneous approach to creativity. Xenakis's music continues to be widely performed, even though many of his works have a scale and ambition that make them difficult to replicate. The historical performances of many works, like *Persepolis*, have had significant, complex, and continuing impact, even when the exact circumstances and details of those performances have been hard to uncover. The cutting-edge nature of some of Xenakis's methods, and the pressure under which performances were put together, have meant that materials did not often survive in ways that were easy to access. It is only now that some archival resources are beginning to yield details that shed new and important light on spectacles that are fast receding into history.

Thus, Cyrille Delhaye probes the archives of the CIX housed at the Université de Rouen Normandie, to uncover the history of Les Ateliers UPIC, the organization originally set up by Xenakis in 1985 to promote the UPIC computer music system he developed from the 1970s through the 1990s. Delhaye outlines the materials and provenance of the archive, before exploring in detail the documentation relating to the work *Taurhiphanie* (1987), which was the first of Xenakis's works to use the real-time

possibility of the UPIC system. This work is still widely performed as an electroacoustic piece, but its origins were as a spectacle, designed for the arena at Arles, involving multiple live elements including bulls (*taur..*) and horses (*..hiphanie*). Delhay explores Xenakis's use of "live elements," one of the foundations of his creative impulse, and demonstrates the crucial importance of archival materials in bringing the impact of such spectacles into the present.

Similarly, Mikhail Malt and Benny Sluchin investigate the rarely performed works of Xenakis that took game theory as their inspiration. In particular, they concentrate on two works for double orchestra, *Duel* (1959) and *Stratégie* (1962), using computer simulation to make an exhaustive study of the strategic possibilities inherent in the rules that Xenakis devised as the basis for the performances of these works, that pitted orchestras and conductors against one another in a sort of combat. Because of the complexity of the possible outcomes, computer modeling gives Malt and Sluchin a unique insight into the dynamics of the system Xenakis invented, as well as into the consequences of that system for actual performances.

Anton Vishio considers the monumental electroacoustic work *La Légende d'Eer* whose definitive format has only recently been reconstructed from archival materials.¹² The title, of course, refers to the writing of Plato (428/427 or 424/423–348 BCE), a constant in Xenakis's background, and in particular the notion of recurrence which lies behind the archetypal arch-form in music. Taking the work of James Hepokoski and Warren Darcy as a starting point, and considering a range of literary sources, Vishio explores the energetic and metaphoric elements of recurrence in order to reflect on the richness of experience that Xenakis evokes.

Mikako Mizuno is concerned once again with archives, in this case the reports of Sansei Engineering who were the contractors for the one of the pavilions (*Tekkhookan*) for Osaka World's Fair in 1970, sponsored by the Iron and Steel Institute of Japan, for which Xenakis created the electroacoustic work *Hibiki-Hana-Ma* (1969–70). Mizuno charts the progress of the discussions and agreements during the preparations for the event, and shows how the artistic conceptions, which were architectural/spatial in their origins, put pressure on both the technical and the artistic realization which provoked a mixture of innovation and compromise. She explores the ways in which artistic and philosophical speculation come up against the technical possibilities of a particular industrial paradigm: in this case a Western, techno-industrial regime within the context of a Japanese ethos of post-war rapprochement, demonstrating that technology requires acts of translation between cultures as it tries to turn concept into reality. This view of the *bricolage* that determines eventual, practical outcomes from principled beginnings reveals a characteristic of Xenakis's work, its cross-disciplinarity and conceptual sophistication.¹³

¹² See for example Friedl, 2015, and also Reinhold Friedl, "Xenakis's Legend," <https://www.reinhold-friedl.de/xenakiss-legend->

¹³ See Xenakis, 1979.

Erik Christensen and Lise C. Bjerno continue the phenomenological thread, begun in the texts of Araya and García de la Torre, by taking a data-driven, descriptive approach to the investigation of the sound world of Xenakis's early work, *Pithoprakta* (1955–6). This is one of the first of Xenakis's works to use his insight that stochastic processes, that is processes of change within the randomness of the distribution of events, lie behind all of the phenomena of life, from political demonstrations to thunderstorms. Using questionnaire responses, Christensen and Bjerno interrogate the consequences of listening, revealing the affective layer that arises from the experience of musical events that, in their conception, seek to confound an associative aesthetic response by attempting a direct modeling of reality.

Imri Talgam takes phenomenology a stage further by examining the ways in which Xenakis's processes of stochastic change come to be notated for performance, using the standard music notation of Western practice. Particularly in his early works, Xenakis's scores tend to be accurate transcriptions of calculations of probabilities that defy traditional rhythmic and metric structures. Talgam shows how the notational practice that Xenakis developed sets up phenomenological turbulence for the performer, in its relation of concept to experience, that can only be calmed by the re-transcription of passages in order to create more substantial, albeit perceptually near-accurate relationships between parts. He takes the piano piece *Mists* as an example, to show how different notational decisions lead to different trade-offs in the phenomenological mappings between eye (notation), hand (in performance), and ear.

This Section ends with Mauricio Arturo Meza Ruiz's exploration of the sonic imaginary of UPIC, through a comparison between the first work for UPIC, Xenakis's *Mycènes Alpha* (1978), and *eua'on* (1980), by his friend and colleague, the Mexican composer Julio Estrada. The discussion centers on the presence in both sound and drawing of the physicality of the hand, which is a key element of UPIC's operation. This leads Meza to conduct what he calls a "tracealogical" analysis of the two works, showing how the graphic elements that constitute the sonic structures inhabit fundamentally different dynamic-expressive worlds, each of which contains graphic traces of the body involved in their making. Meza proposes that these traces develop from different terrains of creativity, distinguishing the active and the re-active as twin but opposing energies at the heart of UPIC's potential.

The Section *Xenakis and Architecture* provides some glimpses into what was a major part of Xenakis's creative life, though it remains relatively unexplored.¹⁴ Xenakis worked as both a structural engineer and architect at the architectural studio run by the Swiss/French artist known as Le Corbusier, participating in many of the defining projects of architectural modernism, including Chandigarh, the convent of La Tourette, and, most significantly for Xenakis's creative reputation, the Philips Pavilion at the Brussels World's Fair of 1958. And yet, the concern with space and spatial form, with

¹⁴ But see Xenakis, 2008.

materials and methods of construction, design and the physical acts of drawing were constants in all of Xenakis's work, of whatever provenance or genre. The architectural spirit, creating forms for living, informed everything he did.

Brigitte Métra, herself a renowned architect, whose firm Métra + associés was co-responsible with Jean Nouvel for the extraordinary new Philharmonie de Paris, reflects on Xenakis's architectural principles as she considers the ways in which space, sound, and material forms interact to create buildings that enable the life of music in new and socially flexible ways. She finds, in Xenakis's writing, surprising resonances with contemporary concerns for form, space, and function, that have, in a sense, got themselves into the blood of architecture after the modern.

Guy Pimienta confronts head on the relationship between Xenakis and Le Corbusier, engaged at such a critical and formative point in Xenakis's life after his injury and his flight from the Civil War in Greece. Le Corbusier's studio was the refuge from which Xenakis constructed the beginnings of his creative life. Pimienta documents the contrasting visions and preoccupations of each man, showing how they intersected and diverged. He charts the growing realization on the part of Xenakis that the music he loved and the architecture he practiced both faced the same creative problems. The turning point in this realization was the co-inspiration of the design for the construction of the Philips Pavilion and the score for the orchestral work *Metastasis*.¹⁵ After that, Xenakis never looked back, and, as Pimienta shows, the break with Le Corbusier, as confronting as it was, marked the real beginning of Xenakis's creative life, formed on the hard ground (*sol dur*) of a difficult apprenticeship.

To end this brief Section, Panayotis Tournikiotis considers in greater depth Xenakis's training as a structural engineer, detailing the design work that Xenakis carried out during his work on various projects for Le Corbusier's studio. Tournikiotis includes in his discussion important photographic evidence from the various buildings on which Xenakis was employed. He also considers the design challenges posed by the various architectural briefs and traces the creative solutions that Xenakis proposed. The detail of these solutions: the use of space and color, the diagonal basis of the hyperbolic paraboloids that created many of Xenakis's forms, his visionary use of light and trajectories of movement through built spaces, all point to preoccupations and creative reference points that continued to permeate all of Xenakis's output, particularly evident in the series of polytopes, invented and constructed by Xenakis between 1967 and 1987 (whether realized or not). Xenakis continued his architectural work throughout his life, although only a small number of domestic projects were eventually built. Nonetheless, as Tournikiotis points out, Xenakis's multidisciplinary

15 Throughout this volume, we shall refer to Xenakis's breakout work as "*Metastasis*." In the Xenakian community, there is an ongoing debate about how to spell it: "*Metastaseis*" (implying the plural) or even, "*Metastassis*" (as it appears on one of the composer's manuscripts of the work, see Figure 29.1a in Cândido Lima's chapter). But Xenakis himself consistently wrote "*Metastasis*" in his books and in his archival notes; therefore, we have opted for this spelling.

approach—what the author refers to as the attribute of being “polytropos”—is the single defining feature of his life.

Living Testimony documents the memories and experiences of some of those who knew and worked closely with Xenakis. While always partial and personal, such testimonies provide particular sorts of insights into the thoughts, practices, and working relationships that develop between friends and colleagues. They can also get under the surface of certain stock images of a person, revealing unsuspected layers of motivation and expression, as well as disclosing something of the impact that figures like Xenakis, and the work that they produce, can have on other minds. In the case of someone born more than one hundred years ago, the testimonies of those still living provide a historical perspective that serve to record events and impressions that are already fading, and that triangulates contemporary views with the recollections of past interactions.

Nikos Kornilios is the son of one of Xenakis’s comrades from the dark days of the Dekemvriana.¹⁶ A film director, previously a composer who attended Xenakis’s classes at the Sorbonne, he provides a vivid and poetic narrative that records the debt—historical, familial, intellectual, and emotional—of one artist to another.

American composer Curtis Roads is one of the pioneers of computer music, and in particular of a technique known as granular synthesis, which starts from Xenakis’s critique of Fourier analysis (a mathematical strategy developed in the eighteenth century that seeks to decompose complex waveforms into a collection of simple sinusoids with related frequencies). Xenakis developed a completely different view of waveforms, based on mathematics described by Dennis Gabor (1900–79), which led him to a radical approach to the synthesis of sound used by Roads in his development of granular synthesis.¹⁷ Roads documents his personal encounter with Xenakis and with Xenakis’s theoretical writing, charting his own path through the early history of computer music, and relating the way in which his own creative journey is fundamentally indebted to Xenakis’s insights.

Takehito Shimazu is a Japanese composer who attended a course in Paris in 1990, organized by Les Ateliers UPIC, as a consequence of which he wrote a number of works involving Xenakis’s UPIC system. Shimazu narrates the details of his encounter with UPIC, and describes his use of the possibility of sampling, which was at that point a new development in UPIC’s operation. He developed a deep understanding of UPIC and of Xenakis’s intentions in the development of the system, and he reflects on its use in both composition and education, focusing on the physicality of the hand in graphic action, and the ways in which that physicality invests creative intention with a unique clarity of purpose.

The Mexican composer Julio Estrada was one of Xenakis’s longtime friends and colleagues. Here, he presents for the first time two conversations he recorded, at

¹⁶ See Iatrides, 1972.

¹⁷ See Xenakis, 1992, p. 242

Xenakis's studio in Paris, in which the two composers discuss in an informal and illuminating way a range of topics of mutual interest. To follow, and based on his conversations and meetings with Xenakis, Estrada lays out a sort of spiritual and intellectual biography, recording his own impression of Xenakis's accomplishments, and noting those aspects of Xenakis's thought and work that continue to have such an impact on Estrada's own creative life. It is clear, in the passion with which Estrada writes, that there was a deep bond of affection and recognition between these two men; something to do with the "permanent aspiration to be free."

Similarly, the Portuguese composer Cândido Lima had a long and important friendship with Xenakis, a friendship made stronger by the support that Xenakis received, over many years, from the Gulbenkian Foundation in Lisbon, which commissioned a number of important works, including large orchestral works like *Cendrées* (1973) and *Dämmerchein* (1993–4). Lima recounts the beginning of his fascination with the music of Xenakis, their eventual meeting, and their subsequent encounters. This sets the scene for the transcription of portions from three interviews that Lima conducted with Xenakis, two in Xenakis's studio in Paris and one remotely. These interviews cover a range of topics, generating some fascinating dialogues between two extraordinary creative minds.

Finally in this Section, Scottish composer Peter Nelson, one of the core members of Les Ateliers UPIC in Paris during the 1980s, performs a kind of autoethnography of his experiences teaching and composing with UPIC. Taking some cues from contemporary writers in Science and Technology Studies, he attempts to critique the breadth of purpose and the operative capabilities of Xenakis's conception of the UPIC system, exploring the ways in which Xenakis's initial impulse, derived from his work in Le Corbusier's studio coupled with his desire to improve the speed and potential of mathematical modeling through the use of digital computers, found a rich seam of possibilities in UPIC's unique interface and sense of social, as well as creative purpose.

Meta-Xenakis (or *Where Do We Go from Here?*) brings us back to the vision, expressed in Xenakis's notes for his projected *Polytope Mondial*, quoted above, of a circumstance in which science and prophesy share a stage. This uncompromising view, typical of Xenakis and undoubtedly reflecting his own special history, has nevertheless proved to be an exhilarating challenge to a broad sweep of artists, scientists, technologists, educators, and others, across many cultural and geographical divides. The legacy of Xenakis, in the form of artistic output, fundamental and practice-based research projects, new concepts and technologies, and other—no less visionary—undertakings has in some sense indeed produced a *polytope mondial* of collective effort. This final Section surveys a few of the resulting and continuing projects that have taken inspiration from, and in some cases pay homage to the work and example of Iannis Xenakis.

Thus, Rodolphe Bourotte describes the features and implementation of his computer application UPISketch, a graphics-based application for audio synthesis and composition that takes inspiration from Xenakis's UPIC system. This project,

initially a joint research initiative between the University de Rouen Normandie and the European University of Cyprus within the framework of the Creative Europe Interfaces Network, shows how a rich initial concept is capable of development across all its facets, mathematical, technical, and artistic.¹⁸ UPISketch continues to be a work in progress but is also a functioning application that is freely downloadable, and which has already been featured in a range of compositional and educational scenarios.¹⁹

Similarly, Benny Sluchin and Mikhail Malt describe the operation and use of the Somax2 system, a computer software developed by the Representations Musicales Team at IRCAM in Paris.²⁰ This is a sort of musical artificial intelligence (AI), which learns the material and structural features of a corpus of recorded audio and allows a performer to improvise freely using those materials. The software also implements some improvisational strategies, including memory of the performance as it progresses. Sluchin and Malt report on their use of this software to perform a version of Xenakis's *Keren* (1986) for solo trombone. This work demonstrates the ways in which Xenakis's call for a performative, collaborative, and creative research, based on fundamental principles, continues to drive innovative artistic expression. Applied research at its best!

Raphael Radna presents an introduction to his virtual instrument plugin Xenos, which, like UPISketch, is a direct descendent of one of Xenakis's own projects, in this case the revolutionary conception of Dynamic Stochastic Synthesis (DSS). Radna relates the historical background to his project, and introduces the fundamental concepts developed by Xenakis. He shows how contemporary computing techniques allow the development of ideas that were extremely difficult to implement using the machines of the 1970s and 1980s. His treatment of pitch, for example, refines the basic concepts of DSS, allowing new creative possibilities within a rich and original conception.

Yin Yu (with Conrad Harris) considers Xenakis's use of light in his polytopes from an architectural perspective based on contemporary techniques of 3D modeling. She discusses the ways in which light can be seen as a 'bridge' between music and architecture, and, after a detailed analysis of the ways in which Xenakis developed the structural principles of his light projections, she describes her own work, *The Shape of Light*, created in collaboration with the violinist Conrad Harris for his performances of Xenakis's works *Mikka* (1971) and *Mikka S* (1975).

Iannis Zannos and Takumi Ikeda's discussion of their work *Phoenix-Albatross* gives, like the text of Rodríguez Lara, an example of the way in which Xenakis's conceptual inventiveness continues to exert an influence on contemporary artistic research. *Phoenix-Albatross* also relates to the work of Malt and Sluchin whose computer modeling of game theory reveals the scope and tendencies within the rules that

18 Interfaces Network, "The Project,"

<https://culture.ec.europa.eu/creative-europe/creative-europe-culture-strand/european-networks>

19 Centre Iannis Xenakis, "UPISKETCH," *Centre Iannis Xenakis*,

<https://www.centre-iannis-xenakis.org/upisketch>

20 IRCAM, "Musical Representations," *STMS-LAB*,

<https://www.stms-lab.fr/team/representations-musicales/>

Xenakis devised for his works *Stratégie* and *Duel*. In this case, *Phoenix-Albatross* models the strategies used for *Duel* by utilizing them in a telematic dance performance, using live coding in SuperCollider. Like Malt and Sluchin, Takeda examines the matrices of probabilities, and in this case, devises a genetic algorithm that produces a more even-handed version of the game. The agonistic elements of Xenakis's conception are developed through the telematic, multi-site instantiation of the work, and through the use of movement to engage with the musical parameters of the game.

Thanos Polymeneas-Liontiris takes an autoethnographic approach to his discussion of his use, within his own practice as a performing bassist using feedback techniques, of DSS, one of Xenakis's most influential inventions. He describes his use of Xenakis's two GENDYN programs, as implemented in SuperCollider, with audio and coding examples that include aspects of machine learning.²¹ This musical exploration of a combination of old and new techniques once again shows the ways in which the richness of Xenakis's original conceptions, alongside the openness and creative potential of his speculative approach, have proved inspirational and practically fruitful for later generations.

The architect Andrew Lucia presents a brief overview of his substantial work, *A Catalog of Difference*. This relates in significant ways to the work of Xenakis, both as musician and as architect, since the basic insight of Xenakis—that perceivable structural trajectories are founded on statistical differences—makes the notion of “difference” a key perceptual paradigm. Lucia's work tracks types and instances of difference across a range of media, noting, with Bateson, that “differences that make a difference” are the key to both perception and learning.²² This exemplary work demonstrates the originality and prescience of Xenakis's theoretical writing, as it informs his creative impulse, and shows how the conceptual beginnings outlined there continue to lead to new insights and discoveries.

Computer scientist and musician Bill Manaris thinks through the notion of the algorithm, a fundamental element of Xenakis's practice, in order to show how the formalization of process represented by algorithmic thought raises important issues of agency and authorship. He demonstrates ways in which several of the algorithmic processes used by Xenakis are themselves capable of further creative extension, and gives examples of new, “syllogistic” outcomes that stand as separate but related artworks. This leads to a consideration of the algorithmic arts as a creative paradigm, that stems in substantial part from Xenakis's individual contribution as creator and theorist.

Hugo Solís, Mizky Bernal, Diego Jiménez, Guillermo Leonardini, and Eunice Pérez give an account of collective work undertaken within the Music Technology Group of SUICREA (University Seminar for Research in Artistic Creation) at the National

21 As Polymeneas-Liontiris points out, there are actually several GENDYN programs. These are not to be confused with Xenakis's electroacoustic work *Gendy3* (1991), which is indeed based on one of the GENDYN programs yet is distinct as a work unto itself.

22 Bateson, 1972, p. 271–2.

Autonomous University of Mexico. The project involves, once again, the extension and development of the rich seam of possibilities proposed by Xenakis's UPIC system, in this case including the extension of the two dimensions of the UPIC drawing board into three dimensions, and the investigation of the potential of the "flocking" algorithm, developed by Craig Reynolds.²³ With code examples, the authors explore not just certain conceptual elements that can be implemented within the UPIC framework, but also the creative consequences of thinking and working collectively. This presents more than an analogy with the use of the flocking algorithm, showing the ways in which creative dialogue can enrich creative possibilities in the effort towards a unified goal.

In the final contribution to this Section, Iannis Zannos, Martin Carlé, Vasilis Agiomyrgianakis, Takumi Ikeda, and Hanako Atake take Xenakis's concerns for new technologies in a necessary and contemporary direction by thinking through the implications of what they call 'frugal innovation': the development of a more sustainable and accessible approach to digital technologies. This sits within the activities of hacking, DIY, and maker cultures, and the authors give detailed technical accounts of their materials and hacks. The international collaborative performance project that forms the artistic center of this work combines dance, remote sensing, live coding, and audio processing to create a series of events that take inspiration from Xenakis's work *Kraanerg* (1967) whose program note invokes the "biological struggle between generations unfurling all over the planet, destroying existing political, social, urban, scientific, artistic, and ideological frameworks on a scale never before attempted by humanity."

As a vital addition to the texts introduced above, the digital archive *Meta-Xenakis: Sustainable Resources* includes and makes available a range of short texts, video, and audio files arising out of the events staged during the Meta-Xenakis program curated over three continents throughout 2022. These include performances of new work, and works by Xenakis, alongside demonstrations of projects like UPISketch and archive materials related to Xenakis himself.

Finally, as mentioned above, the Appendix documents the eighty or so events hosted respectively by each Meta-Xenakis team throughout the world in 2022. Several are included in the digital archive of our final Section *Meta-Xenakis: Sustainable Resources* and several links will enable readers to experience many of the other events.²⁴ Like the texts collected together in this volume, these resources stand not simply as a testament to the life and work of one of the twentieth century's most significant creative figures, but also as a progress report on the creative, scientific, technological, and conceptual work that continues to face up to the questions and challenges posed by this most challenging of men.

23 Cf. Timmie Wong, "Boids" (2008), *Stanford University*, <https://cs.stanford.edu/people/eroberts/courses/soco/projects/2008-09/modeling-natural-systems/boids.html>

24 In the event of future Meta-Xenakis events, please visit our Additional Resources at <https://doi.org/10.11647/OBP.0390#resources> where they will be posted.

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