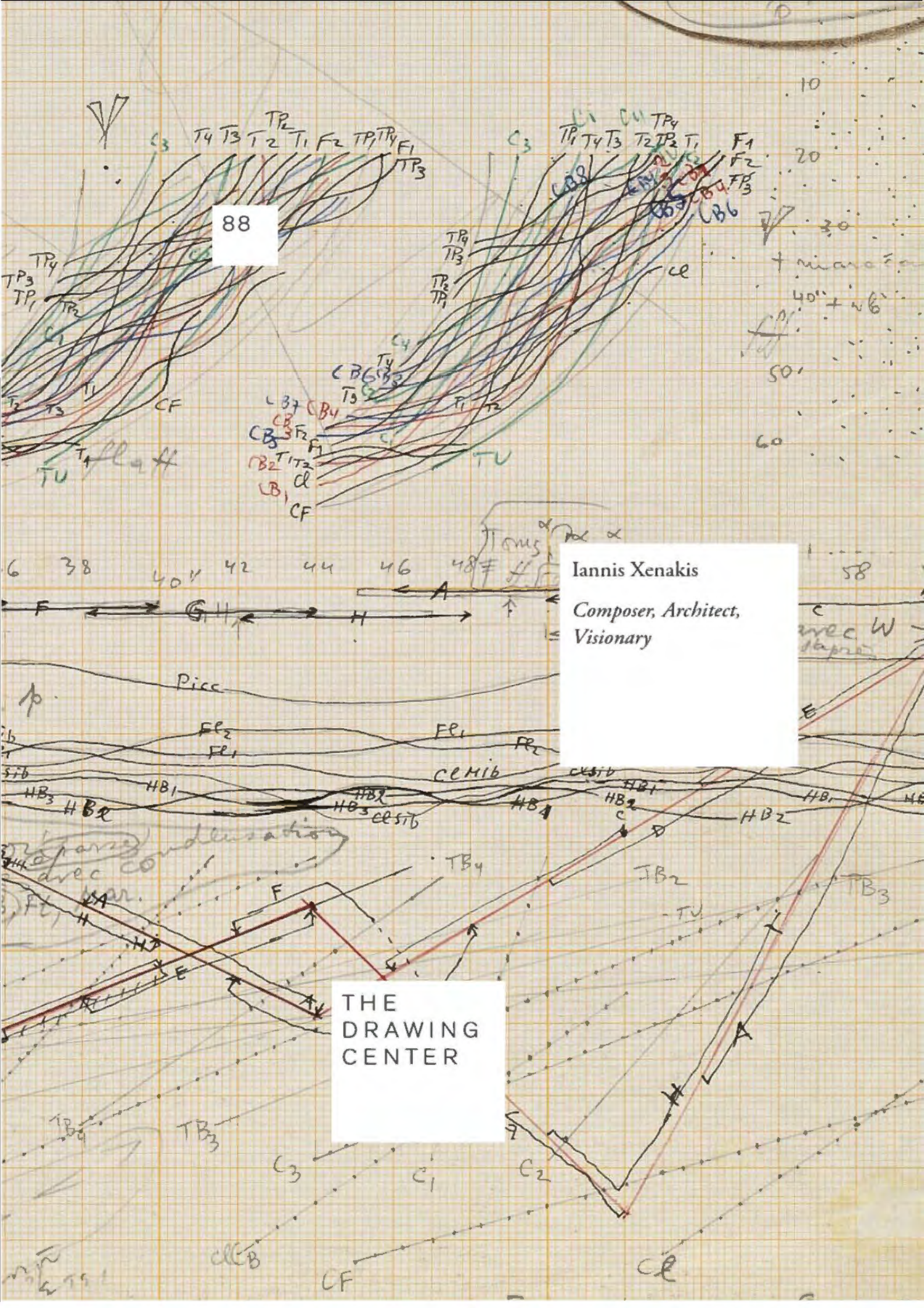

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Iannis Xenakis

Composer, Architect, Visionary

THE DRAWING CENTER

Iannis Xenakis
Composer, Architect, Visionary

The Drawing Center
January 15 – April 8, 2010

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Curated by
Sharon Kanach and Carey Lovelace

DRAWING PAPERS 88

Essays by
Ivan Hewett, Carey Lovelace, Sharon Kanach,
and Mâkhi Xenakis

PL. 1
Iannis Xenakis in his studio, Paris, c. early 1960s

Foreword

In 1990, as an undergraduate student at the University of California, San Diego, I had the good fortune of attending Iannis Xenakis's performance of *Voyage Absolu des Unari vers Andromède* at The Salk Institute, which had premiered in 1989 at the International Kite Exhibition in Japan. Xenakis generated the soundscape for this piece by flying kites whose strings were attached to a computer. The computer then created sounds based on the kites' movements, which was amplified by speakers arranged in a circle surrounding the audience. Set against the backdrop of Louis Kahn's Salk Institute campus at sunset, the performance marked a profound moment of primordial synergy between sound, nature, architecture, and one's own body. Deeply affected by the experience, I approached Xenakis at his office on campus—he was a visiting professor of music at UCSD during this time—to discuss the piece and learn more about his work. He was a generous and compassionate teacher and spent more than an hour with me expounding on the mathematical and scientific ideas that served as the foundation for his compositional philosophy. A few of his points were too complex for me to understand at the time, but I found him fascinating and his ideas and enthusiasm propelled me to further explore experimental contemporary music, which remains a passion of mine to this day.

At the 2007 Venice Biennale, Carey Lovelace, a critic, curator, and playwright I know from New York, mentioned to me that she was going to Paris to visit the Xenakis archive at the Bibliothèque nationale de France. From the ensuing conversation, I learned that Carey had studied with Iannis in the 1970s at the Université de Paris I, the Sorbonne, as had her friend and former classmate, Sharon Kanach, a musicologist and the preeminent scholar of Xenakis's life and work. As I was intrigued by what the archive might hold, Carey agreed to share her findings with me and soon sent images of compositional scores

and architectural sketches that spanned the duration of his fifty-year career. I immediately asked Carey and Sharon to curate an exhibition at The Drawing Center, setting into motion a two-year research period that involved many enlightening discussions, the culmination of which is the exhibition *Iannis Xenakis: Composer, Architect, Visionary*, and this publication, the first solely devoted to this modernist polymath's works on paper.

Many people deserve to be thanked for their dedication and hard work in realizing this exhibition. First, I would like to extend my gratitude to the co-curators, Sharon Kanach and Carey Lovelace, whose knowledge, sensitivity, and devotion to Xenakis's oeuvre made it possible for The Drawing Center to present this groundbreaking show and to produce new scholarship on this body of work. I would like to thank Ivan Hewett for his excellent essay for the catalog and Haiko Cornelissen at Steven Holl Architects for his expert advice.

I am grateful to Mrs. Françoise Xenakis and her daughter, Mâkhi Xenakis-Klatzmann, whose steadfast support of this project is beyond exemplary. They graciously hosted us on numerous trips to the Xenakis archive and on many occasions shared their personal recollections of Iannis and his work. Their continued trust and belief in The Drawing Center and its mission have made this project one of the most pleasurable during my tenure here.

This exhibition would not have been possible without the exceptional cooperation of the Bibliothèque nationale de France in Paris, in charge of the maintenance and preservation of the Xenakis archive. I would like to acknowledge the invaluable contribution of Bruno Racine, President, as well as his colleagues, Ms. Catherine Massip, Conservateur général, directeur du département de la musique; Françoise Simeray, Responsable des expositions extérieures; Anne-Sophie Lazou, Service des expositions extérieures; Maria Serrano, Département de la reproduction; and Vincent Reniel, Departement de la reproduction.

The Drawing Center's hardworking and conscientious staff deserves special recognition for their enthusiasm in bringing this project to fruition. Special thanks go to Joanna Kleinberg, Assistant

Curator; Emily Gaynor, Public Relations and Marketing Officer; Anna Martin, Registrar; Dan Gillespie, Operations Officer; Nicole Goldberg, Director of Development; Jonathan T.D. Neil, Executive Editor; Joanna Ahlberg, Managing Editor; Peter J. Ahlberg, AHL&CO; and Isabelle Deconinck, LA pr.

To the institutions who have already agreed to welcome *Iannis Xenakis: Composer, Architect, Visionary* to their respective venues, I would like to thank Mirko Zardini, Director, Giovanna Borasi, Associate Director, and Daria Der Kaloustian, Senior Exhibition Coordinator, Programs, of the Canadian Centre for Architecture; and Philipp Kaiser, Curator, and Susan Jenkins, Director of Exhibition Management, at The Museum of Contemporary Art, Los Angeles.

I also want to thank all of the organizers, performers, and venues who are participating in The Drawing Center's public program series that will run concurrently with the exhibition: Joel Chadabe, Founder and President of Electronic Music Foundation; Claire Brook, publisher, Pendragon Press and Founding Member of Xenakis Project of the Americas; Luca Veggetti, choreographer; JACK Quartet; Transmission Ensemble; Daniel Teige and Diapason Gallery; Jan Williams and the New York University Steinhardt Percussion Program; Carl Skelton and The Brooklyn Experimental Media Center; The Morgan Library & Museum; Judson Church; Barbara Dobbs Mackenzie, Director, Barry S. Brook Center for Music Research and Documentation at The Graduate Center of The City University of New York; and Cristina Cacioppo at the 92Y Tribeca.

Finally, I am deeply appreciative of the intellectual and financial support of The Drawing Center's Board of Trustees and exhibition funders who have supported both the idea of the exhibition and its catalogue, including the National Endowment for the Arts, the Graham Foundation for Advanced Studies in the Fine Arts, The Grand Marnier Foundarion, The Andy Warbol Foundation for the Visual Arts, and one anonymous donor.

Brett Littman
Executive Director

PL. 2
Iannis Xenakis on site, Mycenae, Greece, 1974

Curators' Statement

It is fitting that this first American exhibition devoted to the influential avant-garde composer Iannis Xenakis should take place at The Drawing Center. For even though he worked in a dizzying range of disciplines, notably architecture, everything found form on the page. Of course, his efforts while working in the atelier of Le Corbusier (1947–59), where he designed several iconic buildings, involved architectural renderings and technical drawing. Then, starting in the mid-1950s, when he began to introduce advanced mathematics as an organizational principle in his music compositions, he mapped out an architectonic space in which he employed calculations and graphic visualizations to determine both detail and overview. Musically speaking, these eventually rendered up visceral yet unearthly, exquisitely rich compositions, both instrumental and electro-acoustic, that were, for the most part, steeped in a late-twentieth-century atonal (and microtonal) sensibility. (For example, his groundbreaking *Pithoprakta* (1955–56), composed using probability theory, creates different "sound clouds." It opens with string players lightly striking the bodies of their instruments and moves into plucking strings and tapping bows, among other effects, forming ever-changing primal sweeps of sound.)

Throughout history, a strong link has existed between drawing and music. After all, manuscript notation (which until recently was always hand-rendered) is a kind of coded "picture" of music. In the Western tradition, the five lines of the staff can be seen as a kind of grid, with dots representing pitch "heights," as it were, and other configurations symbolizing durations. Beginning in the 1950s, this "picture" was opened up further, when the hybrid avant-garde practice of "graphic scores" created a new interplay between "the hand" and sound by employing an array of different strategies including words, glyphs, pictograms, and other symbols

intended as instructions or triggers for certain kinds of musical actions.

Recent art-historical surveys have explored the interplay between the pictorial and aural in a more general way. *Visual Music*, co-organized by The Museum of Contemporary Art in Los Angeles and the Hirshhorn Museum in Washington, D.C., examined that branch of synaesthesia that involves a link between color and sound. It also documented such key exchanges as Wassily Kandinsky's attempt, prior to World War I, to bring painting into the realm of pure abstraction by using the atonal compositions of Arnold Schoenberg, with their liberation of "dissonance," as a model to help free his work of subject matter.[1]

However, it was in a completely different way that Xenakis "imaged" music. He was not "drawing" sound in the one-to-one naive manner in which artists create "symphonies of color" or linear approximations of, say, jazz riffs. Nor was he, like the fashioners of graphic scores, creating visual documents meant to be performed. Instead, on paper, he was working through strategies to deploy physics and mathematics as means to organize sound. (This recourse to science goes back to his Greek precursors such as Pythagoras, "father of mathematics," who designed scales on which our own are based. These were generated by the intervals resulting from dividing a vibrating string into halves, thirds, quarters, eighths, and so forth.) He graphically plotted out the results of his advanced calculations. Perhaps in part because of the consonant, proportional relationships they realize graphically, these documents are often pleasing to the eye—even, at times, it might be proposed, easier to follow than the music they generate.

Drawing exists in two dimensions. But its conceit is that flatness transforms into an illusory three-dimensionality—or into a different kind of fictive space, where figuration creates imaginary landscapes. Xenakis's works on paper, although not intended as "art" as such,

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1 *Visual Music*, curated by the Hirshhorn's Kerry Brougher and Judith Zilczer, and MOCA's Jeremy Strick and Ari Wiseman, the Hirshhorn Museum and Sculpture Garden, Washington, D.C., June 23–September 11, 2005, and The Museum of Contemporary Art, Los Angeles, February 13–May 22, 2005.

evoke another dimension entirely. Indeed, they belong to a different sensory domain: the ear.

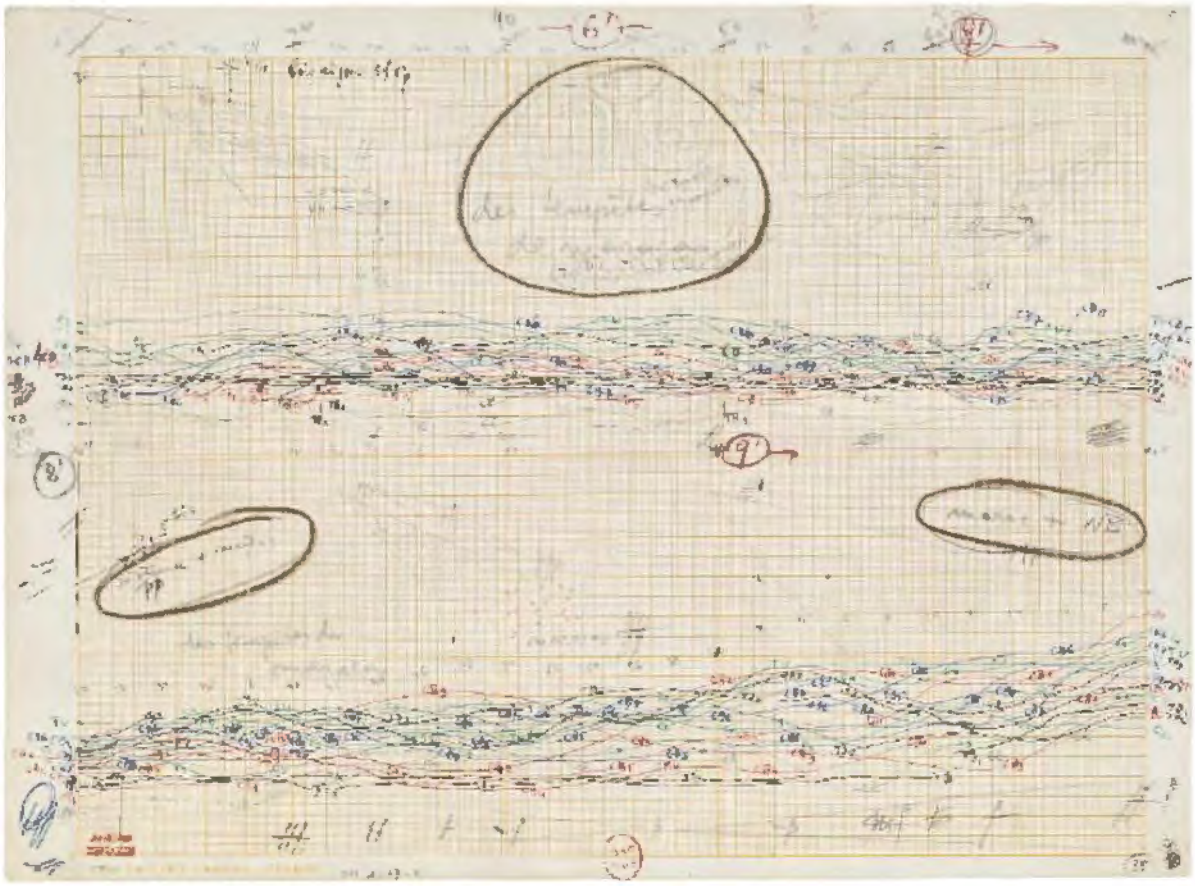
Beyond all this, Xenakis's protean practice involved site-specific multimedia works. These, it could be argued, "drew" in space—within built structures or in the landscape. Such events were often carefully mapped out on paper in all their particulars, in chronological "scores" and performance site plans. In general, though, many such documents manifest multiple "passes," over-writing in different ink-colors, self-commentary in often tiny handwriting (in French, sometimes Greek, and even English). In short, Xenakis "thought through the hand." These paper "traces," which begin in the mid-1950s, foreshadow an interesting side avenue in the history of drawing known as "process art," which developed during the 1960s. Robert Smithson, Sol LeWitt, Agnes Denes, and Dorothea Rockburne, among others, combined elements of science with visual art. They, too, often executed works on paper of a propositional nature that involved writing, diagrammatics, small schemas. Xenakis's preparatory drawings, although never intended as finished art, share in this tradition.

Whether drafting a sketch, a complex study charting the trajectories of instruments on a Cartesian grid, or a score for a laser-light-and-sound multimedia work, Xenakis created visually compelling artifacts. Given that he produced some 140 musical works, numerous architectural projects (realized and unrealized), four books of essays of, at times, mind-bending complexity, five major multimedia spectacles, countless unpublished writings, and ancillary projects, such as bis design of tbe UPIC digitized drawing board, selecting items for this show was challenging. We decided to focus on initial landmark musical works, his breakout *Metastaseis* (1953–54) and *Pithoprakta* (1955–56), and a few subsequent pieces that embody important developments and whose visual aspects we find compelling. In *Terretektorh* (1965–66), Xenakis experimented with the physical distribution of audience and orchestral members. For *Erikhthon* (1974), developed during the time he was working with Markov chains, preparatory sketches feature highly graphic veined configurations he called "arborescences." The exhibition's narrative begins with projects developed with Le Corbusier. It also concludes

with architecture: his project plans for the far-reaching Cité de la Musique for the Parc de la Villette in Paris, an ambitious conception that brought together many ideas about sound and space that Xenakis had developed over the years. And in between, we have also included material on his "polytopes," multimedia site-specific works presented in the 1960s and 1970s, often in mythic sites such as the ruins of Persepolis or the ancient Roman baths of Cluny in Paris. In planning this exhibition, we pondered how best to display work that, no matter what its visual interest, is primarily meant to be experienced through the ears. Listening stations allow graphic renderings to be displayed on video screens while listeners follow the corresponding compositions on earphones.

Many of the bracing and rigorously original approaches Xenakis forged reach back through physics and mathematics to the very foundations of art, to a moment in antiquity when the arts and sciences were fused. Visual artists and other visitors to The Drawing Center will undoubredly find Xenakis's approaches compelling, just as we have. They open potentially new directions for both the creation and appreciation of works from the "mind" of the "hand."

Sharon Kanach and Carey Lovelace



PL. 3
Study for *Terretektorh*, c. 1965–66

A Music Beyond Time

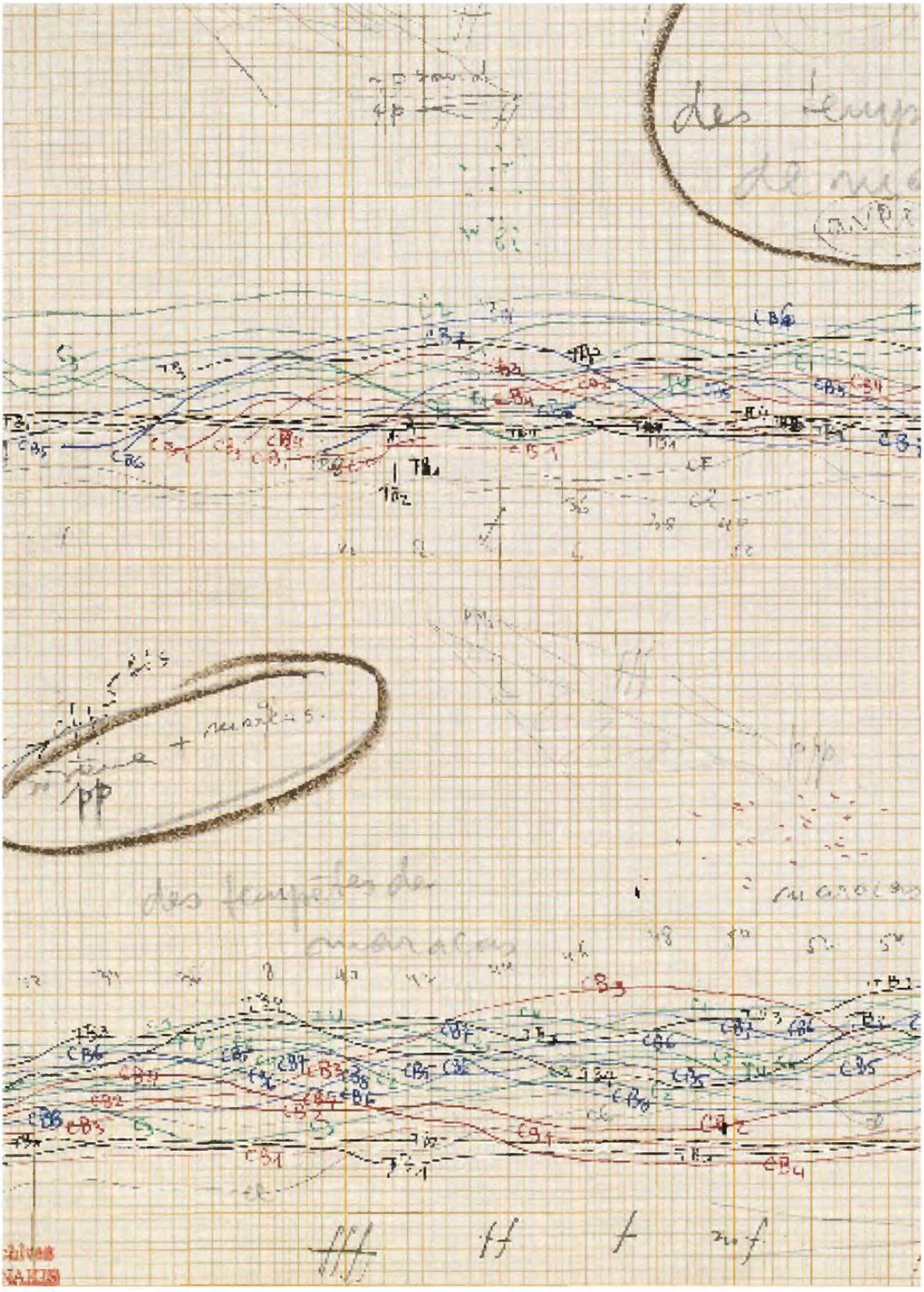
Ivan Hewett

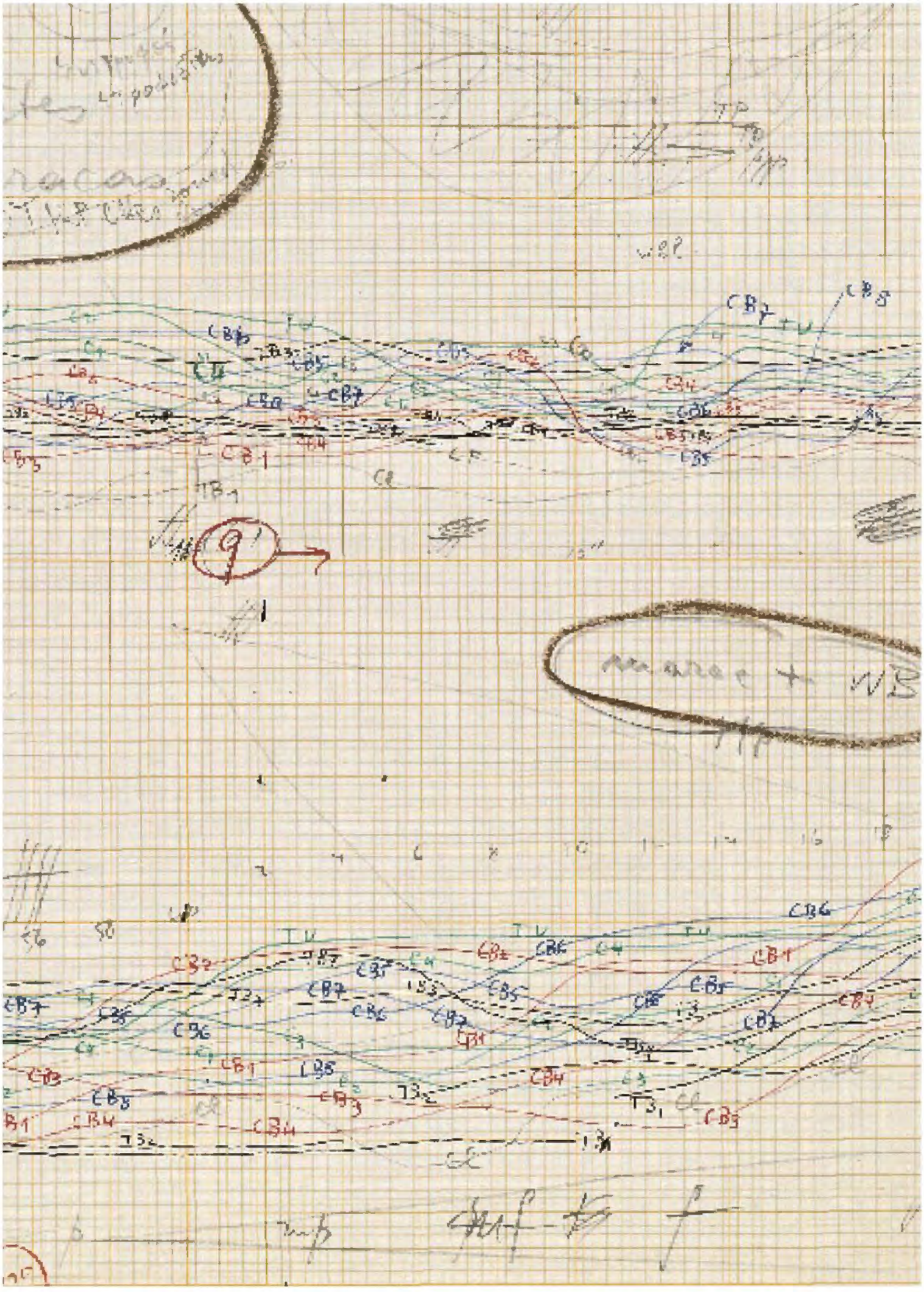
At one level—the level of the nerves and viscera—Xenakis's music is easy to appreciate. It sweeps over us like a force of nature, its abrasive cries and percussive thundering ringing in our ears and vibrating in our solar plexus. Not for nothing did Milan Kundera call Xenakis "the prophet of insensitivity."

But when the initial shock wears off, one realizes that the music works at other levels too. A kind of discourse emerges, of sonic masses in motion. One hears rarefactions, densities, things converging to a point or outwards to dense clouds, lines splitting into ever smaller lines like the branches of a tree, sliding sounds suggestive of vast curved surfaces like those of a modernist building.

Discerning this strange logic only increases the mystery. Where on earth did this music come from? What drove this composer to work on our sensibilities in such a fiercely abstract way? Why the total absence of familiar aural and musical signposts, indeed any sign of the human—apart from here and there an echo of some atavistic folk-music or implacable ancient ritual?

The remoteness of Xenakis is partly the remoteness of the artistic movement of which he was a part: the second wave of musical modernism that emerged after the Second World War. The music of the Angry Young Men who led it—Pierre Boulez, Luigi Nono, and Karlheinz Stockhausen—seems rebarbative, abstract, and "inhuman" in ways analogous to Xenakis's. They claimed a historical necessity for their music, but at a distance of more than half a century, this has proved to be dubious, to say the least. One needs historical imagination and a sympathetic ear to discern the still burning intensity in their music, now that the strident polemics that animated it have passed into history.





Xenakis needs the same sympathy. But with him the difficulties are multiplied, because although he is commonly numbered among the modernists, he doesn't altogether fit in their company. He was always the one who stood apart, literally a "xenakis" (*Ξενάκης*), meaning "little stranger." Even in later life, when he was honored and much performed around the world, he never lost his aura of loneliness.

To understand that sense of being apart one has to go right back to his origins. Xenakis was born in 1922 on the margins of Europe, into the prosperous Greek-speaking community in Braïla, a coastal town in Romania. He was a bookish, sensitive child, crushed by the early death of his mother, which seems to have stimulated him to find meaning in things beyond the reach of accident and time, a realm of immutable laws he would find mirrored in Nature, and eventually music. Beyond personal factors of temperament and family misfortune lay the temporal and cultural displacement of the Greek middle class which his parents typified. Greece had suffered a long interregnum during the rule of the Ottoman Empire, when it was cut off from Western trends. With liberation in the early nineteenth century came an urgent sense of having to catch up on every level: political, social, and cultural. But by the time Xenakis's parents came to embrace bourgeois European civilization it was already under threat, hollowed out from within by modernism.

It's hardly surprising that Xenakis's relationship with the Western tradition would be problematic. He lacked the facility and precocious gifts one reads about in most composers' biographies. Later, when his father sent him to private school on the island of Spetsai, he thrilled to the European art and music he discovered from his English public school headmaster. But this "book-knowledge" was hardly fortified by day-to-day practical music-making. Music did not dominate his mind, and in fact took a back seat to the "otherworldly" disciplines such as science and mathematics, where his sense of being displaced in time was no longer a problem (music too would become another "otherworldly" discipline, when reconceived—but that lay in the future). Meanwhile, beyond the school gates, out there in the fields and woods, lay reminders of the ancient past he found so attractive: ruins, folk songs, orthodox chant in the monasteries, and older even than those, Nature, with its mysterious blend of chaos and regularity.

PL. 4
Iannis Xenakis as a Greek resistance fighter (third from right in truck), c. 1944

PL. 5
Iannis Xenakis with Le Corbusier en route to the Philips Pavilion, c. 1957

The sense of being late and therefore always having to run haunts Xenakis's biography. It was exacerbated by the Second World War, when Xenakis fought first in the anti-Nazi resistance then against the British. By the time Xenakis arrived as a refugee on a winter morning in Paris in 1947, with little more than the clothes he stood up in, his old passion for music had lain dormant for years. But once installed in the atelier of Le Corbusier, and with some stability restored to his life, it resurfaced.

But how to harness this passion? Xenakis had had no professional musical training, and his personal musical world was hardly one that would give him an easy entrée into Parisian musical circles. It was a curious amalgam of ancient Greek theorists such as Aristoxenus, Byzantine chant, folk music, and pockets of Western classical music, above all Bach. What these musics have in common is that they can be conceived—by someone with a determined bent for timeless verities—as freed from the taint of "culture," and therefore invulnerable to time's corrosive effects. Aristoxenus doesn't describe music as it is played, he describes the mathematical substratum of music, the tuning systems whose crystalline structure endures while the musical practice itself keeps changing. Orthodox chant gives an appearance of fixity (one speaks of "Byzantine immobility"). Folk music, prior to the onset of globalization, could be thought of as "age-old," handed down in an unbroken oral tradition. As for Bach, is he not the "timeless" classical composer *par excellence*, a composer whose fugues and canons appear to embody an idea of perfect, abstract order?

These tastes would have seemed peculiar in Paris, where the dominant musical ideology was based on a super-sharp awareness of historical references. It was descended from the sassy streetwise neo-classicism much touted by Jean Cocteau in the 1920s, which by the 1940s had evolved in several directions—pert and sentimental in a way not so far from the *café-concert* in the case of Francis Poulenc, nobly statuesque in the case of Arthur Honegger, who, with his reputation burnished by his anti-Nazi stance, was now the musical God of Paris. Shortly after his arrival, while making his first faltering attempts to turn himself into a composer, Xenakis had an unfortunate brush with Honegger. He attended one of his composition classes, and showed him one of his pieces. "This is not music," said the great man bluntly.

Xenakis's brief encounter with the great Olivier Messiaen was more encouraging. "You are Greek," said Messiaen, "you must follow your own course." Olivier Messiaen, devout Catholic, devotee of Indian rhythms, elaborator of his own severely rational system of pitch and rhythmic modes, was the mentor of a group of young *avant-gardistes* who were contemptuous of the old guard. The most vocal of them was Pierre Boulez, who by 1948 had already made waves with some brilliant early works. These took Schoenberg's severely rational twelve-note technique—in which the unfolding of a piece was determined by successive appearances and transformations of a twelve-note theme—and purged it of its nineteenth-century phraseology. In Boulez's hands the technique became both violently expressive and hyper-rational.

More influential than any of these was another lonely figure, Edgard Varèse, who also lived on the margins of the musical establishment and had been dreaming of a music of "sound-masses in collision" since the 1920s. In 1954, the Paris premiere of his *Déserts* made history by being both the first work to combine orchestral forces and electronic sounds, and for being a scandal to rival the first night of Stravinsky's now canonical *The Rite of Spring*. Listening at home—so that he could record the event—was the thirty-two-year-old Xenakis, still unknown, still struggling to find his voice.

His uncertainties are revealed in the piece he had recently completed, *Anastenaria* (1953–54). The first two movements are in a Greek "ethnographic" style, portraying with atavistic drums and choral cries the ancient Christian rituals of Thracian peasant communities. But in the third movement, *Metastaseis*, there's an irruption into an unprecedented sound-world. We hear a single pitch on violins which burgeons into a dozen separate lines, moving slowly outwards from this central point, until they arrive at a massive cluster chord. It's like nothing ever heard in music before, but neither does it have anything in common with the Parisian avant-gardistes, who in the mid-1950s were dispersing shards of twelve-note series around musical space in a style commonly known as *pointilliste*.

Xenakis had no time for that method (even though one detects traces of it in *Metastaseis*). In an essay written a few years later, by which

PL. 6
Iannis Xenakis, Seiji Ozawa, Olivier Messiaen, and their families in the Xenakis home, Paris, c. 1977

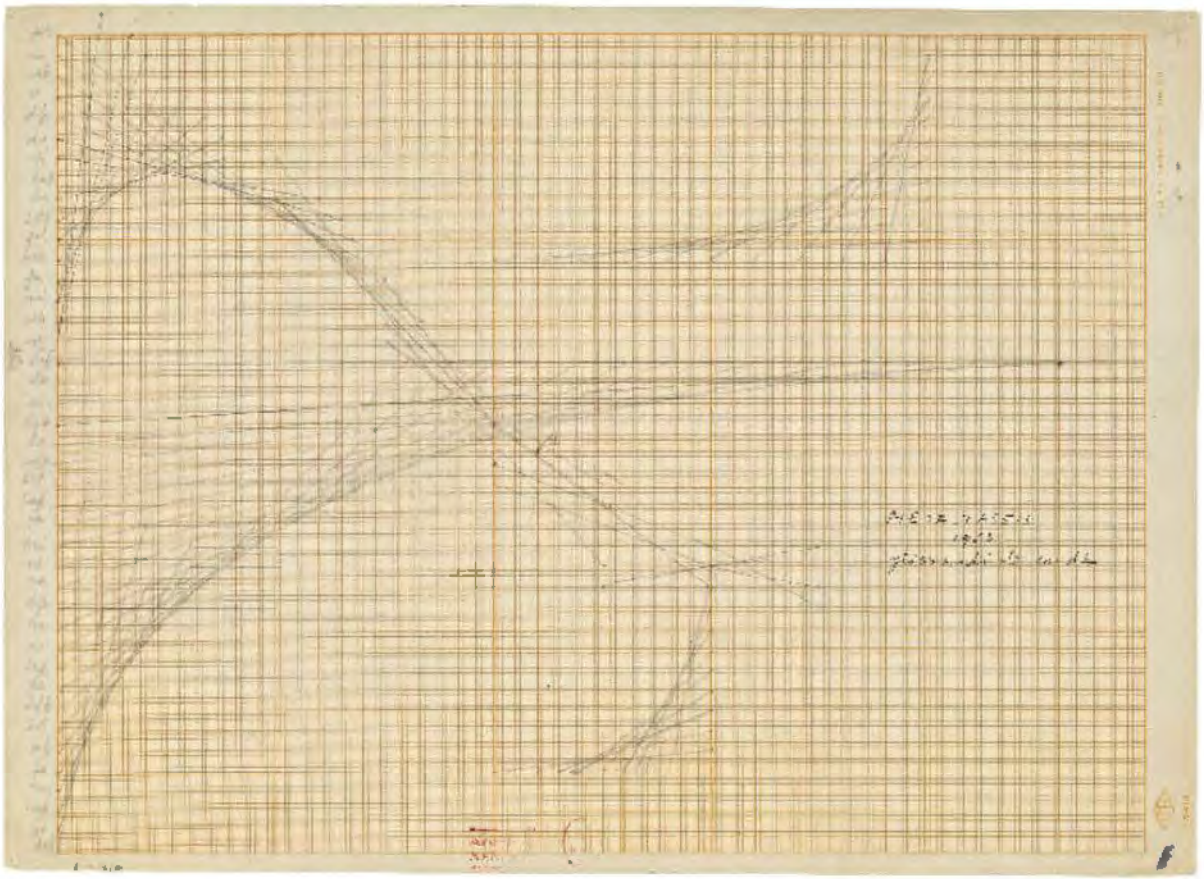
time he had made immense strides in skill and self-confidence, he pointed out what he thought was serialism's fatal error: presenting different forms of a twelve-note row actually creates an effect of randomness, as the textures are too complex for the ear to discern the logic that engendered them. But at the global level, the ear can make out larger patterns. One hears the overall character of a musical statement: its density, its texture, its tendency towards greater or lesser complexity. There's a mismatch between the logic and the aural effect. So—Xenakis suggested—why not give up the note-to-note logic of serialism and use a different sort, one better suited to manipulating these "global" entities?

The technical means for creating this new logic were lying close to hand, in a most unlikely place—his work as a designer and engineer for Le Corbusier. By now Xenakis had risen from being a lowly engineer to being Le Corbusier's trusted confidante. He was in sole charge of the design for the Philips Pavilion at the Brussels World's Fair in 1958 [OPPOSITE], and the remarkable curved walls of that building—based on "hyperbolic paraboloids"—are like transcriptions in space of the aural curved surfaces of *Metastaseis* [PL. ¬]. Goethe, following Novalis, once described architecture as frozen music, but never before had someone tried to embody the metaphor so literally. The premiere in 1955 caused a great stir, with one critic describing how the audience surrounded the velvet-jacketed Xenakis and "pressed him for autographs as though from the first traveler in space."

It was a brilliant debut, and it confirmed Xenakis's distance from the rest of the avant-garde. Their music was full of nervous energy, never once coming to rest, in line with Boulez's view that new music had to reflect a modern conception of a "universe in perpetual expansion." Xenakis too knew all about life's uncertainties, and in some ways had a similar view. "We always live in the shadow of Sisyphus and Tantalus," he wrote, "because everything around us moves, shifts, is in constant turmoil. We are not moving through an epoch of certitudes: Cosmonauts in a swarm, we navigate in the provisional, we must reconsider each thought at every instant."

But really the two are poles apart. Boulez's music reflects the fractured nature of the modern subject, which never commits, always

Philips Pavilion, Brussels World's Fair, 1958



PL. 7
Study for *Metastaseis*, 1953

keeps its options open, and is aware of its own multiplicity. Xenakis's music, in its massive assertiveness and granatic hardness, suggests an objective view of uncertainty as something entirely "out there," in the world. The inspiration is not Freud so much as Heraclitus's flat assertion that "everything is flux," or Lucretius's introduction of the "clinamen," the gentle swerve of the atoms that sets everything in motion.

Metastaseis was the first fruit of that world-view, but Xenakis had enough musical sophistication to realize that he could not spend an entire career describing "curved surfaces" in sound. He needed other mathematical tools, ones that would allow him to unite certainty and uncertainty, "timelessness" and musical motion, in many different ways. He found it first in probability theory, that branch of mathematics which grasps uncertain things in absolutely precise form.

Over the following decades Xenakis tried out different aspects of probability in turn, often by drawing freehand the shape or textures of the sound he was looking for, and then casting about for the mathematical tool that would allow him to fix this shape precisely. First came *Pithoprakta* of 1955–56, where one hears for the first time Xenakis's other trademark sound: the "cloud of points" [PL. 8]. As the composer suggests, these are like things heard in nature, such as swarms of cicadas, or rain pattering on a roof. Or to take a memory from later in his life, they behave like slogans launched by a single voice during a demonstration, which then spread through the crowd like wildfire.

Later works try out different ideas. *Duel* (1959), a contest between two orchestras and two conductors whose "moves" prompt a response from the other, was inspired by game theory. This proved to be a dead end. More fruitful was the idea of a music which was disposed in endlessly proliferating lines. It was given abstract form in so-called "Markov chains," and made thrillingly concrete in works like the virtuoso piano work *Evryali* (1973). Most far-reaching of all perhaps was Xenakis's application of "sieve theory" to music, which allowed him to create—among many other things—a new kind of musical scale. There are many varieties of scale in the world's musical cultures, but they all obey the "natural" limit of the octave, which maps

PL. 8
Study for *Pithoprakta*, c. 1955

out points of strongly perceived similarity in pitch across the audible spectrum (for example, all notes called C sound at one level "the same" no matter how high or low the C may be). Xenakis's originality was to defy "nature" by constructing new scales bounded by different intervals, and his later works are full of them.

These techniques necessitated swarms of calculations clearly best performed by computer, and in 1962 Xenakis wrote the first of a series of pieces composed with the aid of an IBM mainframe. This was not his only brush with new technology. Between 1957 and 1962 he undertook research into electronic sound synthesis at the Groupe de Recherches Musicales in Paris, and composed his first electronic pieces there. In 1966 he brought these two interests together by founding a computer music research institute, which in 1972 became CEMAMu—the Centre d'Etudes de Mathématique et Automatique Musicales.

This might seem to place Xenakis squarely at the heart of the "modernist wing" of new music. But by the early '70s the distance between him and his erstwhile confreres was actually widening. This was partly because the modernists themselves no longer formed a right-knit group, if they ever had. Elliott Carter was pursuing a multi-layered music that specifically appealed to a modern form of sensibility. Berio had already broken the hermetic purity of new music in works like *Sinfonia* (1968–69), which quotes from the entire history of Western music. Luigi Nono was composing vast works that addressed urgent political issues. Boulez remained the most pure, but his hyper-refined musical language, full of ellipses, parentheses, and decorative flourishes, was a world away from Xenakis.

Meanwhile, beyond the modernist circle, art music was opening itself to the world. Steve Reich and Philip Glass embraced the exuberance of pop rhythms in their new minimalist language. The next generation fused this exuberant energy with expressive lyricism. Towards the twentieth century's end, it was clear that in defiance of the modernists, an expressive aesthetic of music rooted in tonality had made a triumphant comeback.

Against this turn to subjectivity, Xenakis stuck to his rigidly monist view of the world and human nature. He would have no truck with

the increasing tendency of composers to revisit history and indulge in a "play of signifiers." His artistic purview broadened, certainly, but this broadening was never a matter of admitting "influences." The only echo one hears is of folk music, but by the 1970s this is no longer the ethnographic realism of *Anastenaria*. In works like *Antikhthon* (composed for Balanchine's New York City Ballet in 1971), one hears strange woodwind keenings, which evoke thoughts of a primal *ur*-folk music, before humanity had yet invented culture. Xenakis loved the ancients not out of nostalgia, but because they seemed closer to the unmediated heart of things. If technology offered a fresh way to reach that heart, he would seize on it unhesitatingly. What he dreamed of was a "universal music," manifested in what he called a "hard core" of formal relationships.

Such a universal music could not be confined within Western music's traditional categories. Those that were too tainted by "culture," such as harmony, had to go entirely. Other categories could be admitted, certainly, but only if reconceived on a highly abstract level. Xenakis regarded the branching-line technique of works like *Evryali* as his own "reinvention of polyphony." Scales, modes, and microtones could also be admitted, as aspects of "sieve theory."

Ultimately music had to go beyond sound itself, to incorporate light and ceremony and text in grand spectacles where each element would be ordered by similar mathematical principles. This grand fusion was realized in the so-called "polytopes," vast outdoor pieces designed for specific spaces such as the ruins of Persepolis in Iran. Some might see parallels in the work of the other modernists, for example in Stockhausen's "spatial" pieces like *Gruppen* (1957), and in his outdoor spectacles such as *Sternklang* (1971). But what distinguishes Xenakis's works is their total austerity. Stockhausen's works have overtly mythic references, whereas Xenakis's are elaborate architectures of sounds and lights, which flash and change color in ever changing patterns.

In the end, the essential solitariness of Xenakis is what strikes one. Today, a decade after his death, Xenakis has many admirers among the still flourishing modernist wing of music, but no imitators, and certainly no school. Like those other great avant-garde heroes,

Stockhausen and John Cage, Xenakis has a surprising appeal to a younger generation. This was already evident during the heady days of the May 1968 revolution, when students at the Conservatoire inscribed the slogan "Down with Gounod, up with Xenakis!" on the building's walls. It persists even now. A recent Xenakis retrospective in London attracted large crowds of iPod-wearing youth. This is remarkable given how remote the postwar modernist wave in music must seem to them. Might this be a sign that, like all great music, Xenakis's transcends the ideas and the world-view that gave birth to it? Or could it be that his music really does capture deep truths about nature—our own, as well as the world's?

PL. 9
Iannis Xenakis (far right) with his two brothers and uncle Sophocles, 1933

How Do You Draw A Sound?

Carey Lovelace

Time itself is the blackboard on which are inscribed phenomena and their outside-time relations within the universe in which we live.

—IANNIS XENAKIS[1]

In a yellowing photo, Iannis Xenakis, age eleven, stands next to his uncle and two younger brothers in a busy port—probably in Romania, where he was born and where his father managed a British-based import-export firm [PL. 9]. His mother had died six years earlier; she had been deeply interested in music. His own passions were many—including archeology, literature, astronomy. Shortly after the photograph was taken, he was sent back to Greece for private schooling. In 1940 young Iannis began engineering studies at the Athens Polytechnic—just as Mussolini's Italians were invading. The "little stranger" ("Xenakis") became a leader in the student resistance movement. Then came the German Nazis, and in 1944, the British. Fighting the invaders, Xenakis nearly died, wounded by shrapnel that destroyed his left eye and part of his cheek, leaving him severely disfigured.

During this time, he was often in prison. Nonetheless, living a semi-clandestine existence, he managed to earn a civil engineering degree—and to study music, a passion he came to relatively late, "never imagining," he later said, that he himself might become a composer.[2] In 1947, to escape internment in a prison camp, he fled to Paris on a forged passport. He was condemned to death in absentia.

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1 Iannis Xenakis, from a presentation on ideas of time given at the symposium, "Recovering Time," organized by l'Université de Bruxelles, 1988.

2 Iannis Xenakis, "Preface," in *Music and Architecture*, comp., trans., and ed. Sharon Kanach (Hillsdale: Pendragon Press, 2008), xvi.

He was recommended for a position in the atelier of French-Swiss architect Le Corbusier. He was shy by nature as well as due to his facial disfigurement; he was also penniless and isolated. After work, he studied counterpoint and harmony and wrote long into the nights. He had determined he would be a composer. And he had met Françoise Gargouil. They married in 1953; she would become a successful journalist and novelist. In 1956 their daughter, Mâkhi, was born.

He sought out leading figures in Paris's thriving music scene, such as the teacher Nadia Boulanger and prominent composers Darius Milhaud and Arthur Honegger. But each, in his or her own way, rebuffed his efforts, his post-Bartokian compositions inspired by Greek folk tunes. In 1951, fatefully, he approached Olivier Messiaen. "You are almost thirty," the influential composer counseled. "You have the fortune of being Greek, an architect, and of having studied special mathematics. Take advantage of those things. Do them in your music."[3] Messiaen would remain a friend and mentor until his own death in 1992.

MUSIC AND ARCHITECTURE

Xenakis's first years with Le Corbusier primarily involved calculating the resistance of building materials. (His engineering thesis had concerned reinforced concrete.) Gradually, though, he won the respect of studio members and, in 1954, was appointed "project architect" for the soon-to-be-legendary convent of Sainte-Marie-de-la-Tourette near Lyon, whose exterior Le Corbusier conceived as a simple rectangle. Xenakis was assigned the interior spaces and designed the cloisters, study hall, library, and chapel—the latter in the shape of a grand piano. The sacristy included "machine guns" of colored light—oblong windows the interiors of whose cylindrical shafts were painted in primary hues, giving the cast light a glow.[4] Xenakis would enter architectural history, though, for what Le Corbusier dubbed his "musical screens of glass."[5]

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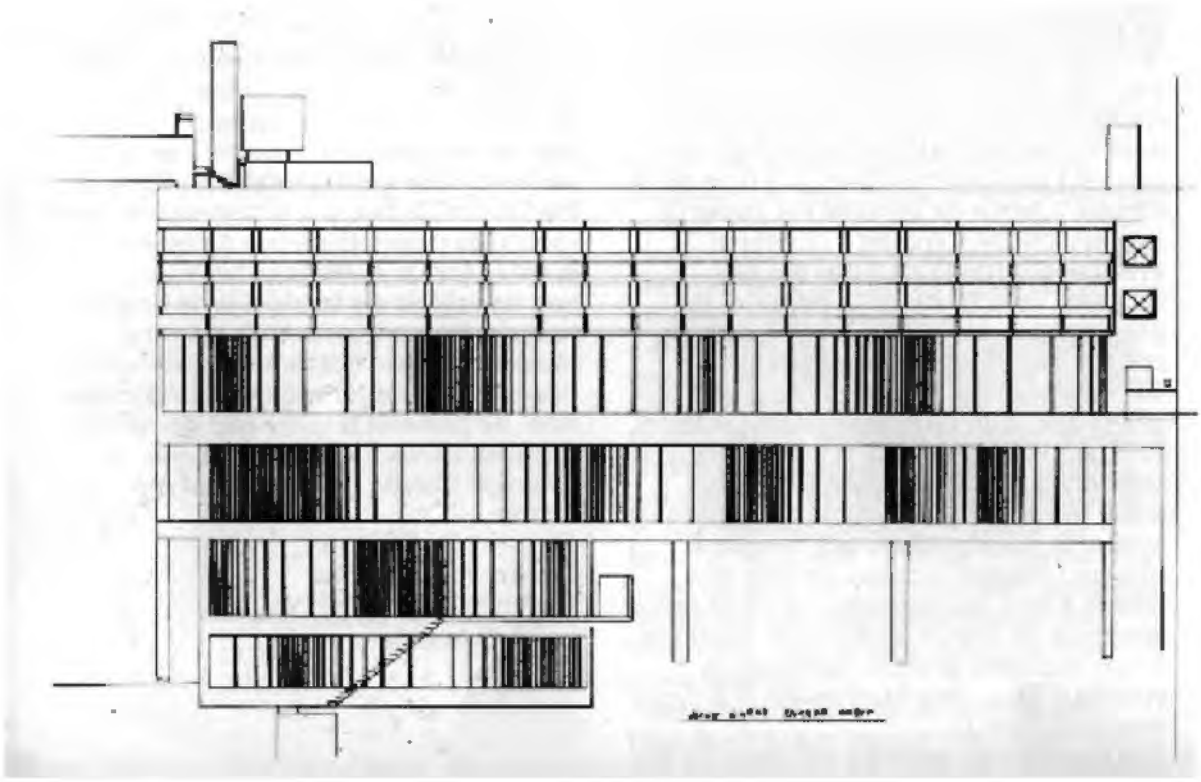
3 Olivier Messiaen quoted in Nouritza Matossian, *Xenakis* (Nicosia, Cyprus: Moufflon Publications, 2005), 59.

4 For a description of these and other Le Corbusier-related projects in which Xenakis participated see *Music and Architecture*.

5 Quoted in Matossian, *Xenakis*, 78.

PL. 10
Atrium of Convent of La Tourette showing undulating glass panes, 2004



PL. 11
Convent of La Tourette (elevation), c. 1959

PL. 12
Convent of La Tourette (west and south façades), photograph c. 2004

Earlier, the modernist innovator, who was just then absorbed in actualizing his ideas about urbanization in such landmark projects as Chandigarh, India, and Marseille's Radiant City, had traveled the world studying architecture, notably that of ancient Greece. He had formulated something called "the Modulor," a complex scale of proportion combining human measurements with the Golden Mean and the Fibonacci series. (It is composed by adding the sum of two numbers to the previous in a series: 1, [1+1=]2, [2+1=]3, [3+2=]5, etc. It is the relational structure of natural phenomena including the nautilus shell and tree rings.)

Designing a double frieze of windows for the Dominican convent's west façade [PLS. 11, 12], Xenakis turned to the Modulor. He plotted out varying widths, the intervals creating shifting rhythms, a kind of vertical polyphony. Lending dynamism to the straightforward concrete-slab rectangle, the celebrated "undulating glass panes" were essentially a "musical solution."[6]

Having entered Le Corbusier's studio with little knowledge of modernism, Xenakis found himself stimulated by his employer's constant questioning, his ingenious design use of simple geometries, his "spiritual force."[7] And, inspired no doubt also by Messiaen's counsel, the young composer began applying graphic solutions to music.

In the conceptualization of his breakthrough orchestral work, *Metastaseis* (1953–54), Xenakis once stated, "the role of architecture is direct and fundamental."[8] Composing on architects' graph paper, he began by sketching arcing shapes—ruled parabolas [PLS. 13, 14]. In this pleasingly mind-bending form, lines at right angles drawn at regular intervals produce a graceful curve at their points of intersection. In his composition, he assigned each of forty-six ruled lines to a separate string instrument—violin, viola, and so on. These were translated in sound as sustained tones or glissandi. Previously,

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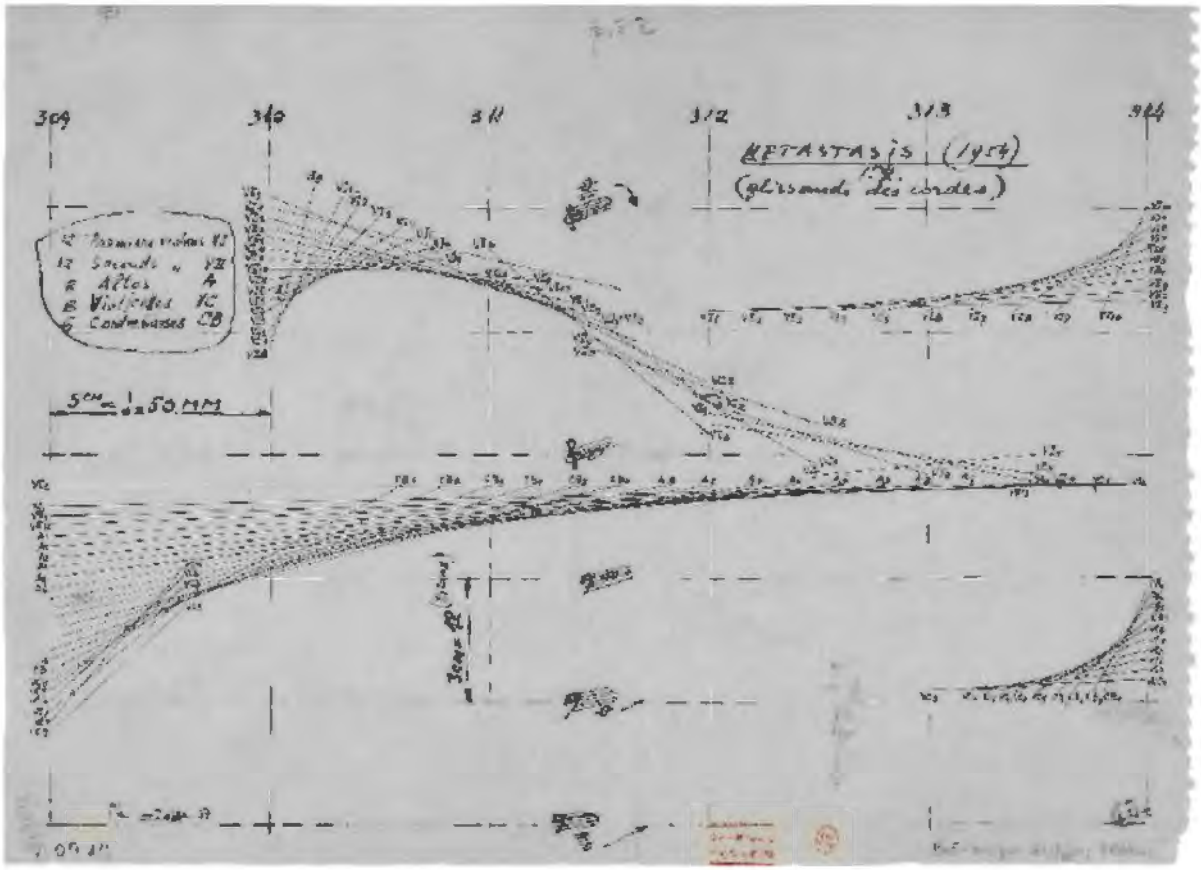
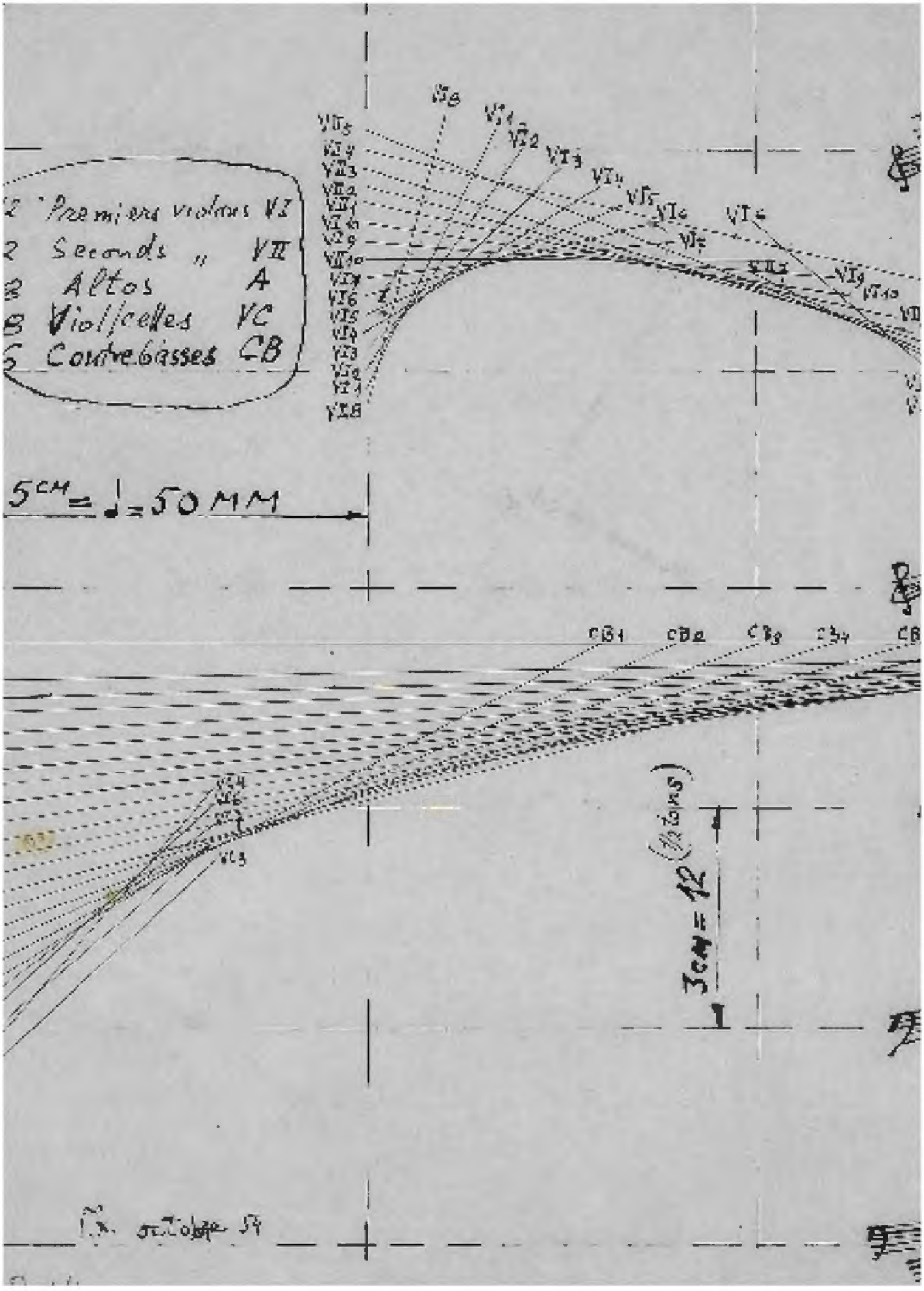
6 Matossian, *Xenakis*, 79. Despite the fact that Xenakis's contributions, including the design of the interior chapel, sleeping areas, and the interior fenestration, are essential to the building's reputation, he is often left unmentioned in historical accounts.

7 Mario Bois, *Iannis Xenakis: The Man and His Music* (London: Boosey and Hawkes, 1967), 5.

8 Quoted in James Harley, *Xenakis, His Life in Music* (New York: Routledge, 2004), 10.



PL. 13
Study for *Metastaseis*, 1954


2 Premiers violons VI
2 Seconds " VII
3 Altos A
3 Viol/celles VC
2 Contrebasses CB
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3cm = 12
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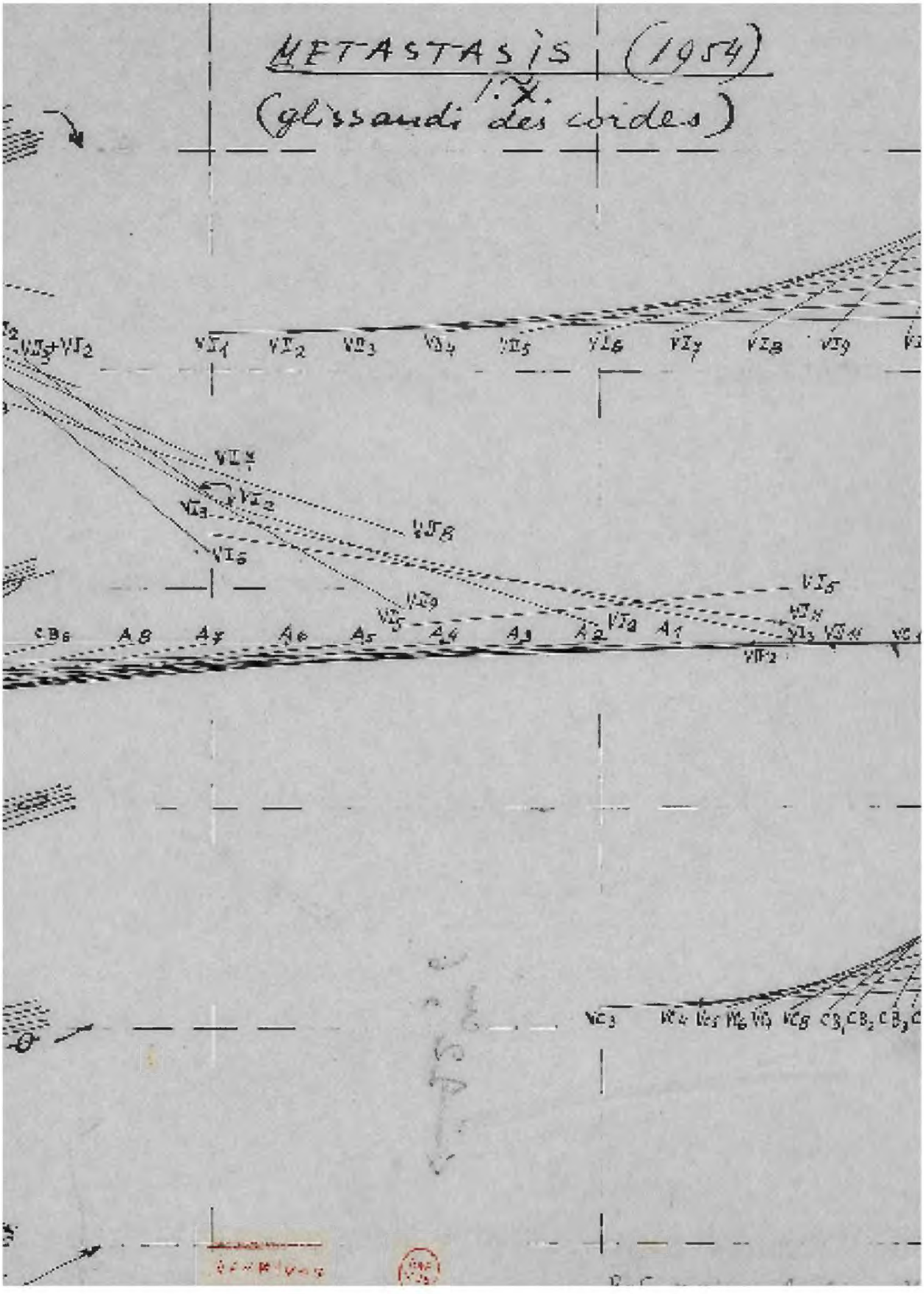
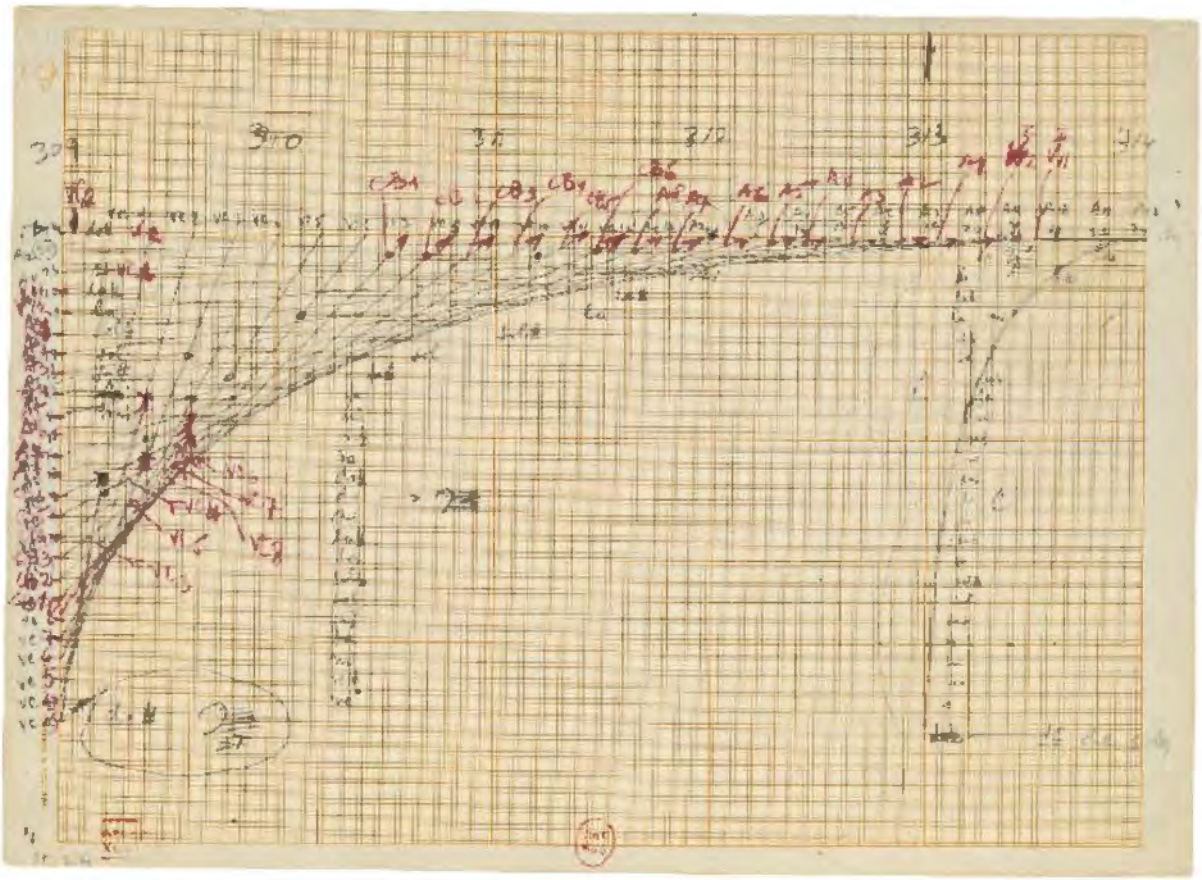
1er octobre 59

METASTASIS (1954)

(glissandi des cordes)





PL. 14
Study for *Metastaseis*, c. 1953

for example in a Paganini violin solo, this "slide" up in pitch had served as a coloristic flourish—never as a unit in itself. In *Metastaseis*, every detail was carefully plotted out. To determine proportions between and within sections, Xenakis turned, again, to Le Corbusier's Modulor.

At the time, Western music was undergoing a transformation parallel to revolutions in visual art. Just as, for example, Russian Suprematists at the beginning of the twentieth century banished representation in favor of pure geometries, so progressive composers aspired to evolve past classical music's harmonic framework with its stress on a tonal base and on dominant/subdominant "resting places." Notably, twelve-tone "serial" composition was based on the idea of a "series" or "cell" of twelve tones each of equal weight, submitted to permutations.

Metastaseis translates as "beyond + stasis." In Xenakis's view, Western music—limited to the tones of the chromatic scale as opposed to an infinite range of frequencies—was static, as was serial music. Although the listener is meant to follow the serial "cell" undergoing permutations, as if it were a melody transforming through a symphony, in complex works, all that is perceptible is a general sonic wash. Xenakis, instead, sought to formulate such musical textures directly. His haunting seven-minute string orchestra work[9] initiated the concept of sound "masses" and generated an unearthly music. The opening consists of long, interlaced string glissandi, "sonic spaces of continuous evolution," as Xenakis himself put it.[10] Its premiere at Donaueschingen, Germany, in 1955 caused a sensation. He was banned, he recalled, from the halls of serial music for years. "Nothing like it had been heard before."[11]

His next work, *Pithoprakta* (1955–56), considered by many his first mature orchestral piece, takes the notion of "mass sound" a step further. It again foregrounds string instruments (while also including two tromhones, a xylophone, and a woodblock). While the opening and

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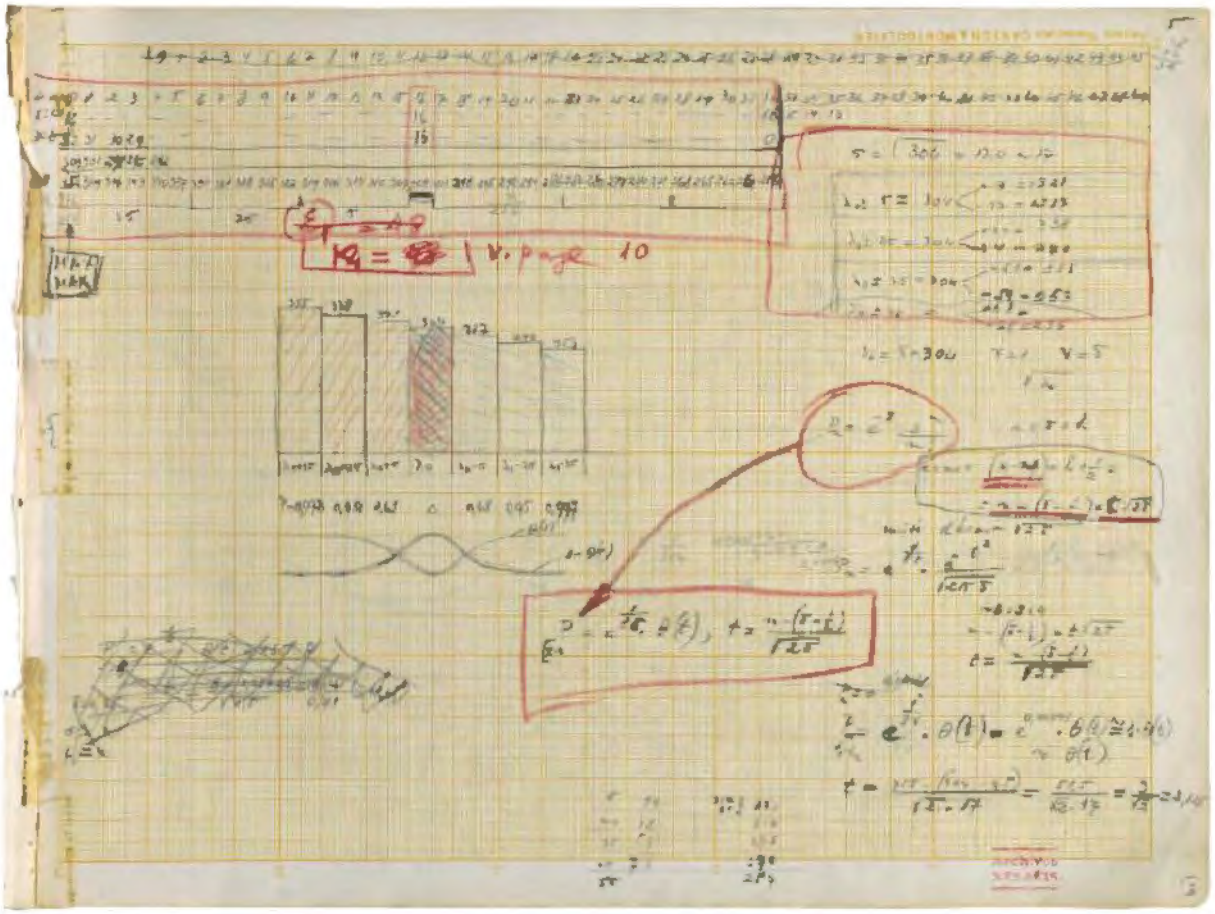
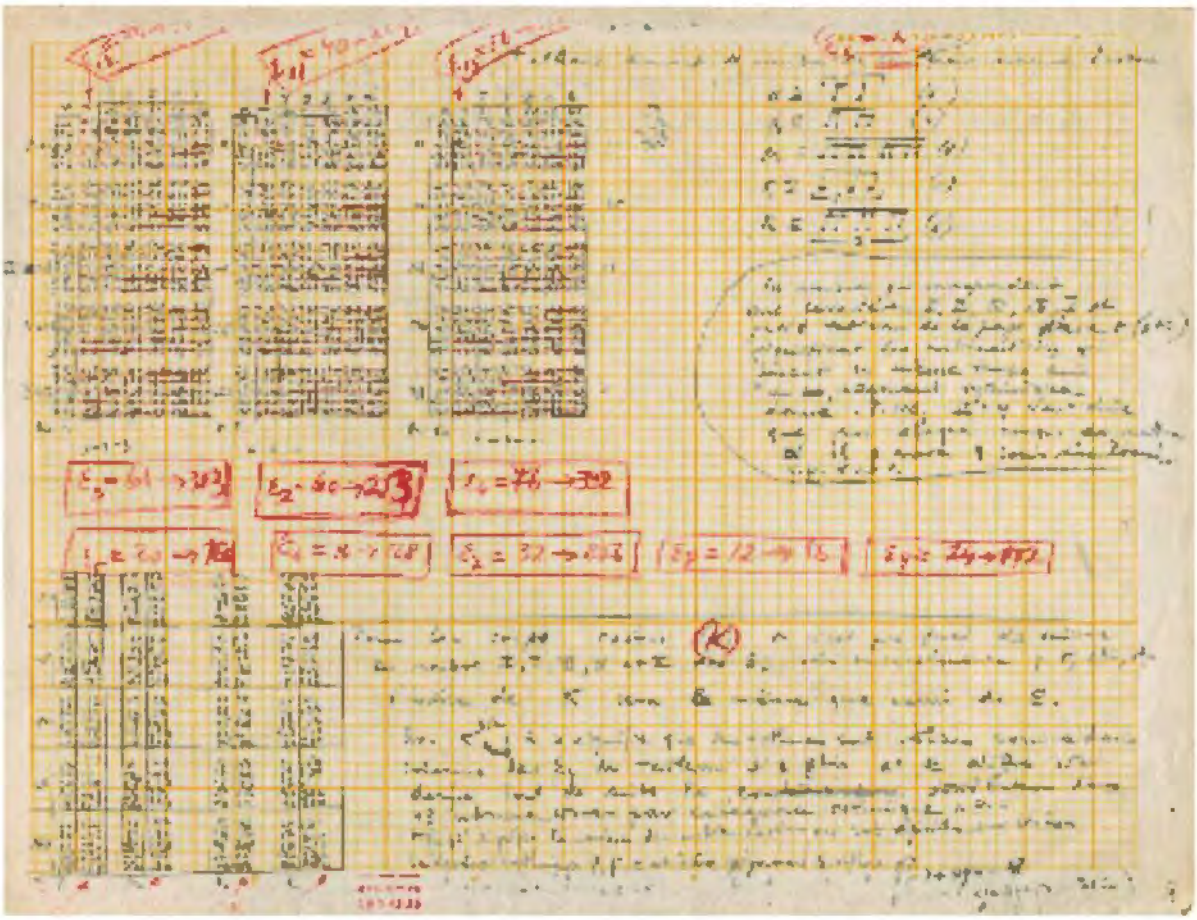
9 Emerging from a single sustained tone into a forty-six-note cluster, the piece is played *a divisi*—that is, each instrument is assigned a separate line. The ensemble also includes seven brass, six winds, and two percussion.

10 Iannis Xenakis, *Formalized Music* (Hillsdale: Pendragon Press, 1992), 10.

11 Harley, *Xenakis. His Life in Music*, 10.



PL. 15
Study for *Pithoprakta*, 1956



PL. 16
Study for *Pithoprakta*, c. 1955

concluding sections of *Metastaseis* are linear (based on glissandi) and use geometry as a formative module, *Pithoprakta* ("action through probability") is based on "clouds of points"—in this case, created by quasi-percussive modes of attack such as *pizzati* (plucked strings), *col legno* (striking the string with the wood of the bow), *arco au talon* (at the base of the bow). Over the course of the work, "points"—distributed according to probability calculations—move at various directions and speeds. Xenakis implemented varying formulas for different sections—Poisson's Law of Rare Events, Bernoulli's Law of Large Numbers, and the Maxwell-Boltzmann Kinetic Theory of Gasses. (The latter projects the movement of gas molecules, that is, particles, which can be seen as equivalents to *Pithoprakta*'s "sound points.") He dubbed this approach "stochastic music"—compositions that are generated by probability-based formulas dealing with large numbers of events.

This seemingly hyper-cerebral approach was, for Xenakis, in fact deeply grounded in nature—which he loved—as well as in human experience. Famously, he invoked an agonizing personal memory, the chaos at a political rally broken up by gunfire:

> The human river shouts a chant in uniform rhythm…[After a] whistle of bullets…The crowd is then rapidly dispersed, and after sonic and visual hell follows a detonating calm, full of despair, dust, death.[1]

The dozens of remarkable, often large-scale studies he created feature colored points or tangles of tangents along a left-to-right axis [PLS. 15, 16]. (Interestingly, these preparatory documents bring to mind drawings by the artist Hannah Darboven, for example, or even obsessive samples of Outsider Art.) As with *Metastaseis*, and nearly all subsequent compositions, Xenakis would translate such visual plottings into musical notation. At its Munich premiere, *Pithoprakta*, too, caused outrage—even the performers were hostile to the work's novel approach. It was conducted by Hermann Scherchen. In 1955, the unknown composer had approached the eminent conductor with the then-unperformed and massive score of *Metastaseis* under his arm. Scherchen had championed Arnold Schoenberg and the Viennese

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1. Xenakis, *Formalized Music*, 9.

School (who, ironically, had invented the very serial music that Xenakis was about to challenge). He grasped that earlier score's value immediately. While he didn't conduct its first performance, he premiered *Pithoprakta* and became an important champion.

Meanwhile, Xenakis was gaining responsibility under Le Corbusier. When the busy atelier was approached by the Dutch Philips Corporation to produce a pavilion for the 1958 Brussels World's Fair highlighting the firm's contribution to modern technology, Le Corbusier proposed a structure housing an eight-minute *Poème électronique*, a futuristic, "immersive" display of projected visuals and spatialized music. Le Corbusier would create the images. For the audio component, he secured renegade composer Edgard Varèse, who was just then helping pioneer *musique concrète*, a still somewhat primitive collage technique involving "found" sounds recorded from everyday life, usually subjected to audio manipulations.

However, distracted by other projects, Le Corbusier turned over the pavilion itself to his protégé, leaving him with a scant sketch of a "free-form hollow structure."[1] Xenakis realized that, acoustically, the proposed globular shape would heighten reverberations and create "dead spots." He began considering a more asymmetrical framework—notably, one based on "saddle-shaped" hyperbolic paraboloids [PL. 57]. These forms have since become modish in such iconic complexes as the Sydney Opera House, completed in 1973. At the time, Xenakis knew that although such shapes had been used for roofs and terraces, they had never structured a freestanding building. Experimenting with the paraboloid curves that he had traced out for *Metastaseis*, Xenakis saw that the straight, ruled lines which graphed the curves could be translated into supporting wire cables. Working with scale models of piano wire, planks, and string, he eventually composed a non-uniform, decentralized structure of conoids sweeping into three futuristic-looking tent-like peaks. Le Corbusier had originally suggested a sprayed-on concrete shell. Instead, Xenakis proposed two-inch-thick panels of pre-stressed concrete, slightly curved to form the sweeping arcs, which would be

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1 A.S. Barthel-Calvet, "Iannis Xenakis Biography," Les Amis de Xenakis, http://www.iannis-xenakis.org/xen/bio/bio.html.

PL. 17
Philips Pavilion, c. 1958

PL. 18
Study for Philips Pavilion (interior sound diagram), c. 1957

PL. 19
Le Corbusier, Louis Kalff, and Iannis Xenakis with scale model of the Philips Pavilion, c. 1957

cast on-site in open sand beds. Fortunately Le Corbusier was enthusiastic about Xenakis's radical alteration of his initial concept.[14]

When Le Corbusier arrived to sign the plans and lay the foundation stone in May, 1957, he neglected to mention the project's sole author. In what became known as the "Xenakis incident," the young composer/engineer registered a heated protest. A bitter struggle ensued; even Varèse took sides (Xenakis's). One day in 1959, the composer and two other employees arrived at the atelier to find the locks changed. They had been fired. Nonetheless, Le Corbusier, who had never before acknowledged collaborators, eventually agreed that Xenakis should share credit.

Open from May 1958 until the World's Fair's conclusion in January, 1959, the Philips Pavilion was a triumph. It was the world's first self-supporting hyperbolic paraboloid building and revolutionized volumetric architecture. Xenakis, who coordinated the interior sound and light technology [PL. 18], was also able to create his first musique concrète tape piece. *Concret PH* (high-pitched sounds derived from charcoal burning) played as the audience entered and exited.

SUBSEQUENT COMPOSITIONS

Through the early 1960s, Xenakis continued to develop new mathematical approaches. Frequently, these were mapped out in essays. In "Probability Theory and Modern Composition," one of several that appeared in the music journal *Gravesaner Blätter* (which his mentor, Scherchen, published), the renegade theoretician outlined *Pithoprakta*'s statistical method of generating orchestral textures. In "À la Récherche d'une musique stochastique," taking his analysis even further, he broke the compositional process down into steps, from conception, to definition of material, to realization. He suggested that such stages might eventually be automated on computer.[15]

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14. For a chronological account of the extent of Xenakis's musical innovations during this period, see Harley's book-long analysis, as well as Matossian's biography, cited above.
15. Xenakis, *Formalized Music*, 22. These stages of stochastic composition, or composition according to probability theories, are: 1. Initial conception; 2. Definition of sonic entities; 3. Definition of the transformations; 4. Microcomposition; 5. Sequential programming; 6. Implementation of calculations; 7. Final symbolic result; 8. Sonic realization.

(Often employing the somewhat impenetrable syntax of algebraic discourse, these essays form the basis of the 1963 *Musique Formelles*, whose explanations of algorithmic compositional method were to have international impact.[16])

In *Achorripsis* ("jets of sound") of 1956–57, he gave this abstracted system musical form. Probability theory (specifically, Poisson's Law of Rare Events) was applied not only to the distribution of notes, but to other features—for example, to the construction of melodic figures. Each of seven rows in a double-entry vector matrix is assigned to a different instrument group or mode of attack (e.g., a string *pizzicato*); columns represent fifteen-second time "slices." In working sketches, Xenakis often used color to indicate additional dimensions. In one beautiful checkerboard version of the grid, reds, blacks, whites, greens, and blues indicate the respective number of "events" within each matrix square [PL. 20].

The systemized procedure used in *Achorripsis* was indeed eventually able to be realized on computer, finding form in works such as *ST/48* (small orchestra), *ST/4* (string quartet), and *Morsima-Amorsima* (mixed quartet). Xenakis implemented other mathematical paradigms—ser theory for the virtuoso solo piano work *Herma*, game theory for *Stratégie*, group theory for *Nomos Alpha* (1966). (All but *Nomos Alpha* were completed in 1962.) He generated numerous compositional strategies, many more than could possibly be detailed here.[17] Many works are technically difficult and include "impossible" elements. For example, the piano work *Evryali* (1973) features a high C-sharp off the keyboard. (Performers consider these a kind of Zen koan.)

Xenakis once remarked that he did not compose at the piano, that instead his tools were mathematics and computer science.[18] He also

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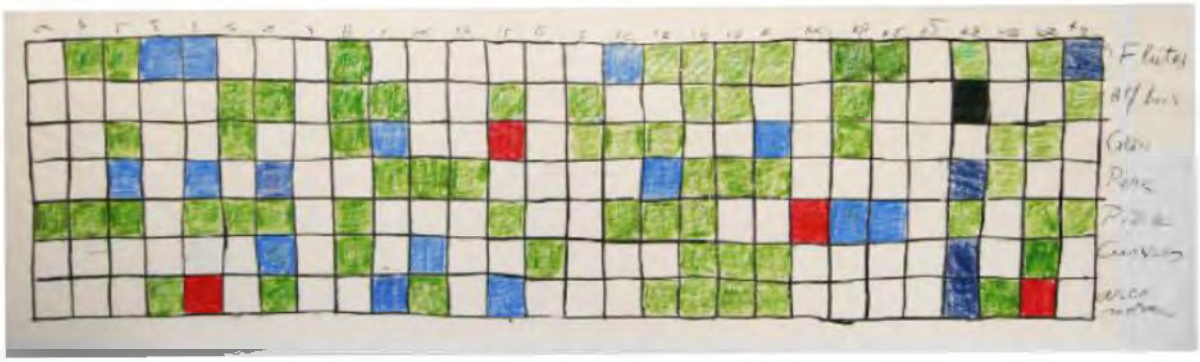
16 The first English edition of Xenakis's *Formalized Music* was published by Indiana University Press in 1971.

17 These include his concept of "screens" and his "sieve theory." For this and more on his electronic music studio, CEMAMu (the Centre d'Etudes de Mathématique et Automatique Musicales), the reader is referred to Harley's monographic book of insightful musical analysis, Matossian's biography, as well as Kanach's editorial commentaries within Xenakis's *Music and Architecture*.

18 Xenakis, *Music and Architecture*, xix.

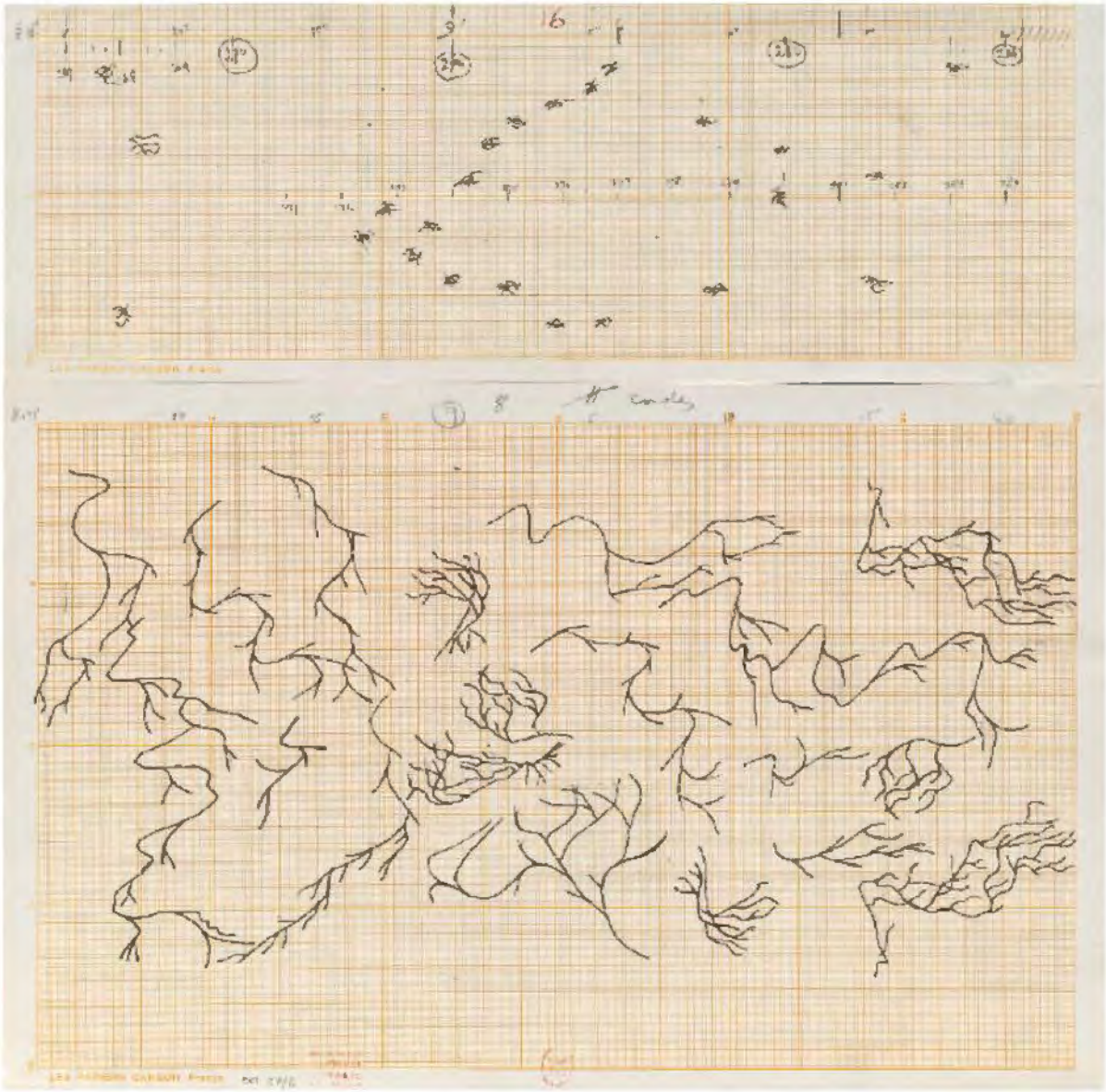


PL. 20
Vector matrix for *Achorripsis*, c. 1964

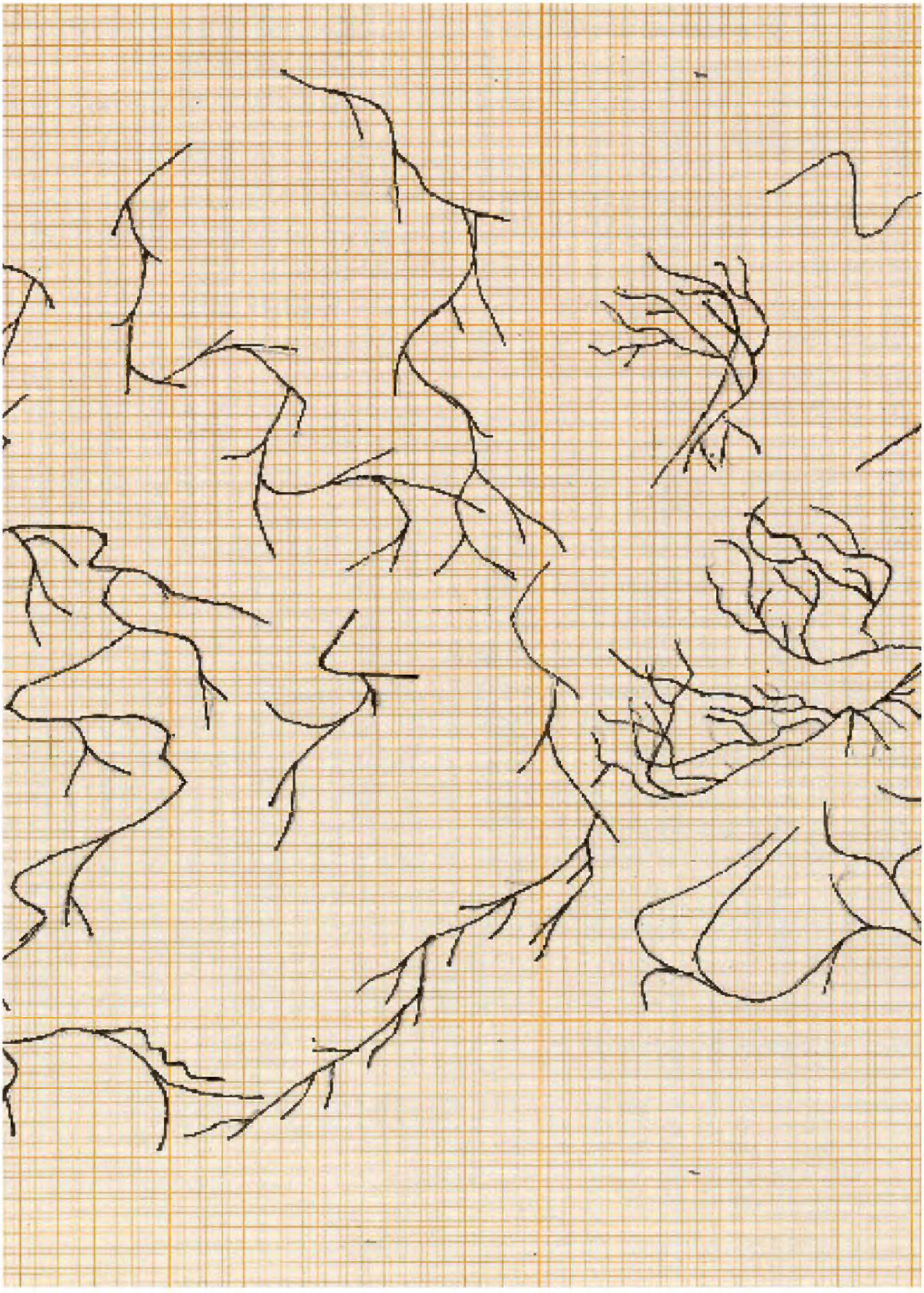
once pointed out that musicians, long before Descartes and the grid, had invented analytic geometry, via musical notation—which is space shared by two elements, pitch and time, unrelated to one another. Xenakis, as it were, occupied a conceptual plane bringing together mathematics, in its two-dimensional visualization, with organized sound. Starting in the late 1960s, he began experimenting with compositions generated by Markov chains, whose probability calculations he used to formulate branching shapes he dubbed "arborescences" or "bushes." These were used in compositions including *Cendrées* (1973), *Noomena* (1974), and *Mikka* (1971). Specifically, he implemented something called the "random walk," a trajectory generated by a series of "steps" (x+1 or x-1) of indeterminate course; the direction and size of each step, determined by probability, is unknown and can be reversible. Thus, "line" (as opposed to *Pithoprakta*'s "clouds" of points) is implied.

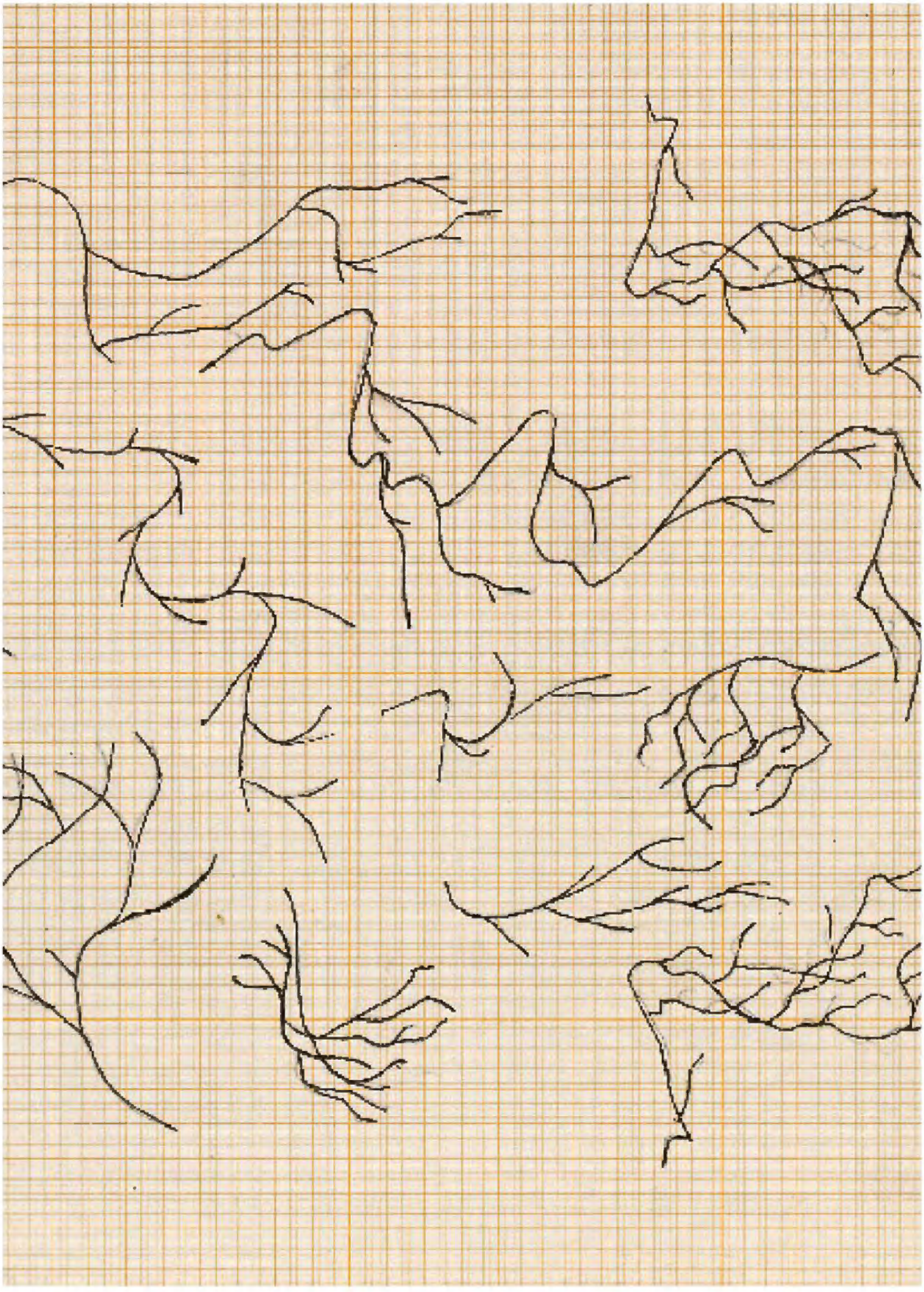
His most graphic preparatory drawings, however, served as groundwork for the seventeen-and-a-half-minute piano concerto, *Erikhthon* (1974) [PLS. 21, 50]. Here, spidery shapes were inscribed along two "tracks"—an upper, narrower strip of graph paper for the piano line, and a lower, larger one for the orchestra. The "dendrite," or branching projection, is transposed—rotated, flipped, turned upside-down—through the course of the piece. In notation, these shapes were translated into chromatic cluster-type runs on the piano and into sweeping orchestral glissandi. One can follow the manner in which shapes are musicalized by listening to the chromatic lines while viewing the preparatory drawings.

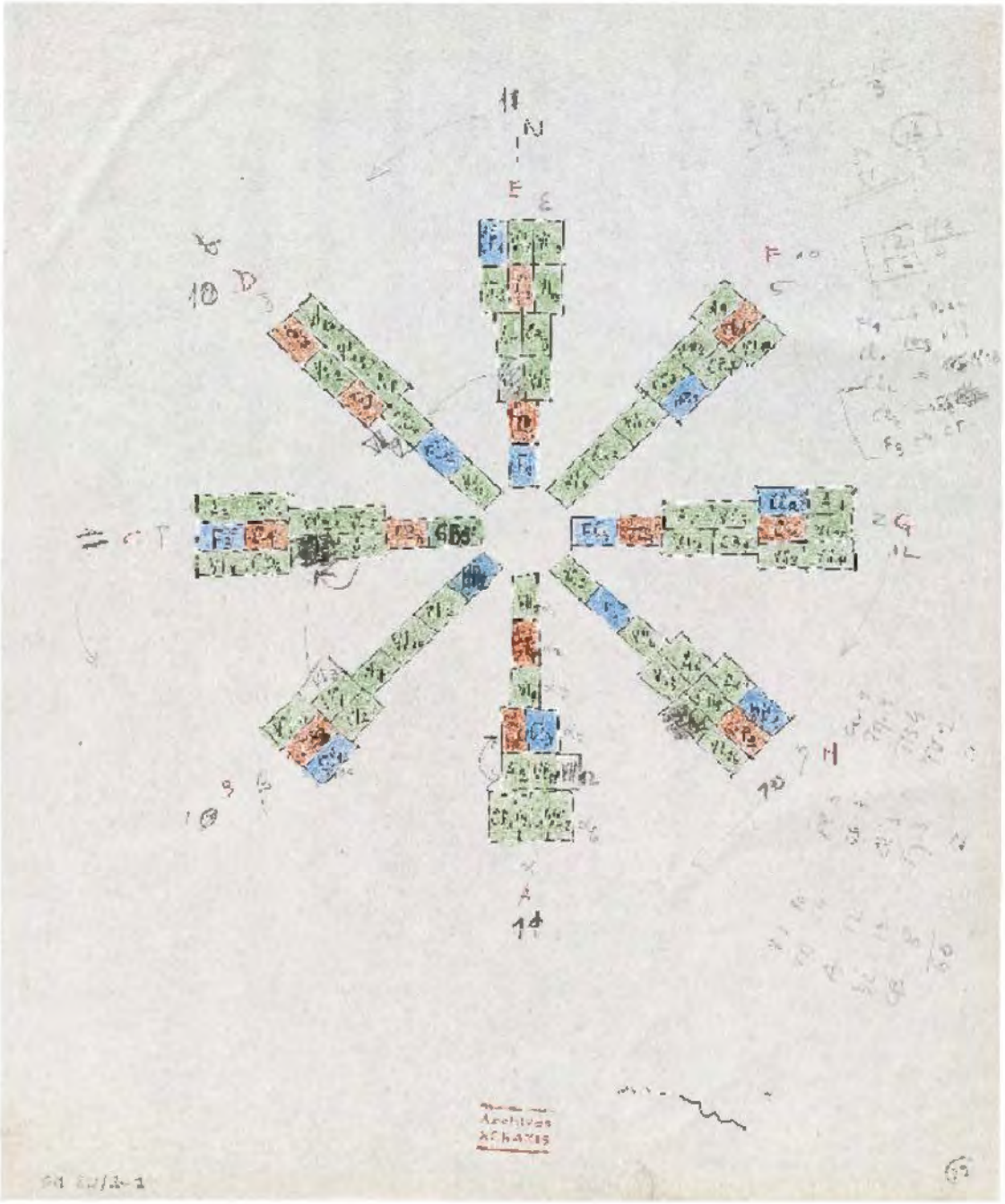
But Xenakis was not interested only in sound mapped in a graphic domain. His fascination with sonic dimensionality dated back to the "immersive environment" of 425 loudspeakers he coordinated for the Philips Pavilion. In his 1962 electronic piece *Bohor* (whose ear-splitting volume sparked a scandalized reception at its premiere), he programmed dynamic shifts of sound between loudspeakers. At another moment, he mused about the habit of restricting audiences to a frontal position in relation to the musicians. In *Terretektorh* (1965–66), he designated that listeners be seated among the eighty-eight performers, who were arranged in a circular formation around the conductor (their placement in part determined by probability



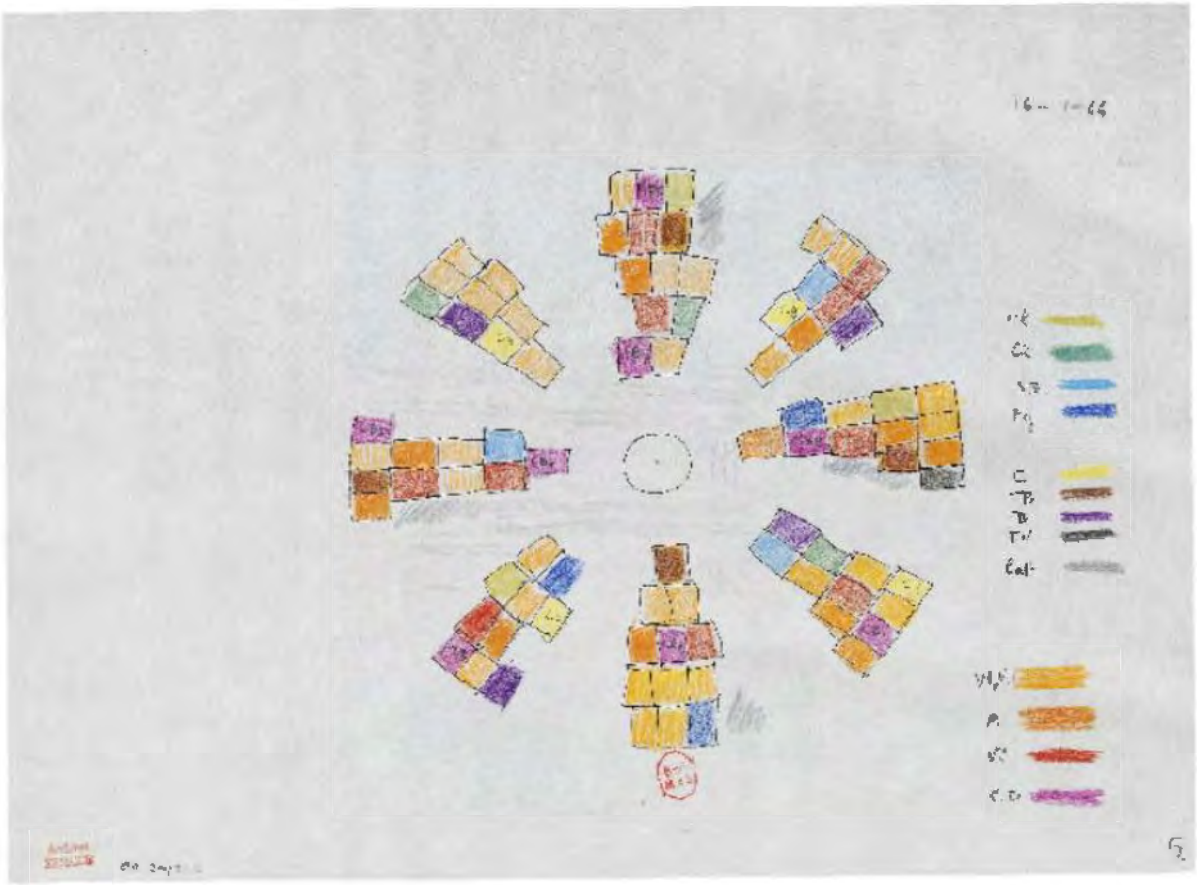
PL. 21
Study for *Erikhthon*, c. 1973



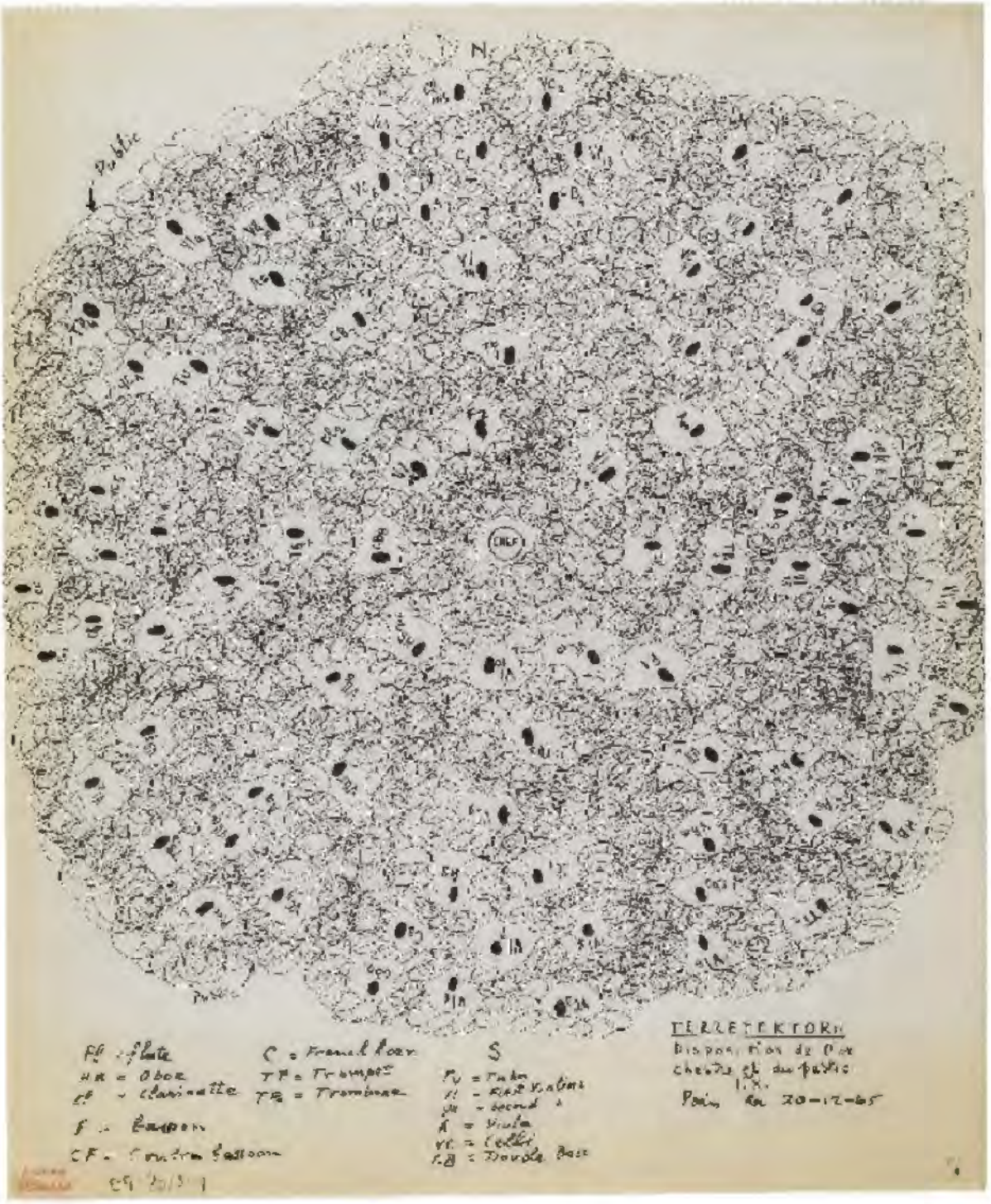




PL. 22
Study for *Terretektorh* (distribution of musicians), c. December 1964–January 1965



PL. 23
Study for *Terretektorh* (distribution of musicians), c. December 1964–January 1965



PL. 24
Study for *Terretektorh* (distribution of musicians), December 20, 1965

calculations) [PLS. 22, 23]. At the premiere, auditors were given camp chairs and encouraged to move about and to change sites of listening. In an engaging, somewhat obsessive-compulsive 1965 pen-and-ink rendering, this kinetic activity is indicated via meticulous swirls through which one can, with concentration, follow potential audience trajectories through the stationary instrumentalists [PL. 24].

Terretektorh, according to biographer Matossian, was inspired in part by one of the composer's many intense experiences with nature and its sounds. Xenakis spent summers in Corsica in the company of his wife and daughter, surrounded by the sea, gazing at stars, immersed in forest sounds, or rattled by the intensity of a tempest.[19] It was an almost violent primordial feeling he was after, sound shifting from instrument to instrument, as if between loudspeakers—a line traced in space.

POLYTOPES

Xenakis was invited to create a multimedia work for the interior of the French Pavilion at the 1967 Montreal Expo. With the *Poème électronique*, he had been frustrated by Le Corbusier's outmoded approach to the visuals: images of movie-style dinosaurs, Charlie Chaplin, and fighter planes were projected on the walls to outline modern culture's evolution. For the Montreal project, Xenakis fashioned a sophisticated, Naum Gabo–like arrangement of steel cables that threaded through the interior of the Jean Faugeron-designed building, forming a virtual architecture of intersecting dynamic shafts of conoids and hyperboloids [PLS. 25, 26]. During the six-minute performance, some 1,200 white and colored flashing lights lying along the cables were programmed to create dazzling patterns that changed every twenty-fifth of a second. Simultaneously, a symphony recorded by four separate "orchestras" of identical instrumentation was transmitted via four sets of loudspeakers, one in each quadrant of the hall. The product was dramatically strident sustained tones, unbroken glissandi, and percussive accents reminiscent of Noh music. The public was free to experience the spectacle from many levels on the six-storey-high building's suspended platforms, linked by stairways [PL. 28].

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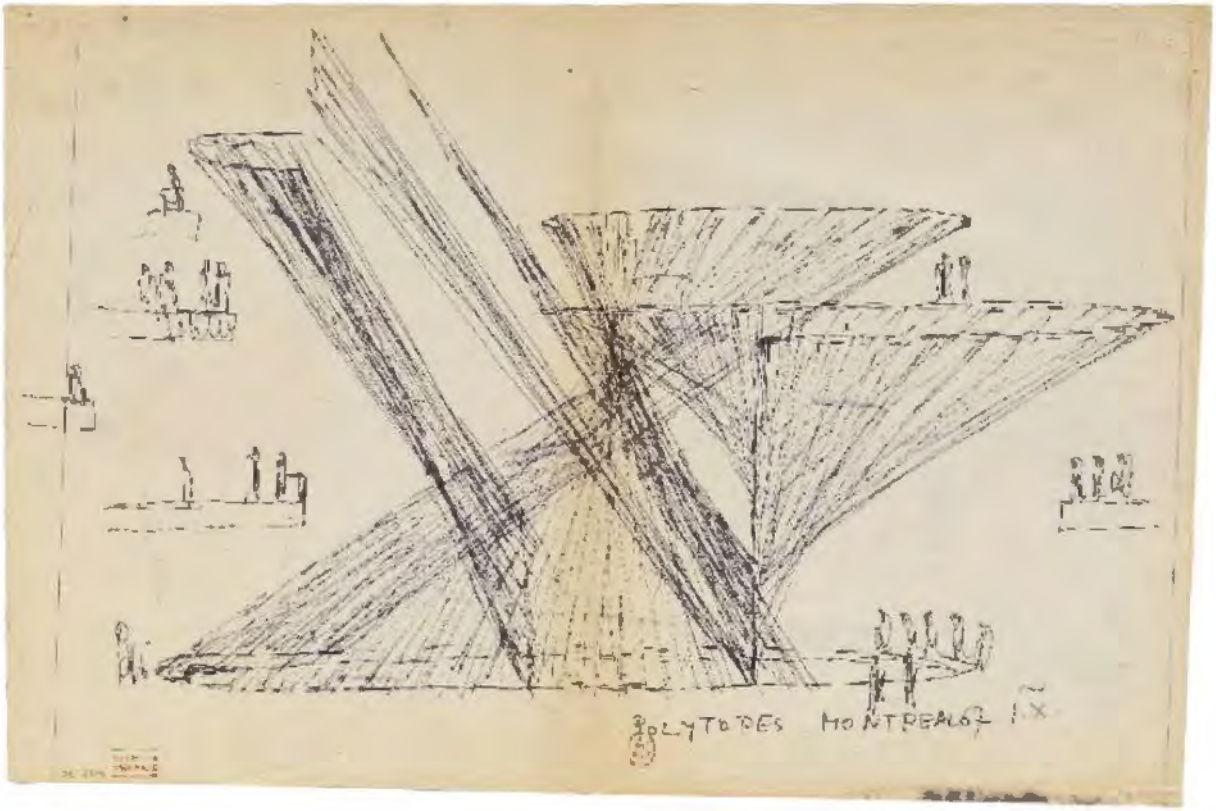
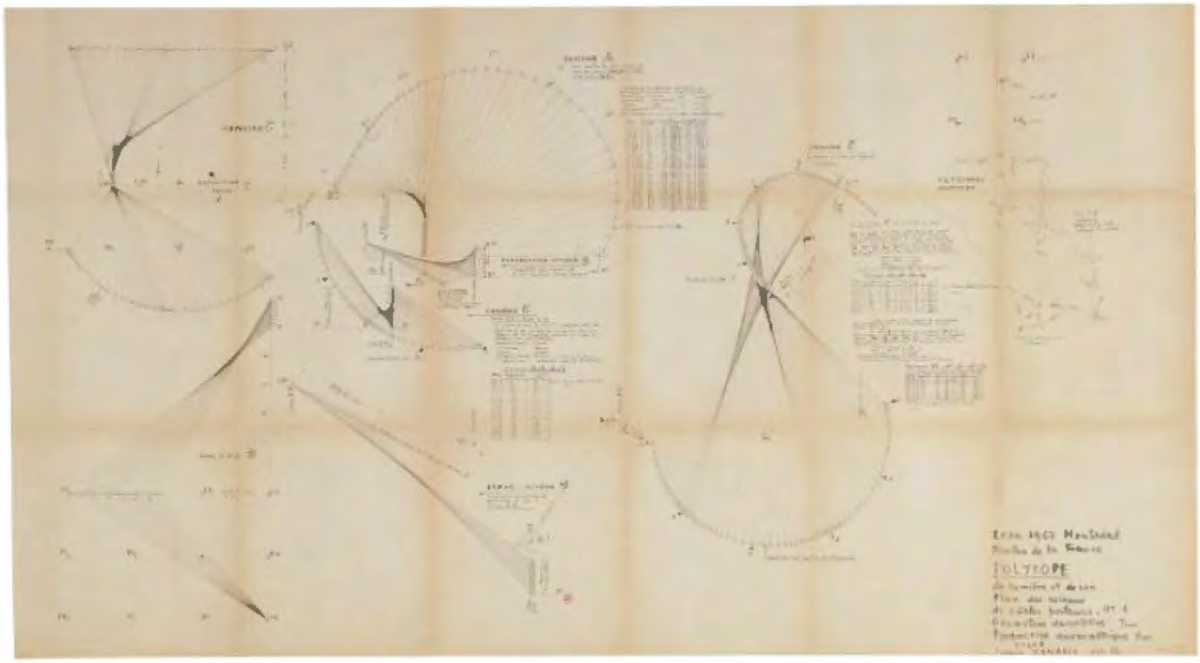
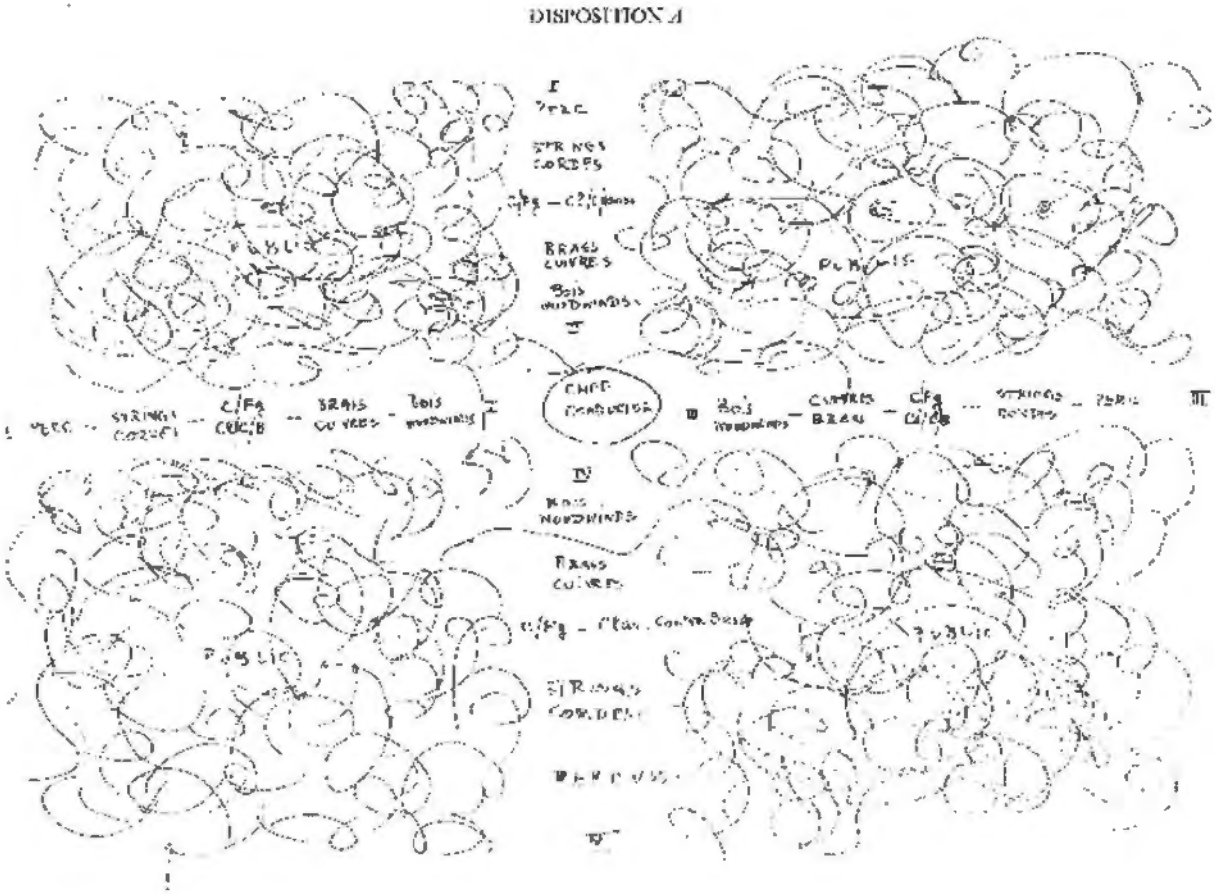
19 Matossian, *Xenakis*, 230.



PL. 25
Study for *Polytope de Montréal*, c. 1967

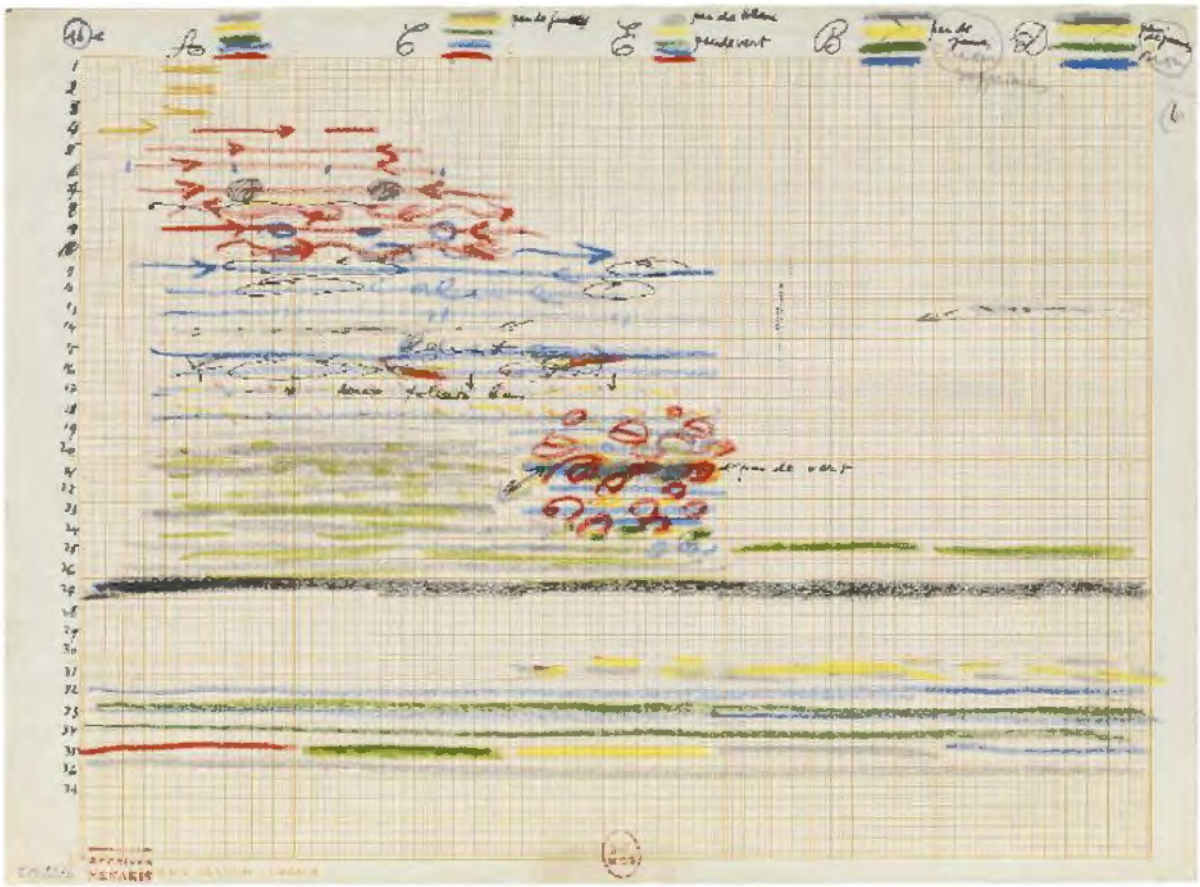


PL. 26
Polytope de Montréal (plans, elevations, axonometrics), 1966

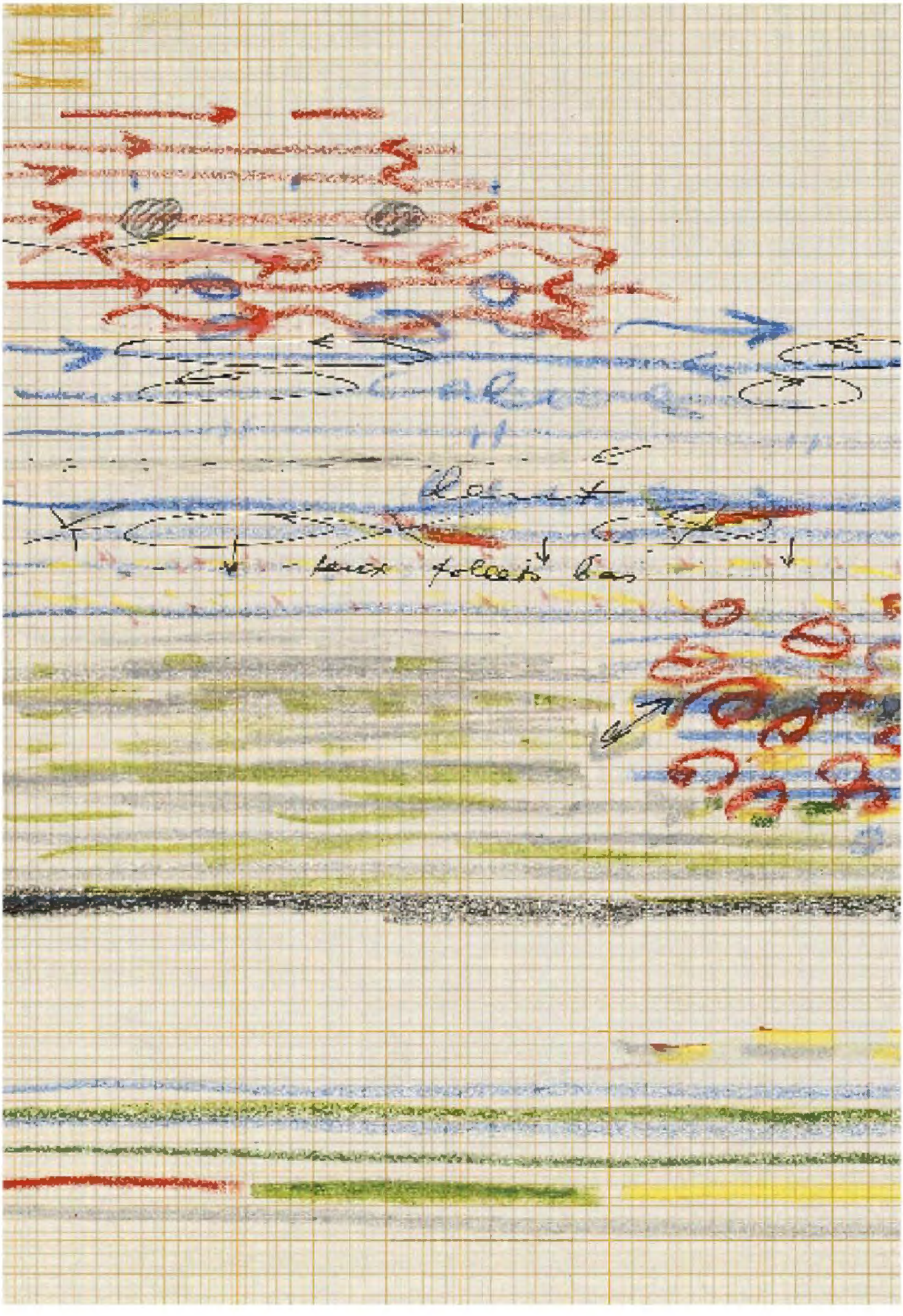


PL. 27
Study for *Polytope de Montréal* (distribution of musicians), 1967

PL. 28
Polytope de Montréal, 1967



PL. 29
Study for *Polytope de Montréal* (light score), c. 1966



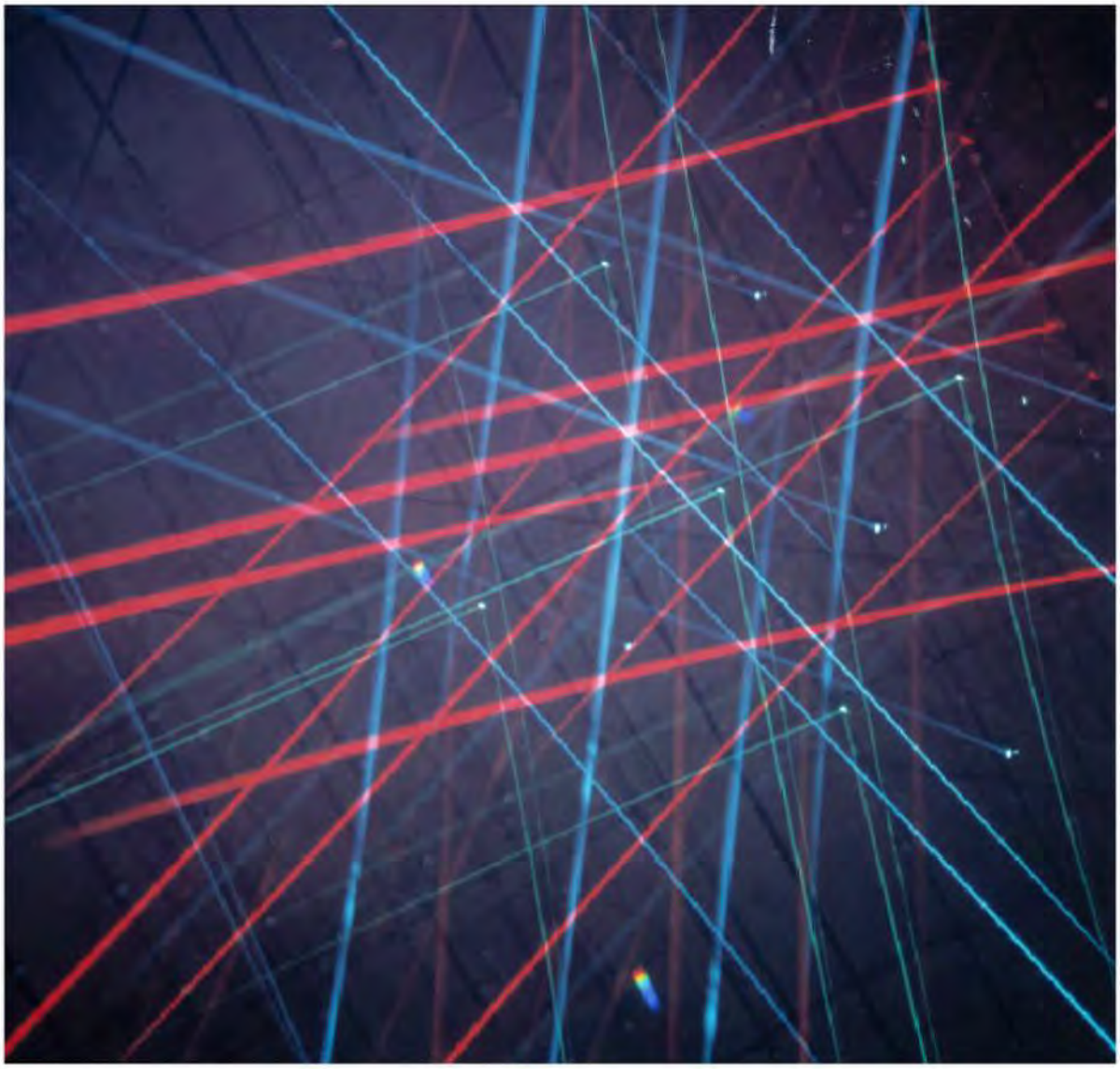
He called this a "polytope" ("many"+ "sites"), and it was the first of many. Just as he had initially used graphic geometries to visualize sound in a new way, he now reversed the equation and used music's formal strategies to craft shifting optical architectures. In a pre-digital age, automated light changes had to be laboriously hand-executed in advance via a primitive film-perforation system. By 1972, when he created the twenty-four-minute *Polytope de Cluny* (set in the ancient Roman thermal baths in Paris), computer technology had evolved to where digital instructions could be transmitted via tape and he could make use of a more advanced light source, lasers.

Within a T-shaped, barrel-vaulted structure, an interior scaffolding was erected, holding 600 lights that could be individually triggered, along with 400 small mirrors adjustable to reflect laser beams of red, yellow, and blue. These appeared to sit solidly in space, like holograms—virtually "drawing in air" [PL. 31]. During its two-month run in late 1972, 500 spectators per performance were ushered in four times daily; many lay or sat on the stone floor, entranced [PL. 30]. The site-specific installation was reprised the following year.

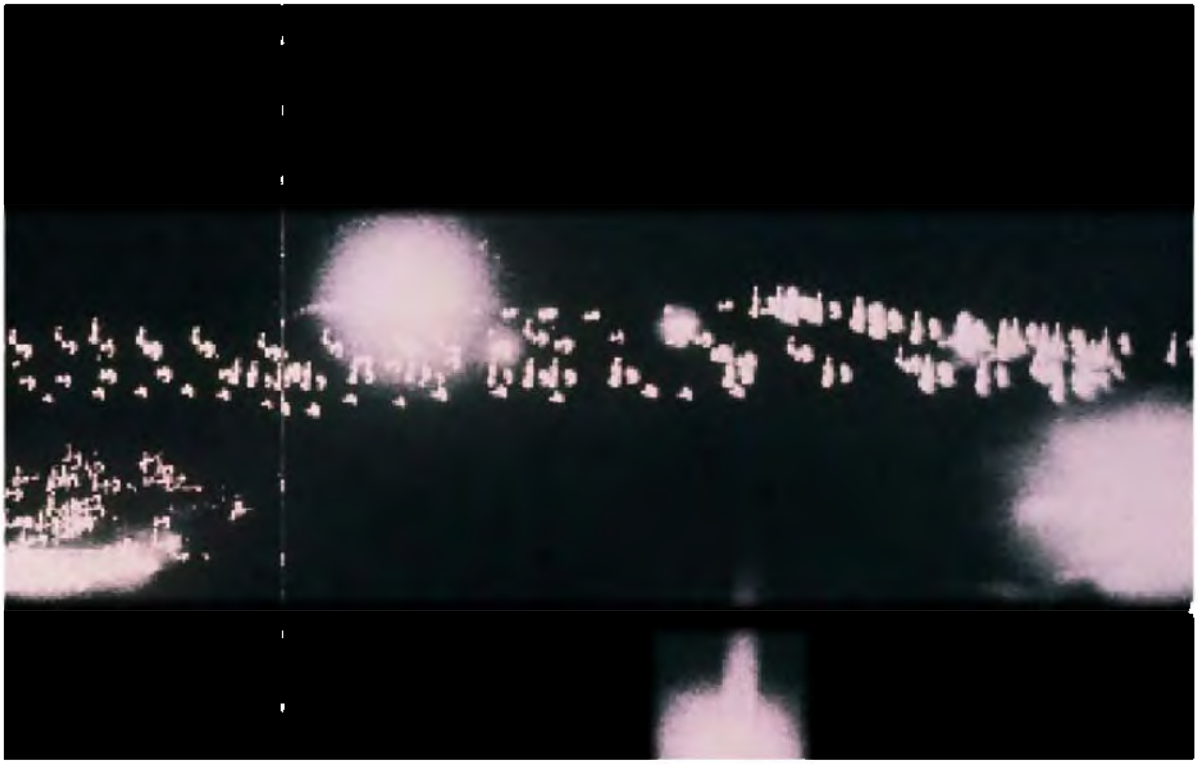
For his 1971 polytope set in the ruins of Persepolis, Iran, Xenakis brought together artistic impulses somewhat at variance with his profile as a cerebral technocrat. He had begun to plumb the wellspring of ancient Greece, as with his 1966 setting of Aeschylus's *Oresteia*, its transformational finale scored for children's choir. That, along with a theatrical dimension, fused together in a multimedia work staged in the dark of night, the audience seated in the Temple of Darius [PL. 32]. Its finale involved 150 torch-bearing children climbing a hill toward a summit, descending in configurations spelling out, in Persian, "We bear the light of the earth." It premiered what some consider Xenakis's most powerful electro-acoustic piece, the eight-track, fifty-six minute *Persepolis*.

Still another outdoor spectacle, the artist's largest, set in ancient Mycenae in the Peloponnese, was a kind of homecoming. By the 1970s, Xenakis, the one-time embattled outsider, living in exile in Paris, had become a kind of cult hero. However, in his native Greece he remained under a death sentence, unable even to visit. With the 1974 Cyprus War, the right-wing nationalist government of the "generals," who

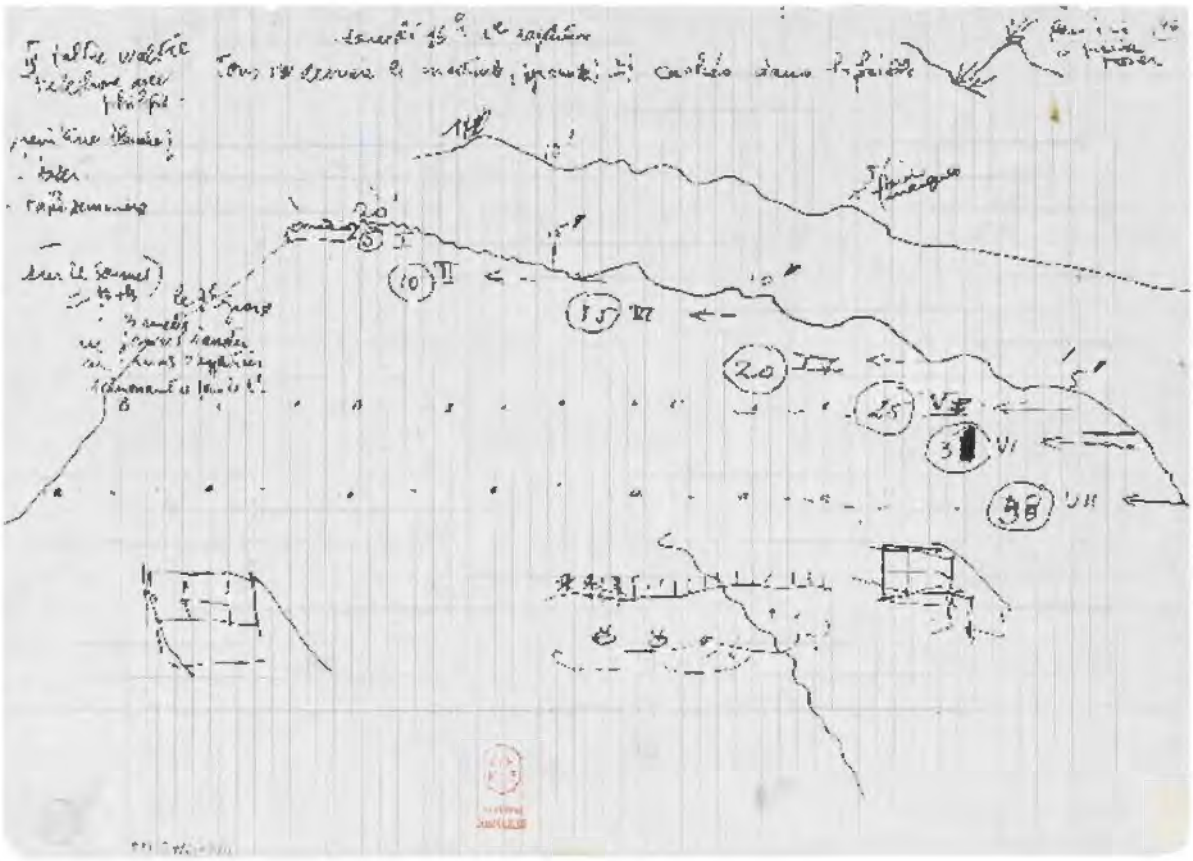
PL. 30
Polytope de Cluny, 1972–73



PL. 31
Polytope de Cluny (laser light show), 1972–73



PL. 32
Polytope de Persepolis, 1971



PL. 33
Study for *Polytope de Persepolis* (site plan of performance), c. 1971

had been in control for the previous decade, collapsed. His return to Athens was steeped in emotion. As his friend Maurice Fleuret wrote in the *Nouvel Observateur*, Xenakis was surprised to find that many knew his name and became tearful upon seeing him, crossing the street to shake his hand. Movingly, "an elderly lady traced her path through the crowds, touching ever so gently Xenakis's tragic scar, as though she were caressing an icon."[20]

The *Polytope de Mycènes* (1978) was staged at the foot of Mt. Elias on four successive evenings [PLS. 34–37]. Like *Persepolis*, it had a mythic component, bur it was even more elaborare, involving searchlights and torch-bearing children; herds of belled, light-bedecked goats suddenly let loose; projections on the walls of the ruined citadel; readings ftom Homet, and performances of several Xenakis wotks drawn from ancient Greek texts, intoned in archaic dialects. At the dramatic conclusion came a fireworks display, a gush of flame along the citadel, and the children's-chorus finale from his *Oresteïa*.

A centerpiece was the ten-minute *Mycènes Alpha*, Xenakis's first full-scale composition using the UPIC, a digitized "musical drawing board" with stylus that he invented [PL. 64]. It is able to translate drawn shapes directly into electronically generated sound. According to Harley, "the rich, harsh sonorities of Xenakis's piece matched the savage magic of the landscape."[21]

During the 1970s, Xenakis's vision for his polytopes grew increasingly global. He imagined intercontinental sound-and-light events communicating via radio beams reflected ftom satellites.[22] In 1974, the French government commissioned him to create an on-site spectacle to coincide with the opening of the Centre Pompidou in Paris. His more sweeping technological conceptions were scaled down into a *Diatope*, an architectural ftamework (portable) some fifty-feet high, composed of steel cables covered by red vinyl, and shaped into three of his signature hyperbolic paraboloids [PL. 38]. The interior had a glass-tile floor

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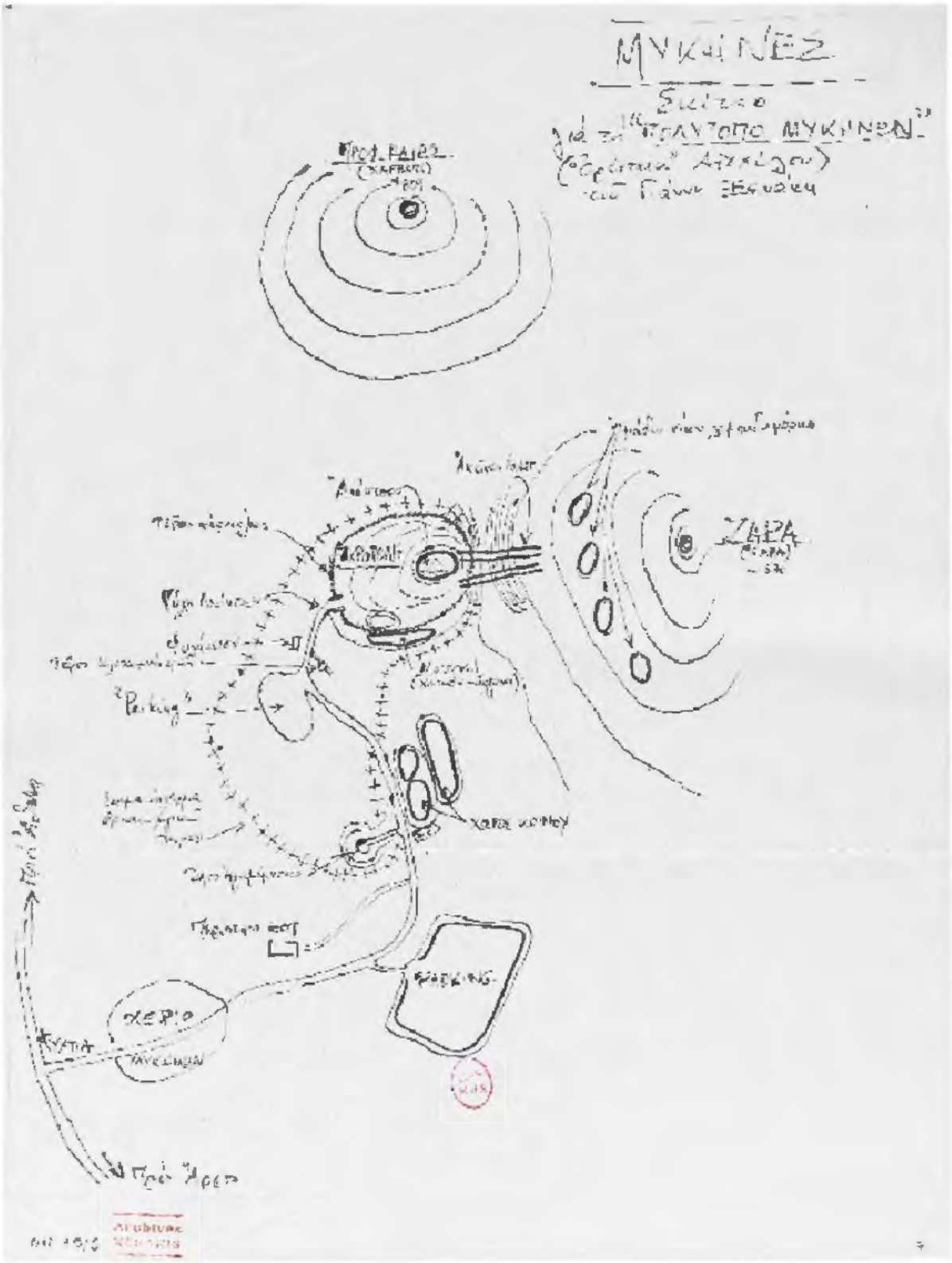
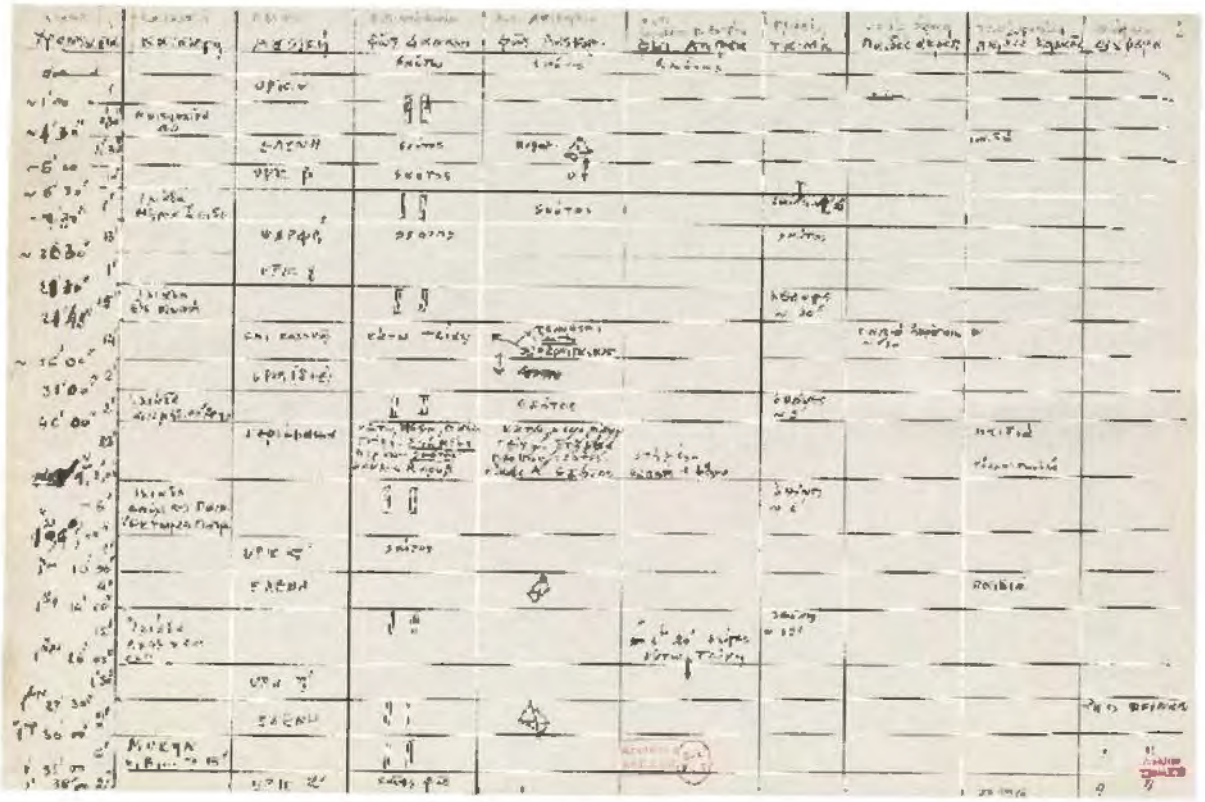
20. Maurice Fleuret, "Le Métèque du Monde Entière," *Nouvel Observateur*, no. 524 (November 25, 1974).
21. Harley, *Xenakis: His Life in Music*, 117.
22. Kanach, "Xenakis' Diatope," in Xenakis, *Music and Architecture*, 247 n.4.



PL. 34
Study for *Polytope de Mycènes* (site plan of performance), c. 1978

PL. 35
Polytope de Mycenes, 1978

PL. 36
Study for *Polytope de Mycènes*, c. 1978



PL. 37
Study for *Polytope de Mycènes* (performance matrix), c. 1978

PL. 38
Diatope, 1978

lit from below. Employing four laser projectors, 400 pivoting mirrors and prisms, and 1,680 flash-style bulbs, he created "galactic movement rendered accessible"[23] [PL. 39]. By the time of the polytope's July 1978 premiere, computer technology had evolved to the point where the 140 million commands necessary could be completely digitized. The seven-track tape work, the forty-seven-minute *La Légende d'Er*, begins with extremely high-pitched sounds the composer termed "sonic shooting stars," gradually descending in register. (The title is taken from a tale at the end of Plato's *Republic*, describing the soldier Er's return from the underworld; it treats themes of death and rebirth.)

OTHER ARCHITECTURAL PROJECTS

In 1964, while a Fellow of the Ford Foundation in Berlin, Xenakis accepted an invitation to contribute to Françoise Choay's book *L'Urbanisme: Utopies et Réalité*. When he had first flown over Manhattan's skyscrapers, their scale had both repelled and attracted him. With this impression in mind, he conceived his Cosmic City—slender, three-mile-high arching towers piercing through the clouds, accommodating five million inhabitants each. They would replace civilization's tendency to expand outward with an upward thrust, "putting the populations in contact with the vast space of the sky and stars."[24] Reminiscent of, but in many ways opposing, Le Corbusier's right-angled, automobile-based urban planning initiatives, the towers, curving inward in the form of revolving hyperboloids, would be ecologically sensitive. For example, their outer shells would be translucent to allow natural light to enter. The towers could be stationed in any area on earth, "a biological collective garment."[25] Xenakis not only sketched the overall concept, he planned actual structural design details, such as the buildings' double walls on a metal framework.

In the early 1960s, Xenakis had begun speculating about a "new kind of architecture," more flexible and dynamic, for "all types of present-day music."[26] Invited in 1983 to sit on a jury charged with

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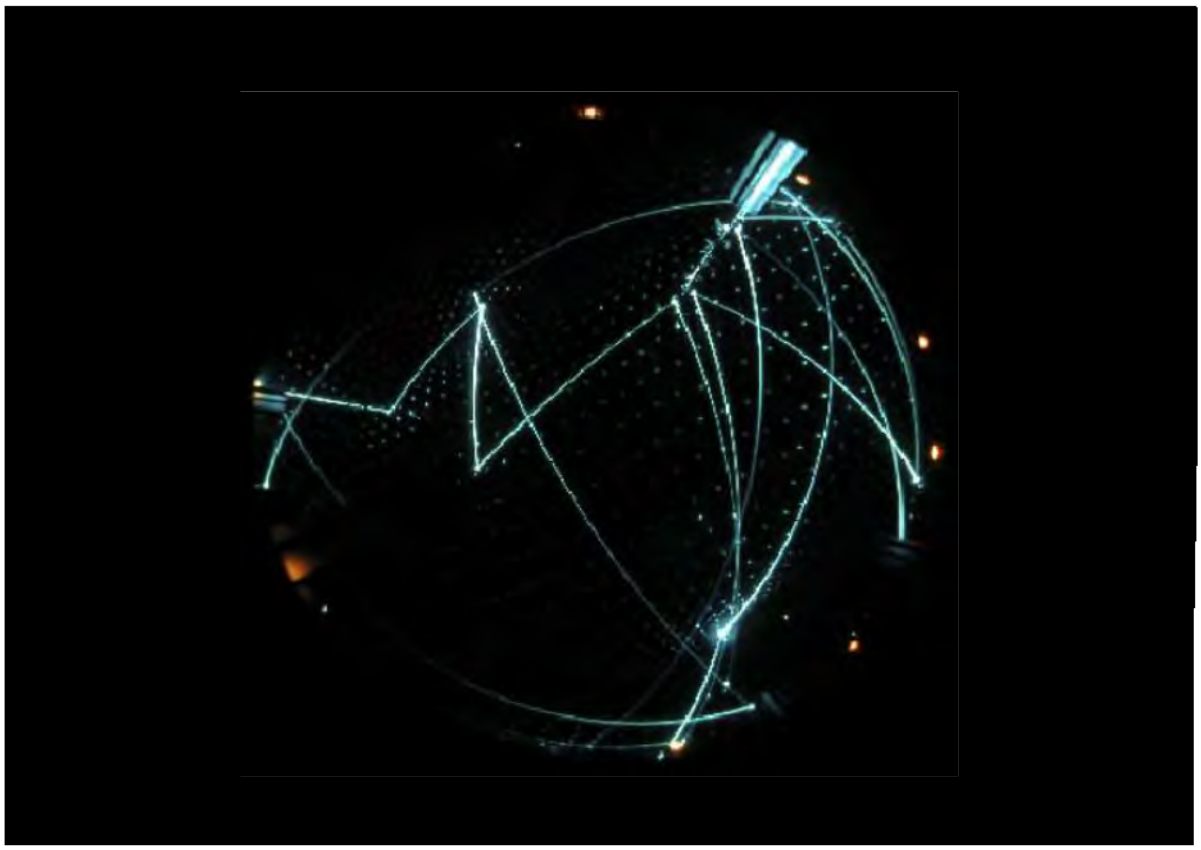
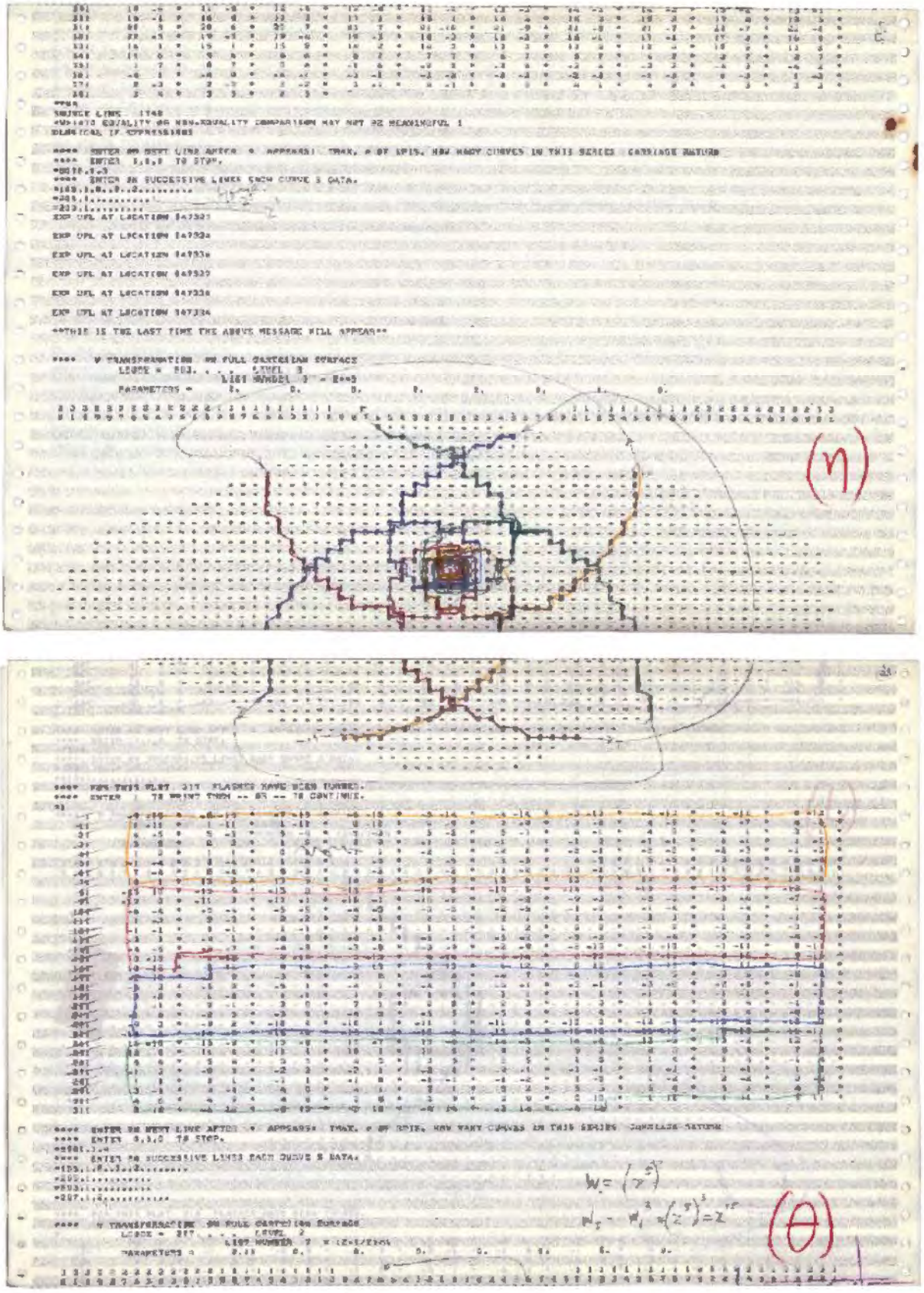
23 Xenakis, *Music and Architecture*, xix.
24 Ibid., 139.
25 Ibid.
26 Xenakis, *Formalized Music*, 236.



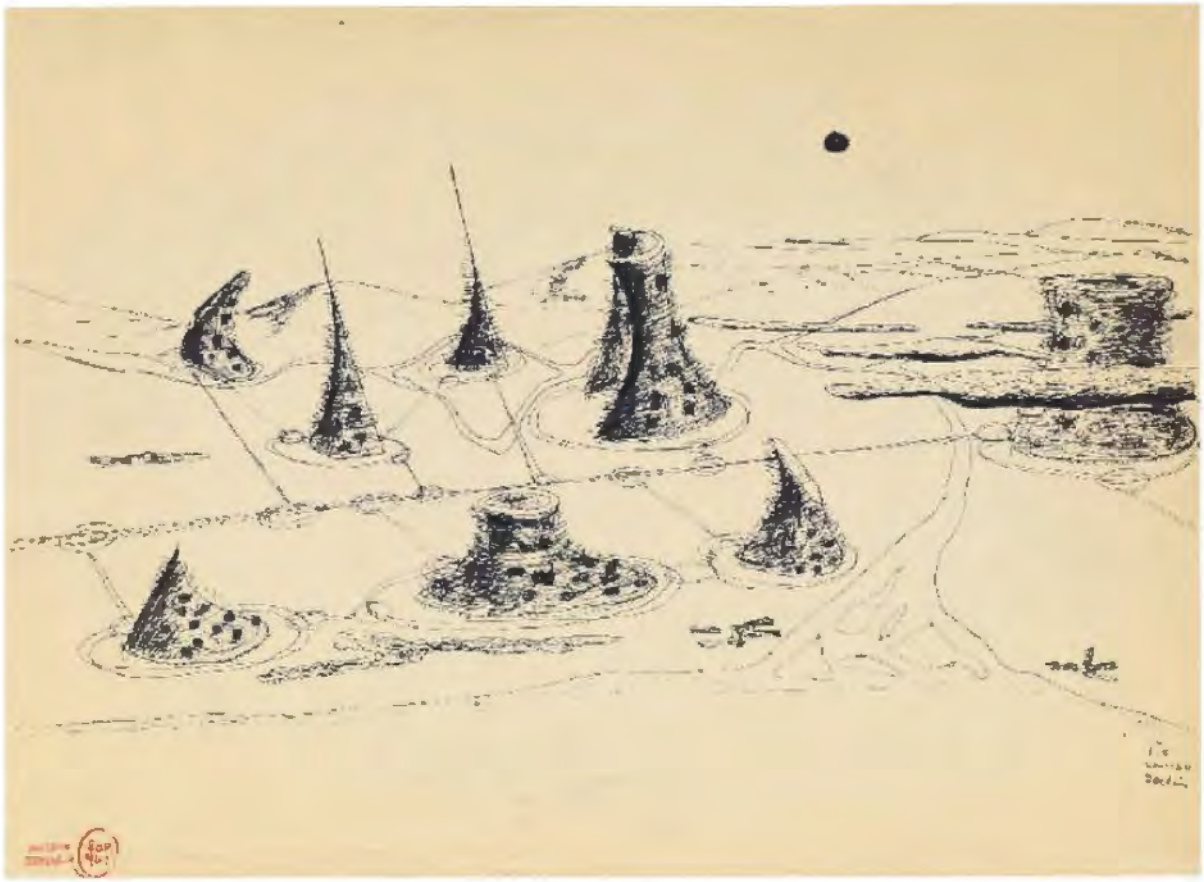
PL. 39
Duotope (laser lights), c. 1978



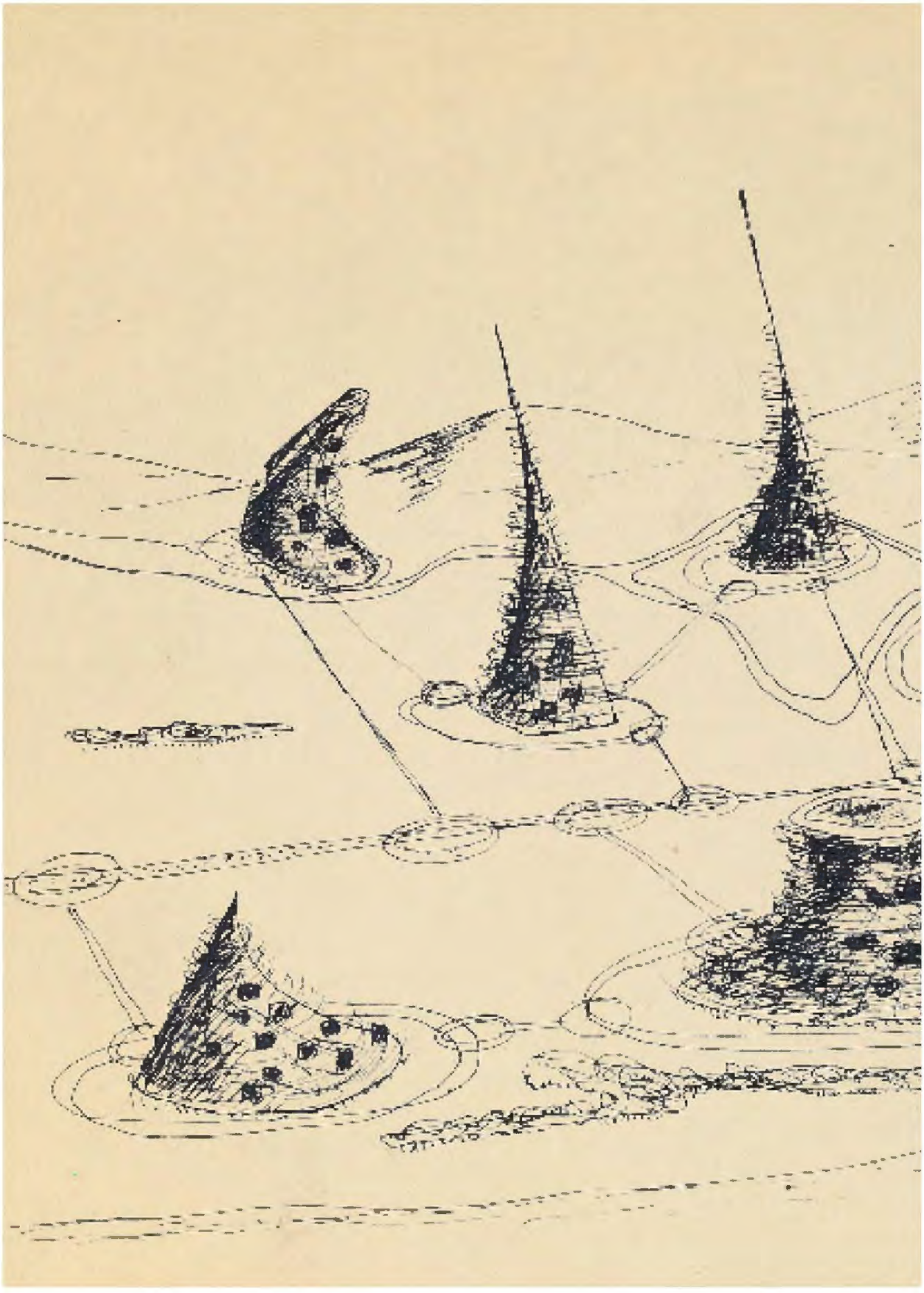
PL. 40
Diatope (light score), 1978

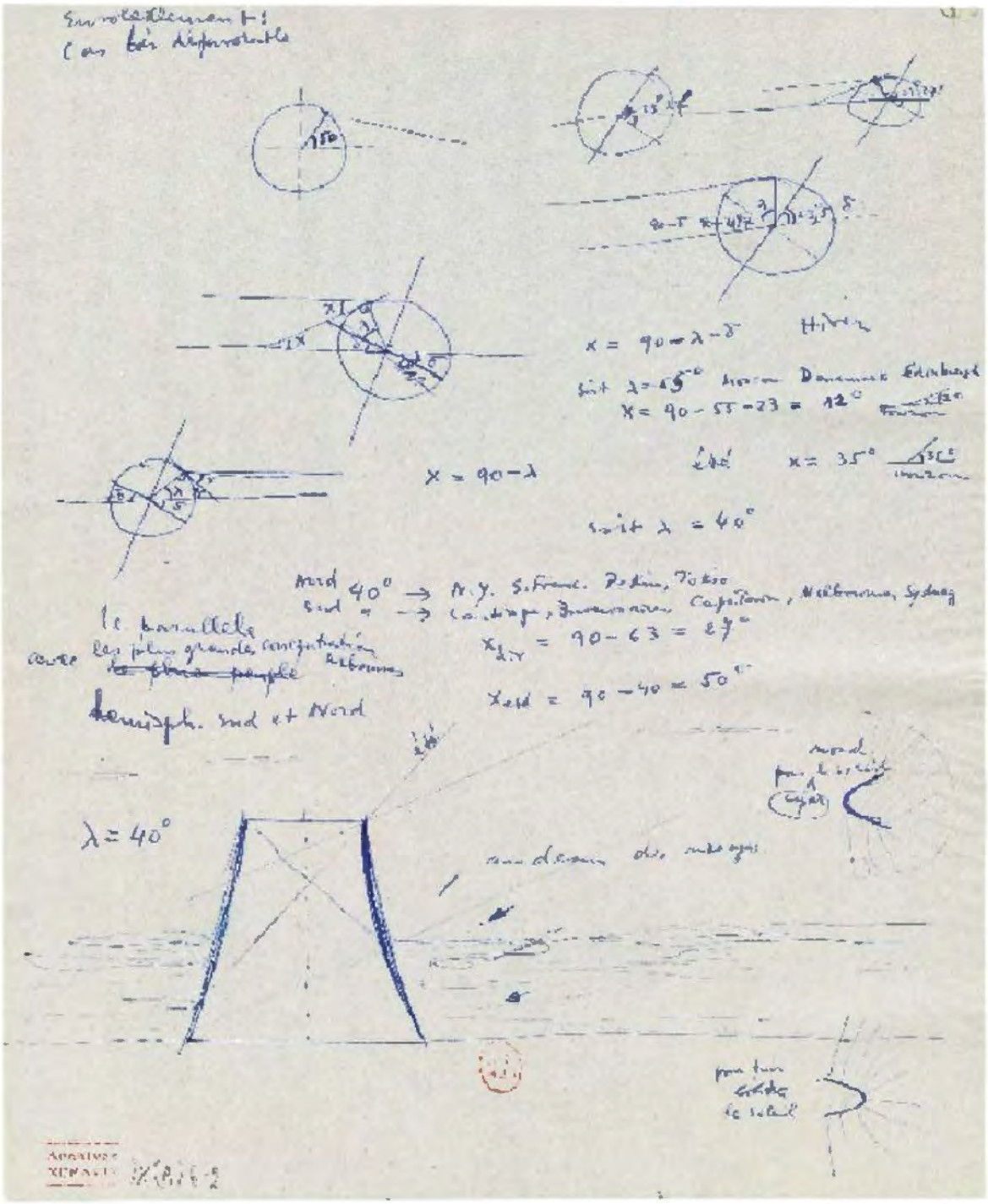
selecting a design for a New National Music Conservatory in the Parc de la Villette in Paris, he chose to submit a plan himself, teaming up with Jean-Louis Véret, a credentialed architect, his colleague from Le Corbusier days. His 1,200-person-capacity "experimental auditorium," a "jewel box of sound," brought together insights developed throughout his career. A quasi-ovoid, asymmetrical "potato-shaped" floor plan would maximize resonance; an eleven-degree torsion would ensure visual interest; the floor would be composed of one-meter-square cube surfaces overall that could be raised or lowered pneumatically up to twenty feet in height, permitting a limitless range of staging configurations; a sound booth would be moveable on tracks overhead [PLS. 44–47]. In the end, though, his Cité de la Musique, whose external concrete shell would have been topped by Xenakis's signature vaulting hyperbolic paraboloids, was not accepted.

Through the 1980s and 1990s, Xenakis continued to craft musical works, each of which continued to map out new territory with exhilarating rigor. Singular, in many ways, he is also without equal. One of his most brilliant insights was that it is by going to the very physical foundations of artistic phenomena—and their basis in physics—that one can find viable ways to move forward. His sketches, drawings, and musical scores, although never intended as "art," occupy a unique place in the history of drawing. Featuring vibrant forms projecting into space within drawing's two dimensions, they are the way he imaged *sound*.

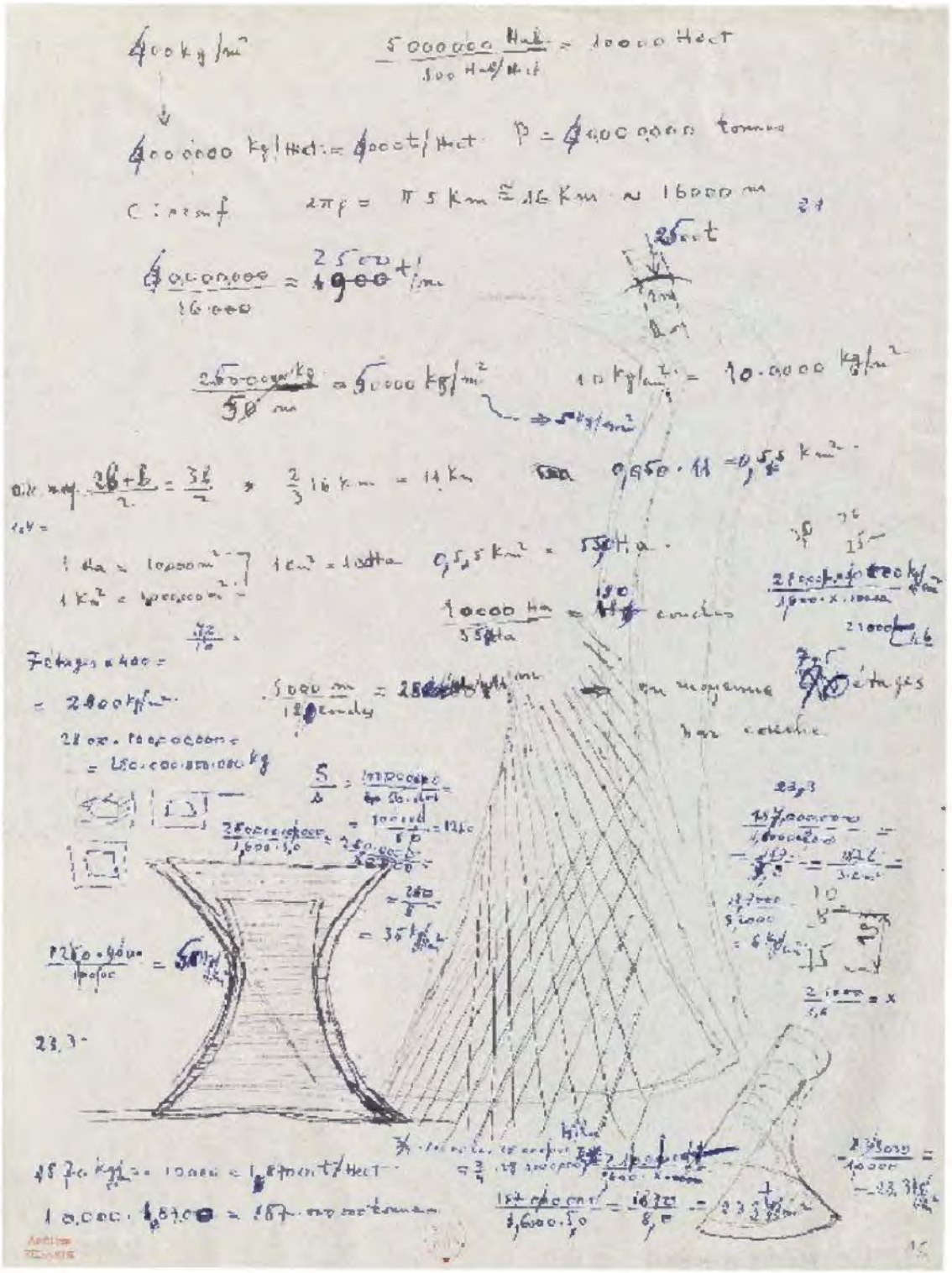


PL. 41
Cosmic City (aerial perspective), 1963

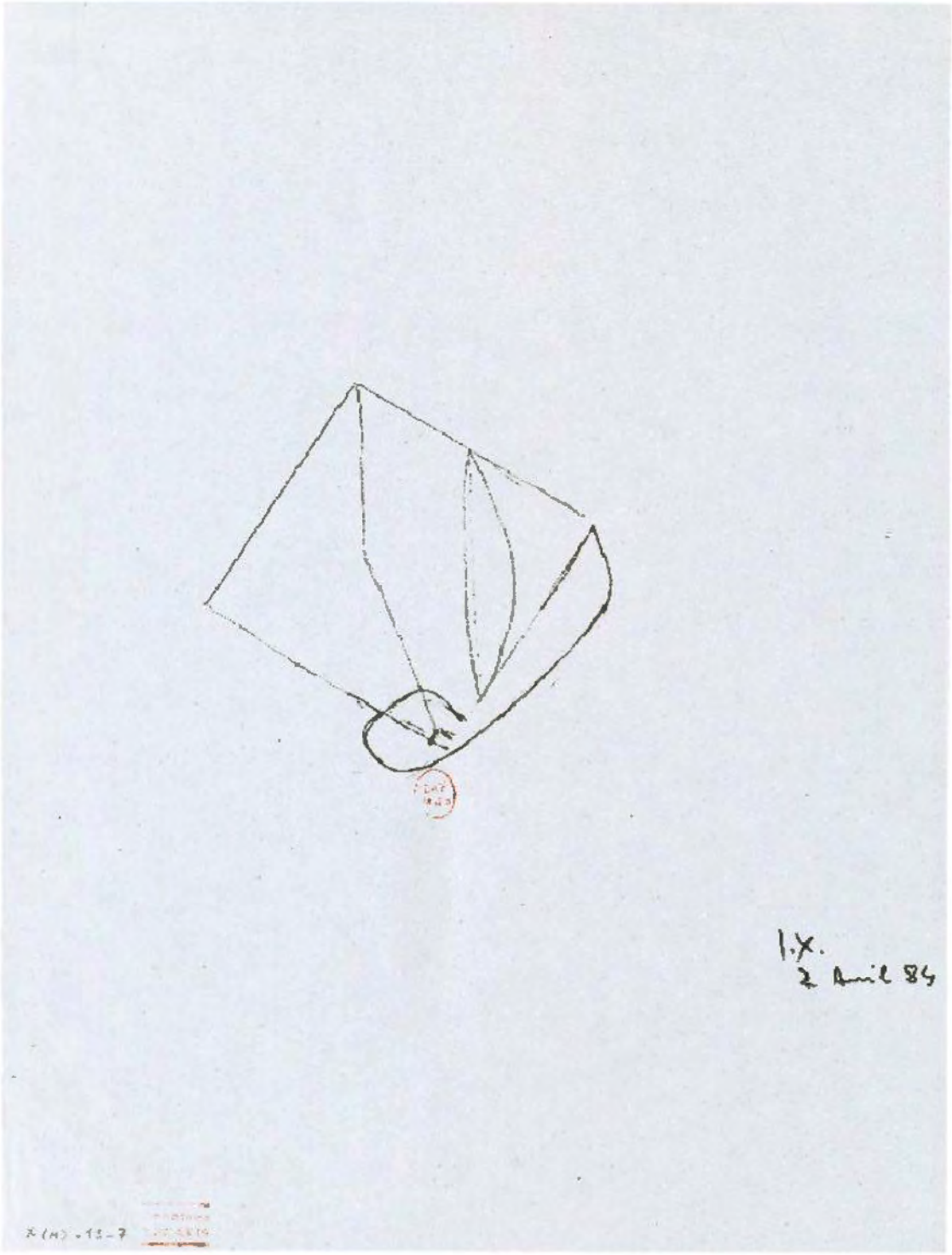




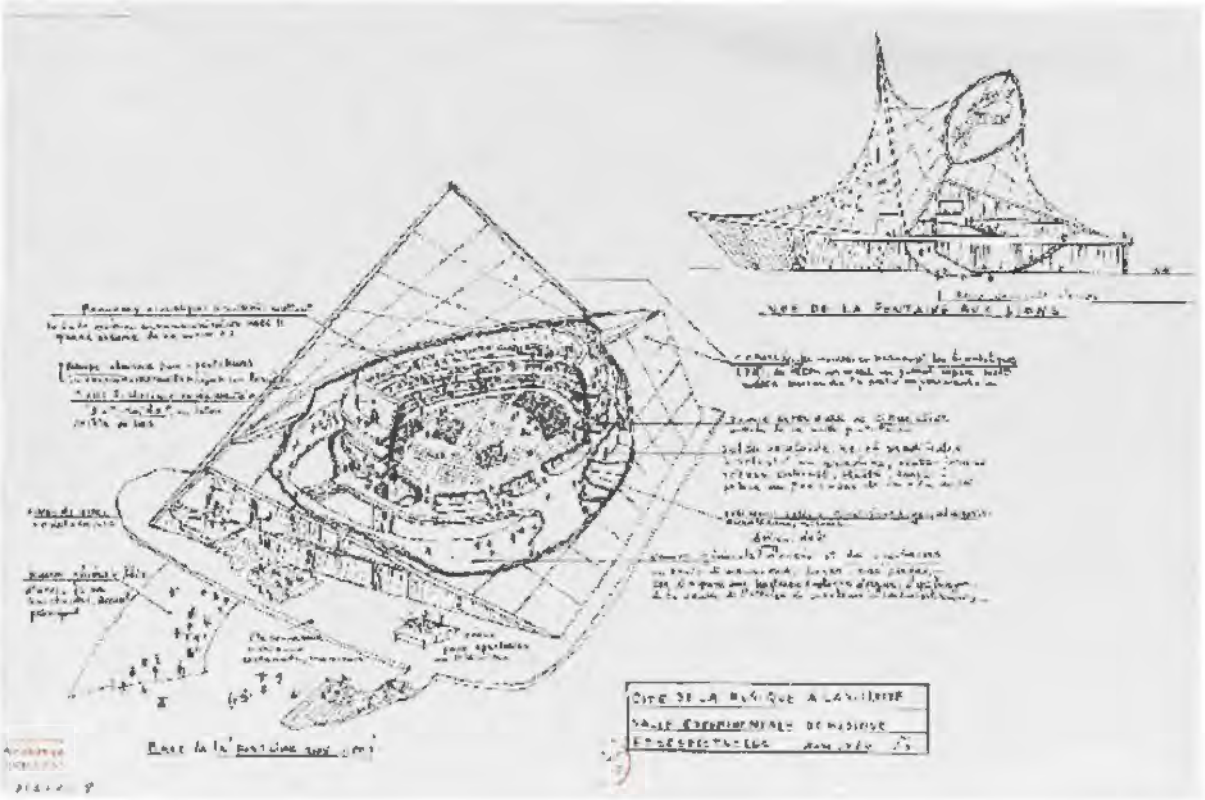
PL. 42
Study for Cosmic City, c. 1963



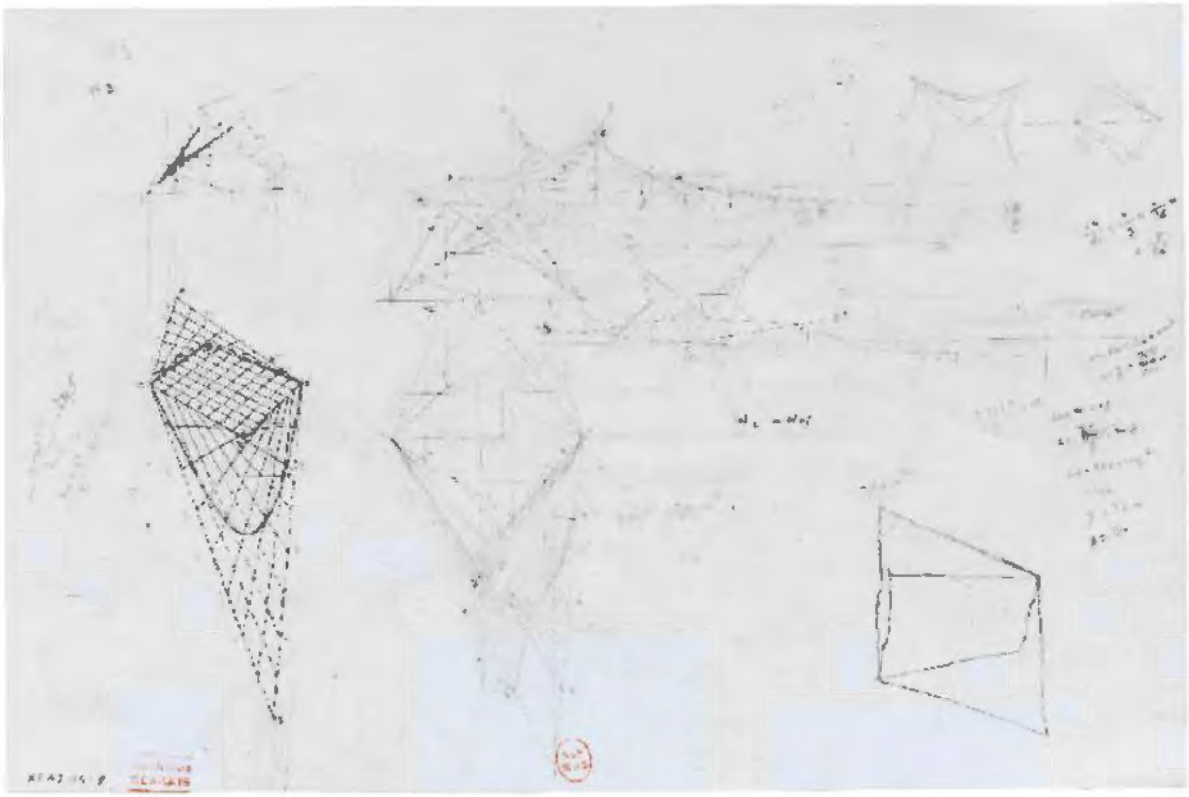
PL. 43
Study for Cosmic City, c. 1963



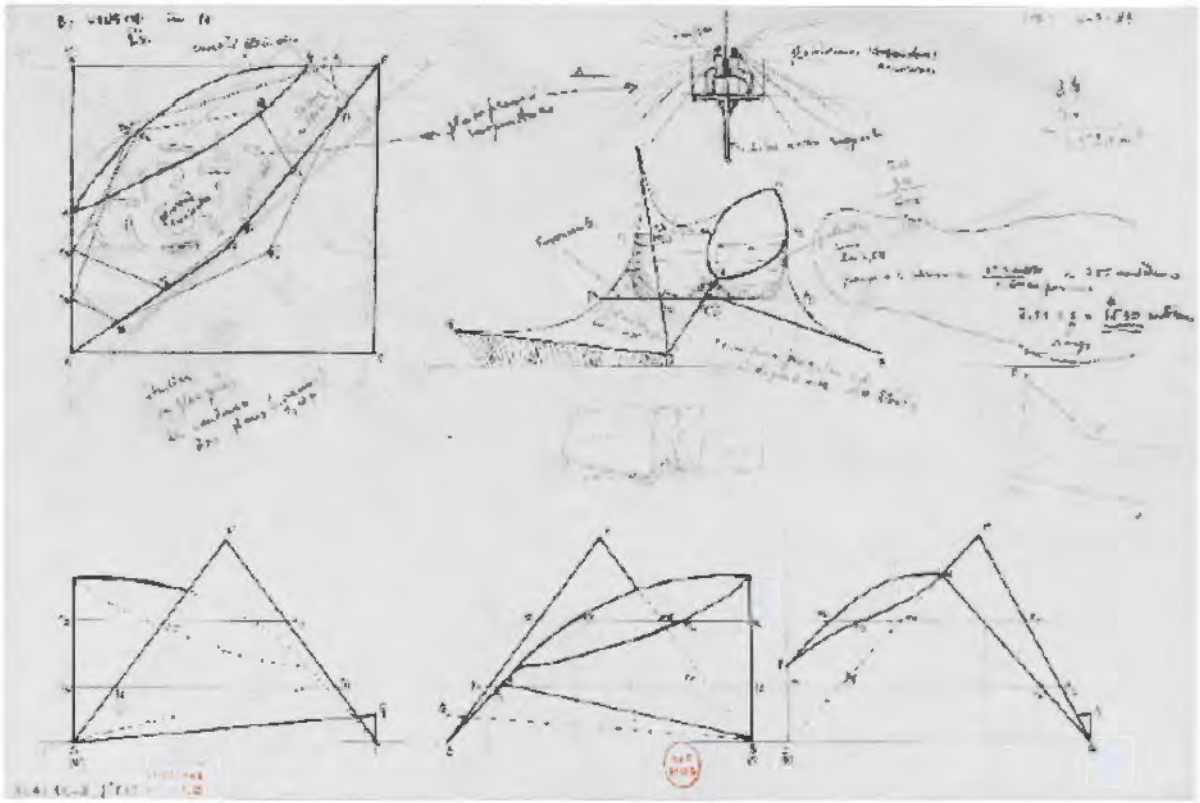
PL. 44
Study for Cité de la Musique, 1984



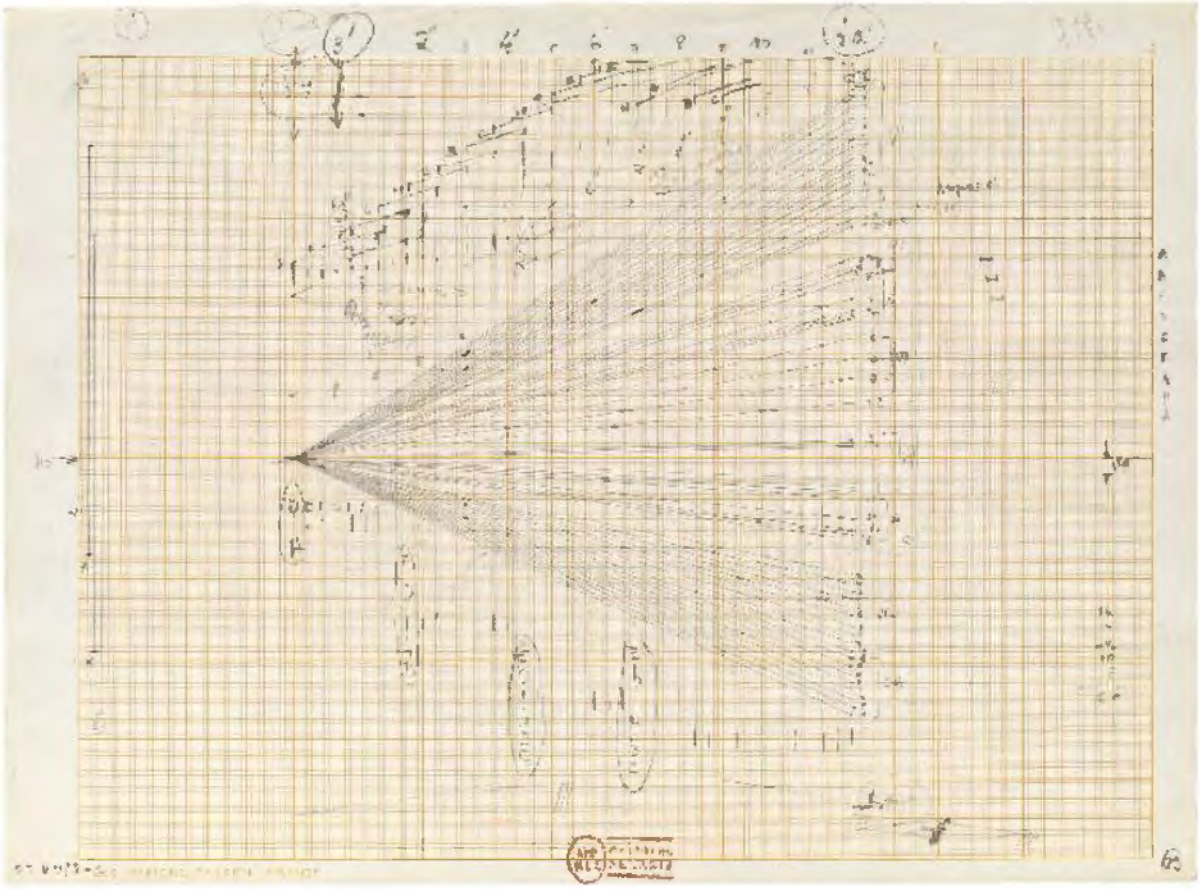
PL. 45
Cité de la Musique (aerial perspective and elevation), 1984



PL. 46
Studies for Cité de la Musique, c. 1984



PL. 47
Studies for Cité de la Musique, c. 1984



PL. 48
Study for *Terretektorh* (glissandi), c. 1965–66

Music to be seen: Tracing Xenakis's Creative Processes

Sharon Kanach

In reality, an artist is a theoretician, a manipulator and creator of forms in movement. Seen from the point of view of art, all our knowledge and our actions are but aesthetic expressions of forms and their transformations.

- IANNIS XENAKIS[1]

Iannis Xenakis (1922–2001) holds a unique position in the recent history of twentieth-century art due to the fact that, before becoming one of the most important composers of his generation,[2] he was trained as an engineer and belatedly recognized as a pioneering architect.[3] His formal education and empirical practice in Le Corbusier's studio for twelve years (1947–59)—both coupled with his natural talent—made Xenakis a remarkable draughtsman, to the point that he maintained a certain edge over his composer colleagues thanks to the fact that he could draw.

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1 This epigraph, as well as the phrase, "music to be seen," are drawn from an article Xenakis published on his *Diatope* (1978): "Problèmes capitaux en composition musicale et l'aide des ordinateurs," in the proceedings of *Conférences des journées d'études, Festival international son et image vidéo* (Paris: Société pour la Diffusion des Sciences et des Lettres, 1982), reprinted in Iannis Xenakis, *Music and Architecture*, comp., trans. and ed. Sharon Kanach (Hillsdale: Pendragon Press, 2008), 266–271.

2 Other composers of Xenakis's generation include the Europeans Pierre Boulez (French, 1925–), Karlheinz Stockhausen (German, 1928–2007), György Ligeti (Hugnarian/Austrian 1923–2006), Luigi Nono (Italian, 1924–90), and Luciano Berio (Italian 1925–2003), and their American counterparts, Earl Brown (1926–2002), Morton Feldman (1926–87), Lukas Foss (1922–2009), and George Crumb (1929–).

3 Xenakis graduated from the Athens Polytechnic in 1947. On Xenakis's architectural career, see Xenakis, *Music and Architecture*.

> In retrospect, I think it was more natural for me to draw. Sometimes, I would draw and my drawings represented musical symbols. I knew traditional solfège, but a certain freedom of thought could not occur that way. I was convinced that one could invent another way of writing music. I started imagining sound phenomena with the help of drawings [...][4]

And elsewhere, Xenakis states:

> Graphics are indispensable; there are things that can be more easily manipulated through drawing. I acquired this experience during the twelve years I dealt with architecture with Le Corbusier.[5]

Traditionally, composers are trained to consider music from a micro- to macro-perspective, true to their etymological root, *componere*: to put together, ultimately at the expense of an immediate grasp of the overall form.

> In music, pupils are generally taught that they should start out from a cell (a theme or basic row) and create out of it the 'building' of the composition. However, the form is missing! Form has to be considered unto itself—not only the form that comes about as a result of development but also the one that affects the details of the work—its cells. And, of course, we also have to be aware of the fact that the cells can affect the form. We work with such synthetic methods in architecture and the same approach ought also to be used in music.[6]

Also, although some composers have become elegant music autographers, not many know how to draw or ever revert to abstract drawing as part of their creative process. Xenakis's preparatory sketches for his architectural projects as well as his musical works bear witness to his constant preoccupation with the overall form. In the same manner that a blueprint enables the eye to capture the layout of any surface at a glance, Xenakis's graphic renderings of a musical work allowed him to judge its global form in an instant, using a similar, plastic, and aesthetic approach.

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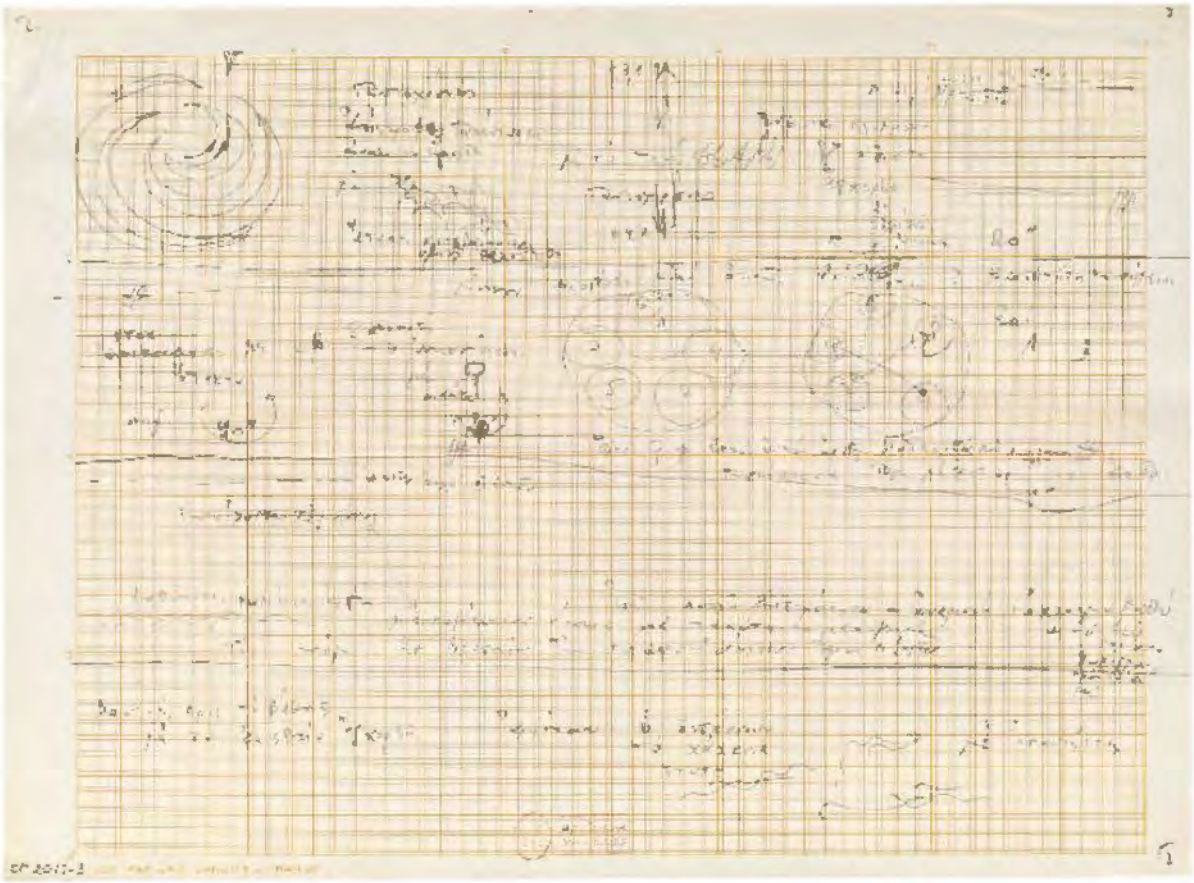
4 Interview with Anne Rey and Pascal Dusapin, "Si Dieu existait, il serait bricoleur," *Le Monde de la musique*, no. 11 (1979). Unless otherwise noted, all translations from French sources are the author's own.

5 Interview with Claire Rémy, "Sons, probabilités, graphismes," *Micro-systèmes* (June 1986).

6 Balint Andras Varga, *Conversations with Xenakis* (London: Faber & Faber, 1996), 127.



PL. 49
Study for *Terretektorh*, c. 1965–66

Not only did Xenakis's compositional approach differ from that of his colleagues, he also uncharacteristically drew his inspiration from abstract structures *outside* the musical realm. His own identity as a composer was based on the premise that his main contribution to the development of music was the engagement of new areas of thought.[3] He not only propounded that music is the expression of intelligence, he went so far as to claim that every work of his put forth a new philosophical question. Yet none of this left him indifferent to the natural world and its phenomena; on the contrary, he delighted in observing the constellations, marveled at the enigma of hidden planets, and pondered whether the age spots appearing on his hand were some visible trace of his own DNA. For Xenakis, neither philosophical interrogations nor abstract forms belonged exclusively to either the scientific or artistic realm or even to one specific science or one specific art; both were an integral part of the act of creation. What was applicable in architecture could perhaps be applicable to music; Brownian movement may be found in molecular biology and also create interesting music. But it was his music that provided the link between his metaphysical inquiries and the sciences and mathematics he employed to further his knowledge.

> As I see it, music is a domain where the most profound questions of philosophy, thought, behavior, and the theory of the universe ought to pose themselves to the composer. The role of the musician must be this fundamental research: to find answers to phenomena we don't understand, and to enlarge our powers of conception and action. So it is a perpetual exploration.[4]

By no means did Xenakis consider such inquiry a uniquely personal quest. On the contrary, he, the author of titles such as *Arts/Sciences: Alloys* and *Formalized Music*, made repeated pleas to revise the education and training of young artists and musicians. This was the prerequisite to a truly protean and a multi-disciplinary approach:

> It seems that a new type of musician is necessary, an "artist-conceptor" of new, abstract, and free forms, tending towards complexities, and then towards generalizations

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3 Ibid., 79.

4 Henning Lohner, "Interview with Iannis Xenakis," *Computer Music Journal* 10, no. 3 (Winter 1986), 54.

> on several levels of sound organization. [...] The artist-conceptor would have to be knowledgeable in such varied domains as mathematics, logic, physics, chemistry, biology, genetics, paleontology (for the evolution of forms), the humanities and history; in short, a sort of universality, but one based upon, guided by and oriented toward forms and architectures.[9]

In addition to such challenging demands he made on classically trained musicians to think "outside the box," Xenakis also argued for the elevation of instinctive or intuitive impulses to be followed, not on a naïve basis, but rather as raw material for compositional pursuit, through *rationalization*.

> Most of our intuitive ideas can't be analyzed. If, however, you can stand back and observe them, so that you can decide which one is of interest, which one possesses any originality, freedom comes within reach. Let's say that consciousness is rational and intuition is something that lies underneath.[10]

Graphic, non-musical representation offered Xenakis the immediacy of being able to visually observe his own creative process, thereby rendering analyzable that which "lies underneath," creating the necessary distance between creator and what is being created. It enabled him to achieve a level of objectivity: of "standing back" before taking the leap into new creative freedom. His eye, as well as his inner ear, thus measured his constant quest for both originality and universality in the arts. In this sense, Xenakis's own experience confirmed that "the hand is the organ of the body that is closest to the brain."[11] Xenakis's *music to be seen*, the architecture behind his sound, demonstrates how, through such processes of objectivity, Xenakis ultimately discovers his own compositional "voice."

In Xenakis's archives, we find traces of the path of his own creativity's processes, his "paper footprints," via various symbols—graphical, mathematical, philosophical musings (words), or any combination of the above. It was as though he thought with pen in hand the way

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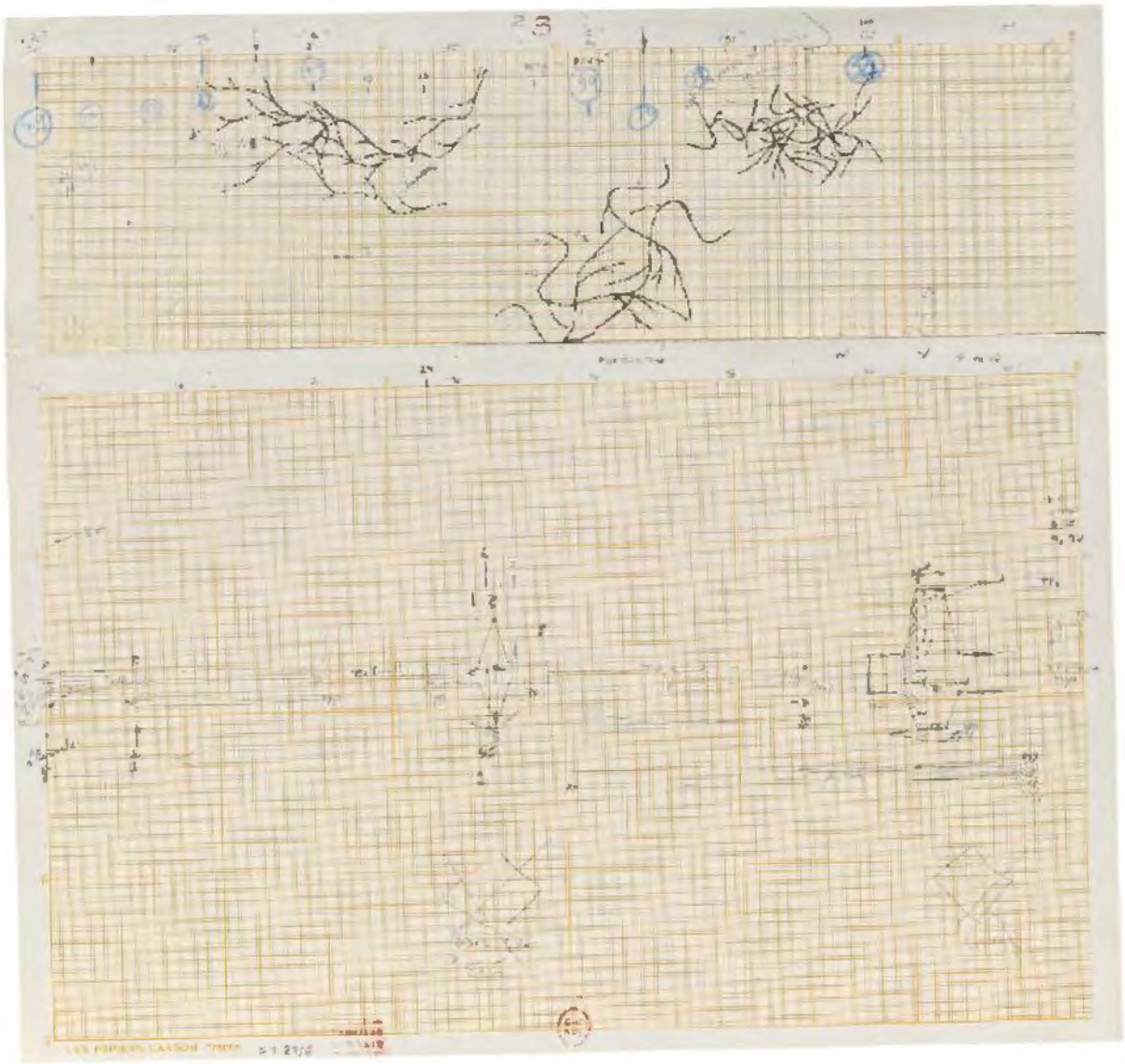
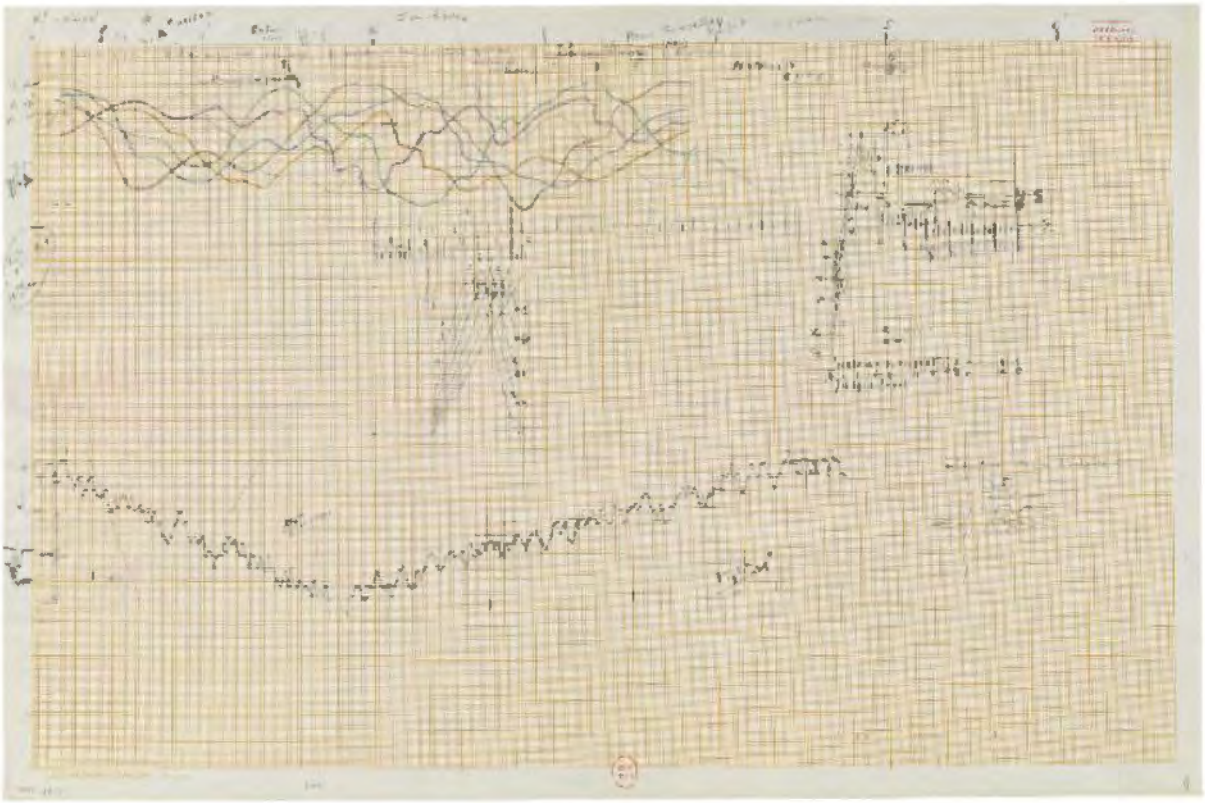
9 Iannis Xenakis, *Arts/Sciences: Alloys*, trans. Sharon Kanach (New York: Pendragon Press, 1985), 3.

10 Varga, *Conversations with Xenakis*, 200–201. See also Iannis Xenakis, *Formalized Music* (Hillsdale: Pendragon Press, 1992), 22.

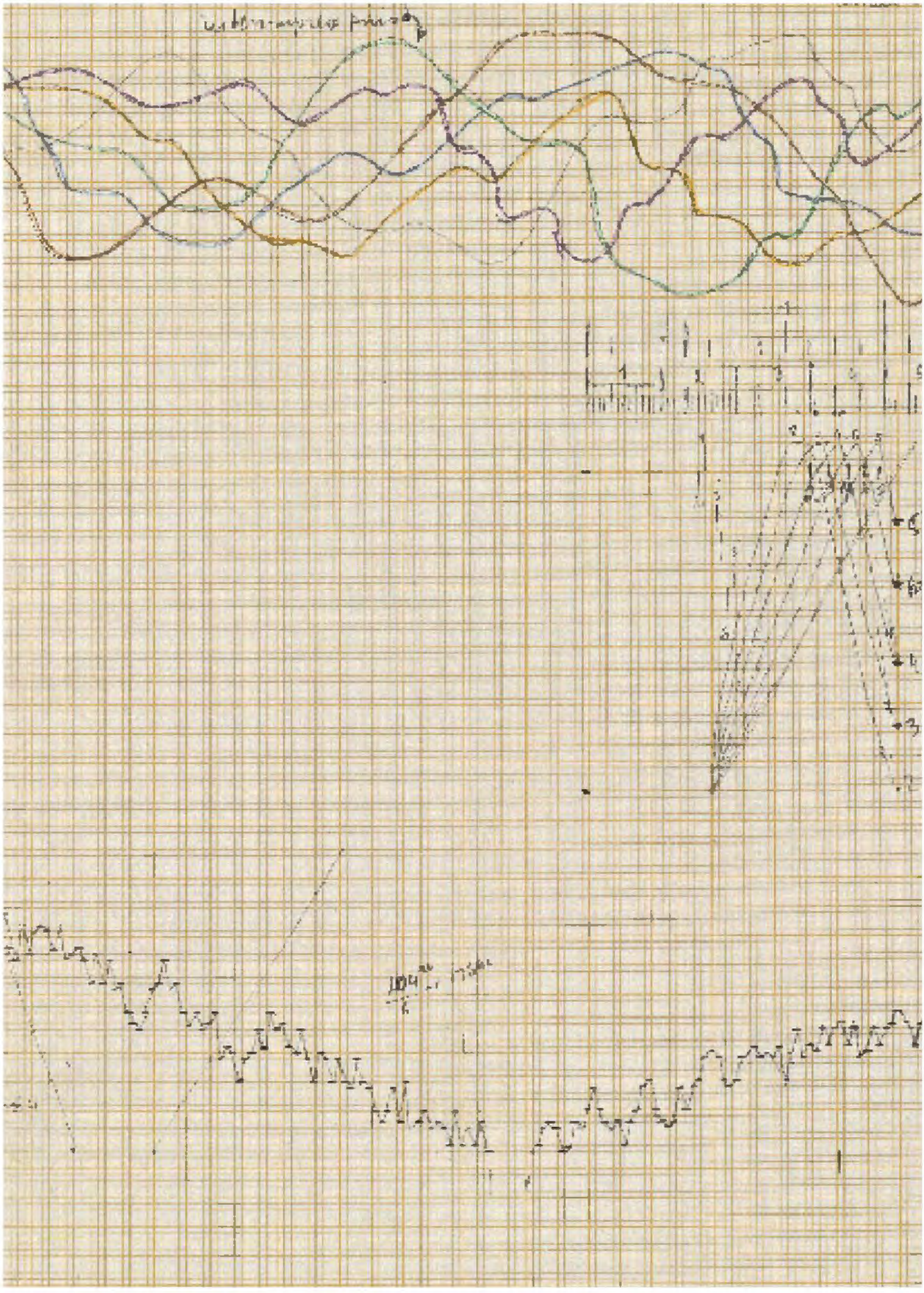
11 Lohner, "Interview with Iannis Xenakis," 51.

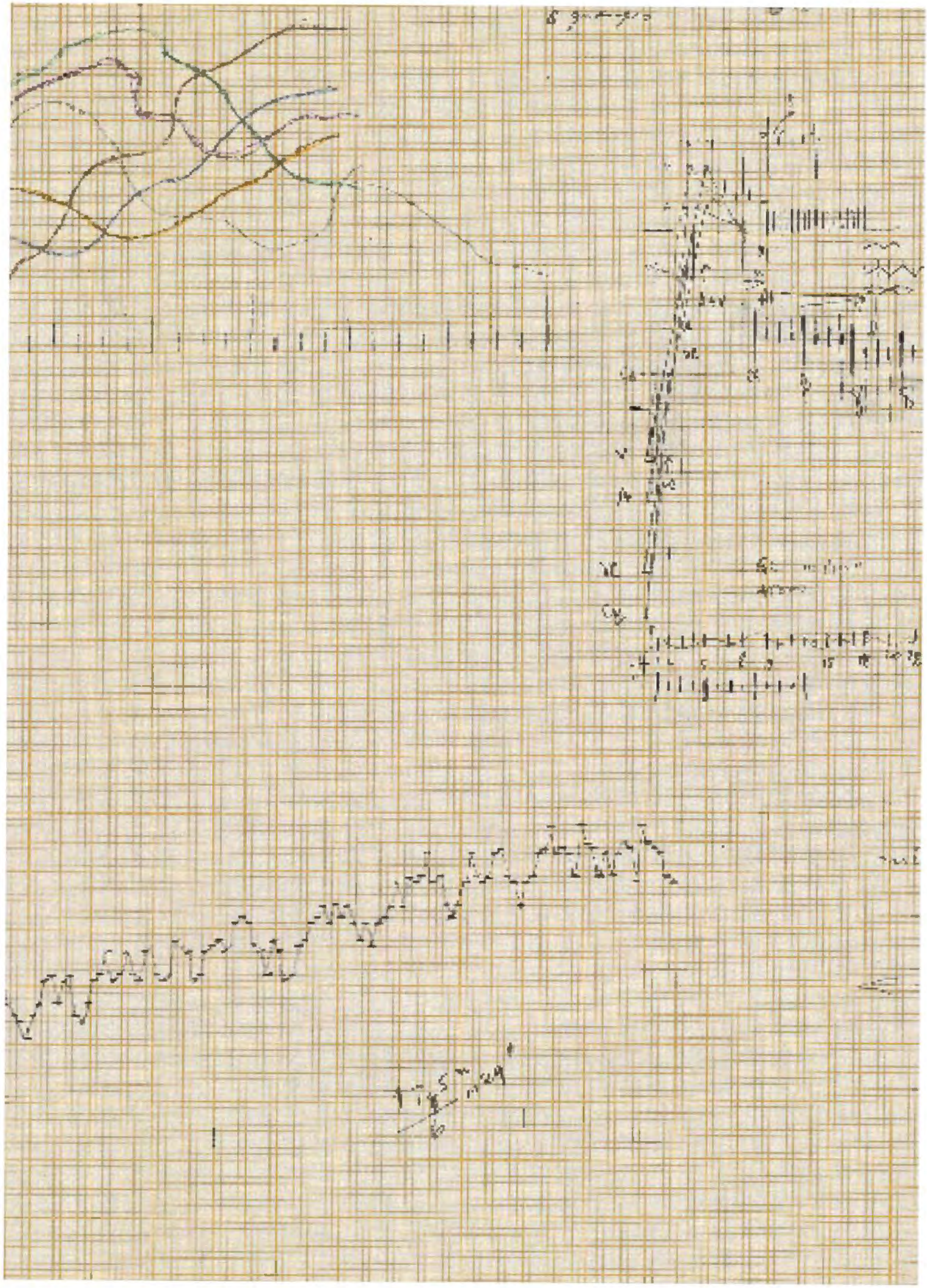


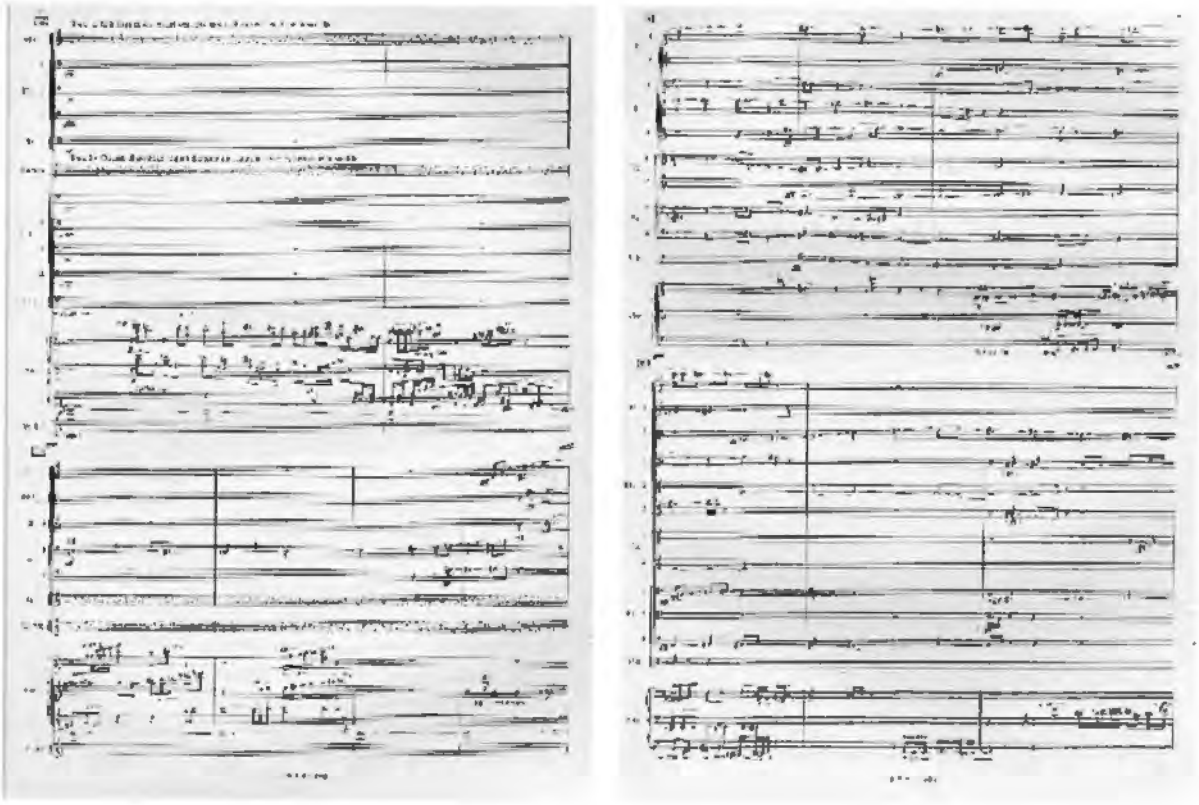
PL. 50
Study for *Erikhthon*, c. 1973



PL. 51
Study for *Jonchaies*, c. 1977







PL. 52
Erikhthon (pages from orchestral score), 1974

others think out loud while developing ideas.[12] Such sketches ultimately were transcribed by him into traditional music notation. This too distinguished Xenakis from his musical contemporaries and those beyond. In the 1950s, several composers, mainly in America and highly influenced by Abstract Expressionism, such as Morton Feldman (in *Projections*, 1951) and Earle Brown (with *Folio and 4 Systems*, 1954), started using non-conventional graphics (sometimes with written instructions) as final "scores," merely suggesting to performers what they *could* perform, without recourse to traditional music notation. Xenakis was opposed to such practices, arguing that the rights to any such performances be duly reverted, at least partially, to the performers, who, in essence, "author" them more or less freely. He openly deplored these pure "'graphists', who exalt the graphic symbol above the sound of the music and make a kind of fetish of it."[13] Xenakis always established a final manuscript score, readable—and universally performable—by other musicians, indicating what *must* be played.[14]

The new trend of graphic scores coincided with the advent of aleatoric music, heralded first by John Cage (1912–92). His *Music of Changes* (1951) was the first work composed entirely of chance operations, and here, the *I Ching*. Unlike the graphic scores of Feldman and Brown, Cage scored this work specifically for piano and transcribed the results of his divinations in traditional music noration. Although Cage's purported "exploration of non-intention"[15] was diametrically opposed to

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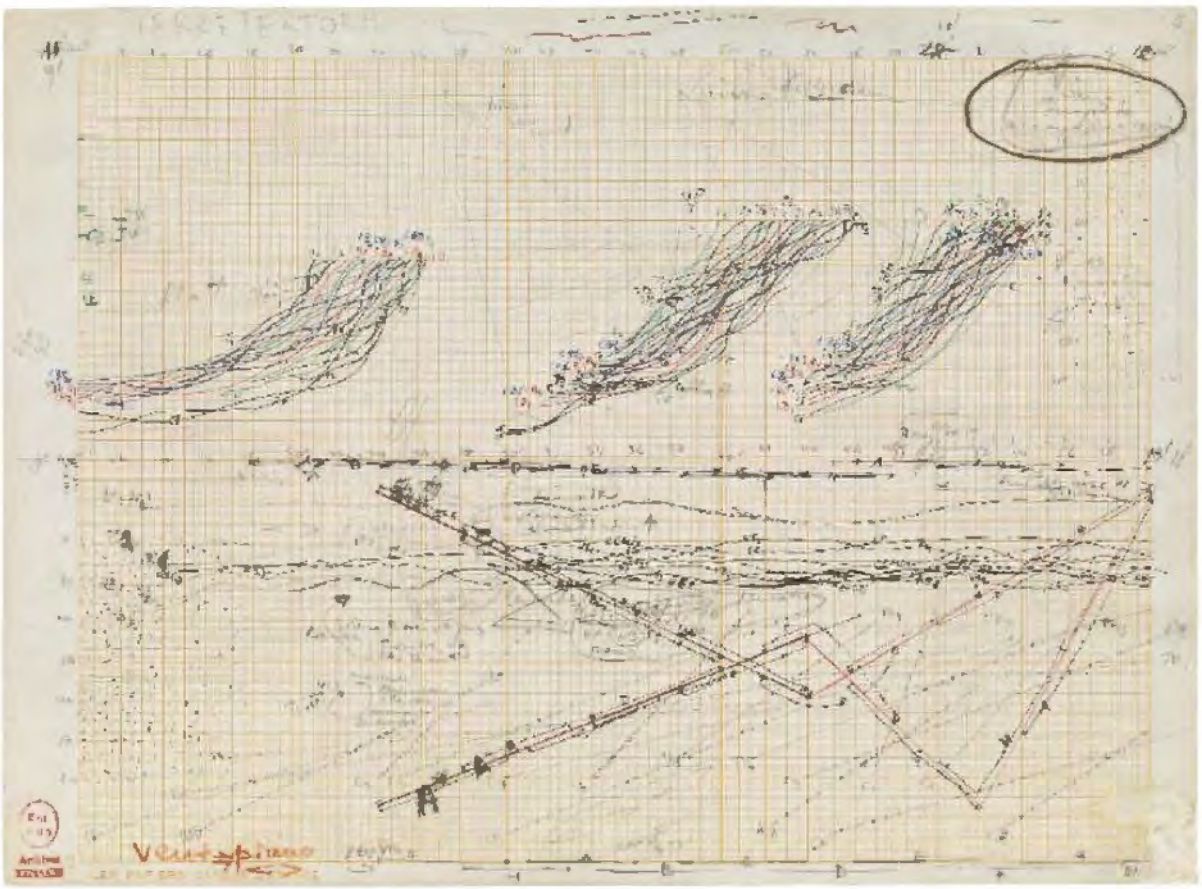
12 During his career, Xenakis was a frequent lecturer, invited by universities worldwide, and he readily used carefully chosen graphic sketches to explain and demonstrate his compositional processes. Likewise, his theoretical books carry more graphic than music examples. Xenakis meticulously filed and kept all such documents, which are now an integral part of his archives on deposit at the Bibliothèque nationale de France. The ensemble of his papers constitutes a vast treasure trove of materials not only for performers seeking insight into his intentions, but also for those attracted to trans-disciplinary approaches to the creation of art.

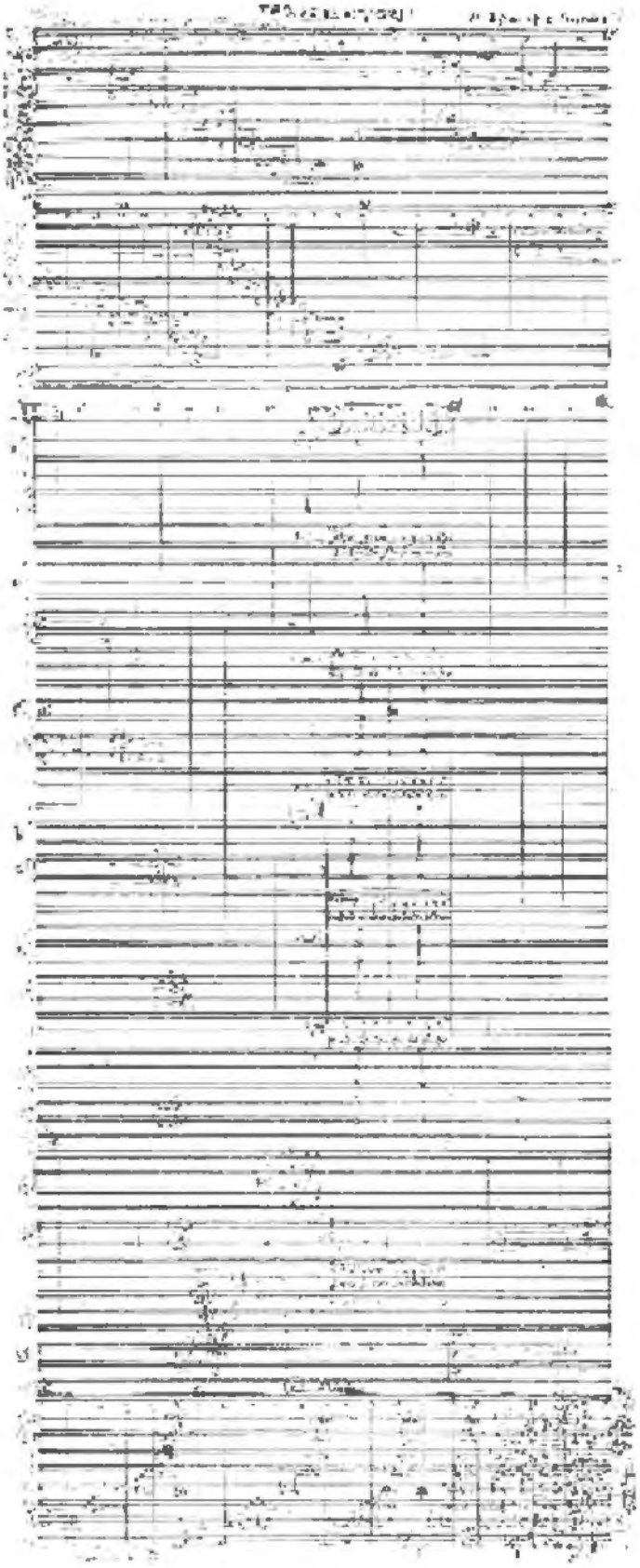
13 Xenakis, *Formalized Music*, 180.

14 Currently, Xenakis's publisher, Éditions Salabert, is in the process of engraving his orchestral works using notation software. Although much more legible than his sometimes minute indications in large-format manuscripts, one can regret the loss of the personal poetics in the composer's pristine renderings, which could ultimately influence a work's interpretation.

15 John Cage, *Writer: Selected texts*, ed. Richard Kostelanetz (New York: Limelight, 1993), 241.



PL. 53
Study for *Terretektorh*, c. 1965–66



PL. 54
Terretektorh (page from orchestral score), c. 1965–66

Xenakis's constant search for compositional control, the latter was much more amenable to the former's methods than to his colleagues' purely graphic forays, finding Cage's work "interesting" and admitting to "being attracted by the freedom and lack of bias with which he approached music."[16]

Because many of his own methods of composition dealt with mathematics involving daunting calculations, Xenakis was, very early on, stigmatized as being a cold and dry composer. The abstraction those methods represented (and its opposition to the neo-romantic vision of the heart-wrung musician) deprived his potential public of any stereotypical model. In his passionate pursuit of the math behind the mysteries of his art, Xenakis often lost the audiences of his lectures and conferences (most often classically trained musicians) behind what he later called the "squid's ink" of his research: the numbers, the formulae, the sheer "otherness" of his approach. However, unlike a squid's protective ink, his provoked the opposite: it was precisely what targeted him for assault by his antagonists. But that was the verbiage and not the actual sound of his music. First performances of his music were often followed by fiery reactions from the audience—either for or against—his tradition-breaking innovations. His musician "opponents" (read "colleagues") were quick to refer to him as a mathematician; his fellow architects, as a musician; and mathematicians, as an *artiste*.[17]

One of Xenakis's most ardent champions recently wrote:

> Xenakis's sketches have nothing in common with those of Beethoven or Boulez. No musical motifs, no "serial" treatments. Moreover, sound emerges following a long process that has nothing to do with music. The numbers of the world are formulas,

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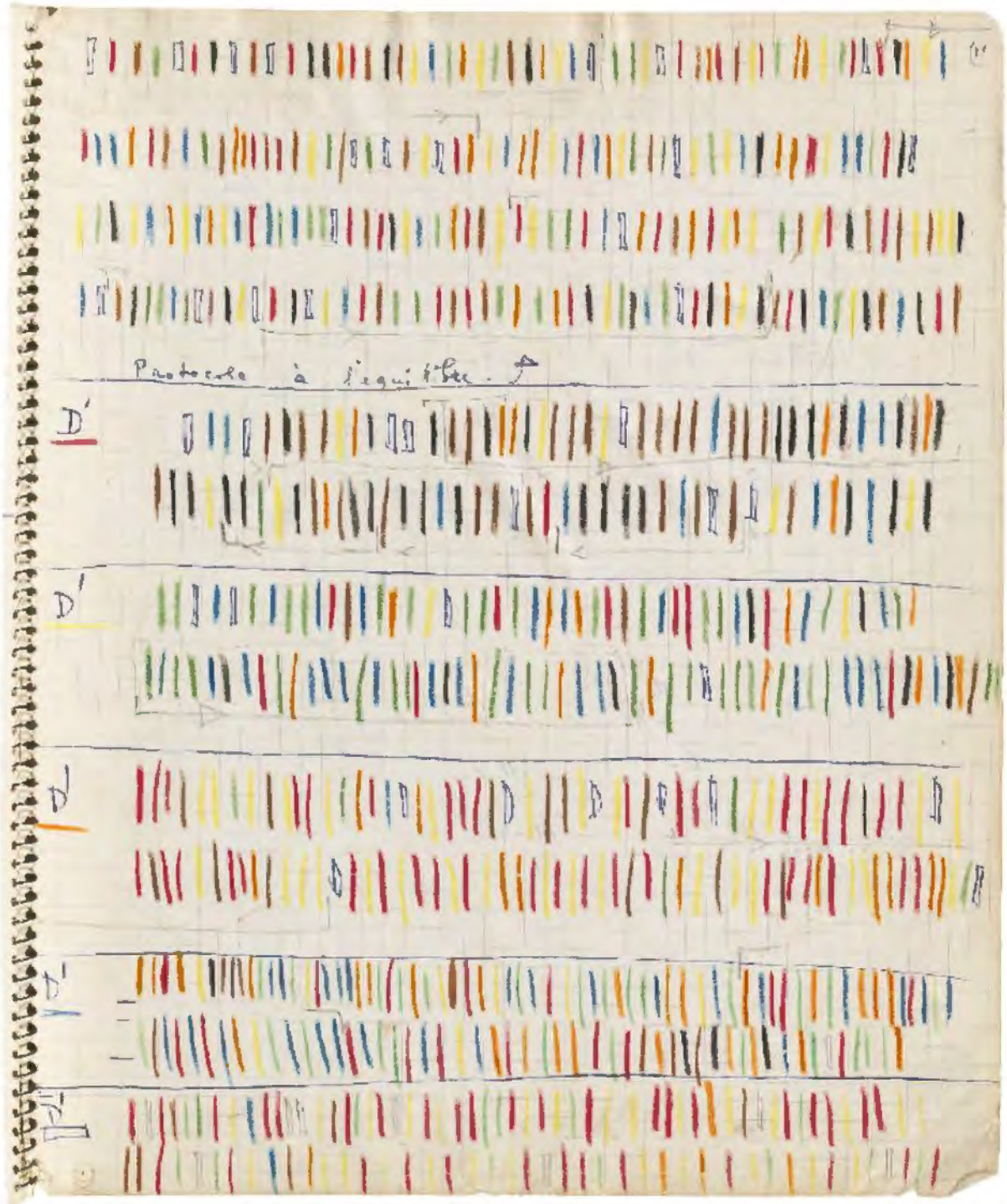
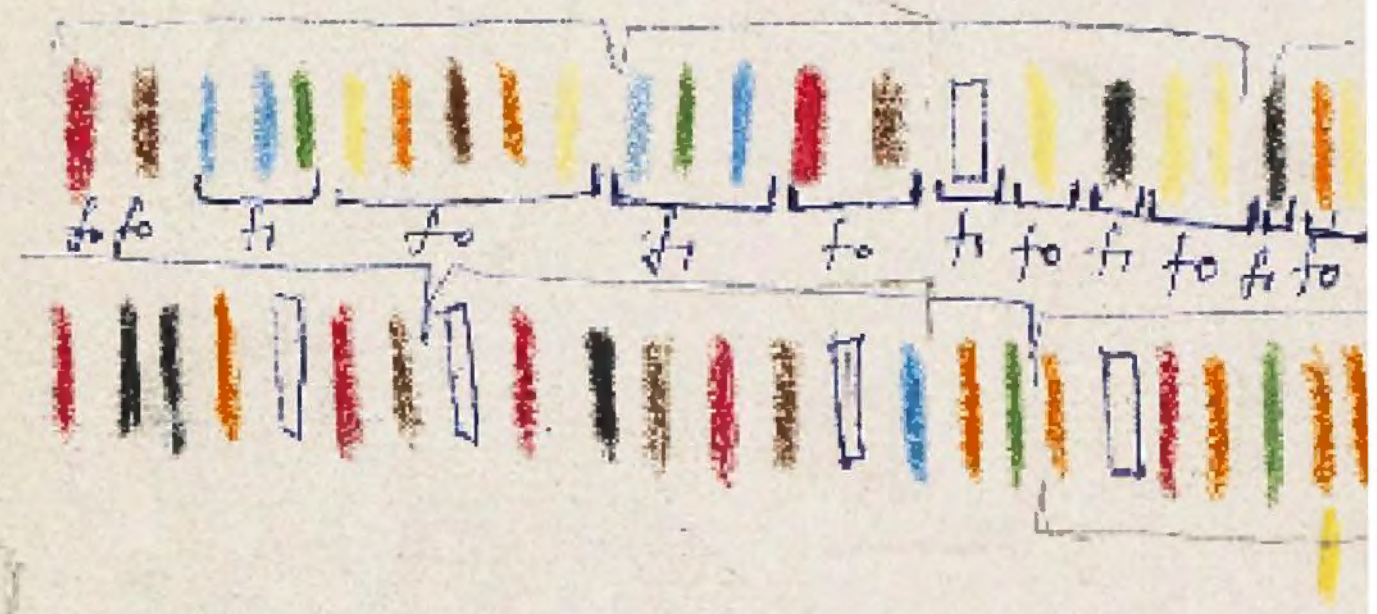
16 Varga, *Conversations with Xenakis*, 55–56.

17 Xenakis was adopted by few intellectuals in the early stages of his career and virtually ignored by the serialists. The world premiere of *Metastaseis* (1953–54) at the Donaueschingen Festival in 1955 tossed oil on the fire that Xenakis had already started across Europe. Just a couple of months before, the conductor Hermann Scherchen, Xenakis's musical mentor, had published in his highly regarded publication, *Gravensaner Blätter*, "The Crisis of Serial Music," his protégé's critique of the twelve-tone method and its limitations. These two events lead to Xenakis's near-total ostracism in Germany until the mid-1970s, when Xenakis was awarded the prestigious "Beethoven Prize" from the city of Bonn.



PL. 55
Page from notebook, 1959

Protocole à l'équilibre.



0,15

0,15

0,09

0,16

5/20 = 0,25

0/20 = 0,00

1/20 = 0,05

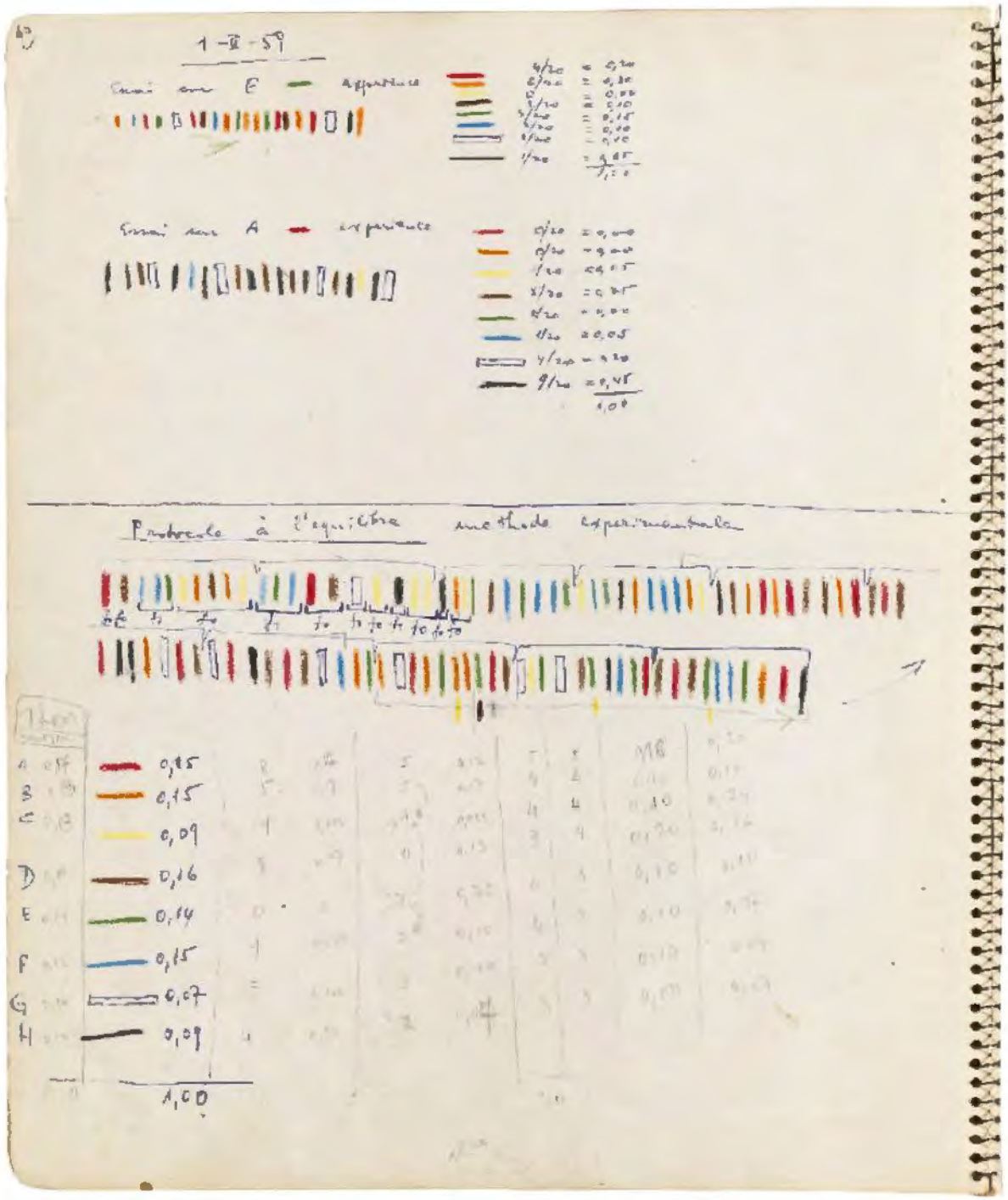
4/20 = 0,20

9/20 = 0,45

1,00

o the de experimental

	5	5	0,16	0,20
	4	4	0,20	0,10
	4	4	0,10	0,24
	3	4	0,20	0,16
			0,10	0,10



PL. 56
Page from notebook, 1959

> drawings, schemas, graphics. Sounds will emerge from these sketches. A slow process of maturation. And these sounds will be neither notes nor scales, nor rhythms, nor timbres, but rather "sieves," "combs," "arborescences," "alchemies," "wefts," "Brownian movements" ... and "symbolic," "stochastic," "cosmic," and also "sliding," like curves and obliques from space.[18]

From Xenakis's preparatory sketches to his manuscripts we witness his unique process of inventing entirely new and radical ways of conceiving music. And his musical universes demanded new explorations. How does one create huge masses of sound, stochastically calculated pointillist interventions, continuous movement, all while never neglecting the musical potency of silence? One can imagine the constant shift from eye to inner ear, back to the mind's sight, via the hand, in the creation of sound worlds yet unheard. The synesthesia inherent to graphic gestures made while searching for new sounds (in contrast to the more analytical approach of traditional notation) certainly played a role in liberating Xenakis's musical imagination.

We know that Xenakis, for whom "art is science"[19] yet for whom "music can lead the way for the sciences,"[20] utilized mathematics not as a goal unto itself, but as a means of cohesion or organization during his compositional process. From the magma of numbers he extracted those results that were, for him, interesting. Then he "tested" them using various graphic methods (colored pencils, literal transcriptions of pitches and durations onto calibrated grid papers, freehand drawings, etc.) before translating them into the most abstract of languages—music notation.

If we take but two of Xenakis's signature contributions to the evolution of musical thinking in the second half of the twentieth century:

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18 Michel Tabachnik, *De la musique avant toute chose* (Paris: Buchet/Chastel, 2008), 67–68.

19 See Thomas Meyer, "L'artiste en choissant invente une forme nouvelle," *Dissonance* 68 (April 2001), 17.

20 Nourtiza Matossian, *Xenakis*, 2nd ed. (Nikosia, Cyprus: Moufflon Publications, 2005), 291. Also, we must not forget that Xenakis published, first in French in 1976 and later in English, a comparative table of "Correspondences between certain developments in music and mathematics," where Xenakis demonstrates how, from 500 BC to 1970 AD, music is often in the foreground of scientific discoveries. See Xenakis, *Arts/Sciences: Alloys*, 99–101.

his use of glissandi (the uninterrupted sliding from one pitch to another by an instrument at a speed determined by the range to be covered in a given time) and his application of stochastics to musical composition, we can see evolve a link between the original idea or concept and its final realization through his process of "visual thinking." In addition, these two examples lend themselves conveniently to Xenakis's own translations from music to architecture. Perhaps as an engineer he developed a penchant early on for the universal principle of least effort.[21] From this, as a musician, he set out to redefine the idea of continuity, of getting from one point to another in continuous evolution, taking into consideration the three variables of duration, speed, and interval. The result: his signature glissando writing in *divisi*, where each individual instrument of the orchestra plays an independent line. Ruled surfaces drawn from straight lines created not only elegant new sculptural forms, but under Xenakis's skillful hand, became the hyperbolic paraboloids from which the notion of "volumetric architecture," exemplified by the Philips Pavilion [PL. 57], and musical masterpieces such as *Metastaseis* were born.

> In the Philips Pavilion I realized the basic ideas of *Metastaseis*: as in the music, here too I was interested in the question of whether it is possible to get from one point to another without breaking the continuity. In *Metastaseis* this problem led to glissandos, while in the pavilion it resulted in the hyperbolic parabola shapes.[22]

From these first nearly-literal translations from music to architecture (Xenakis confessed to the conductor Charles Bornstein in an unpublished late interview that he felt as though he were "watching the sounds emerge from the ground"[23] during the Pavilion's construction—literally erecting a music to be seen!), Xenakis's reciprocal *déformation professionelle* evolved into a compositional tool of

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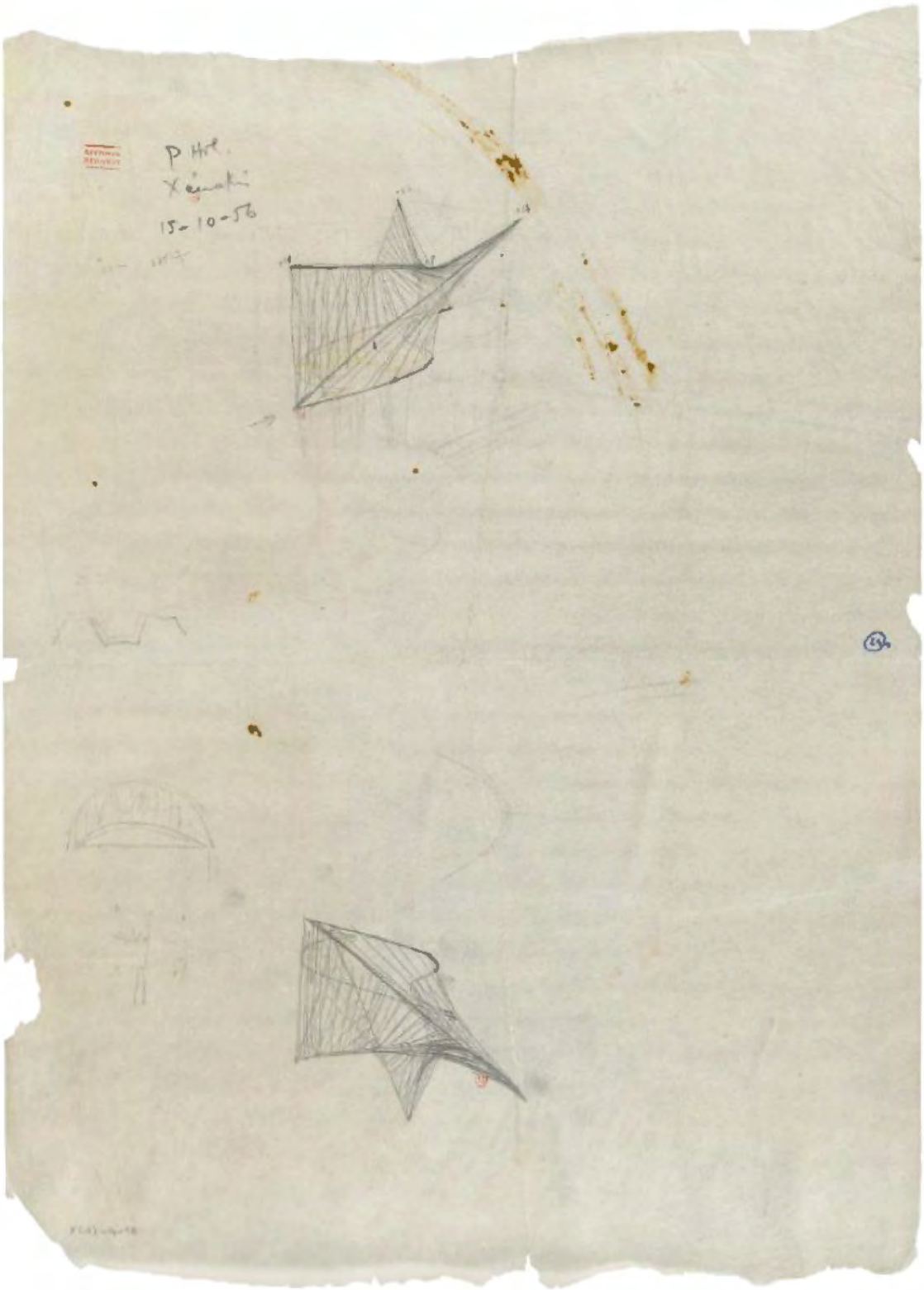
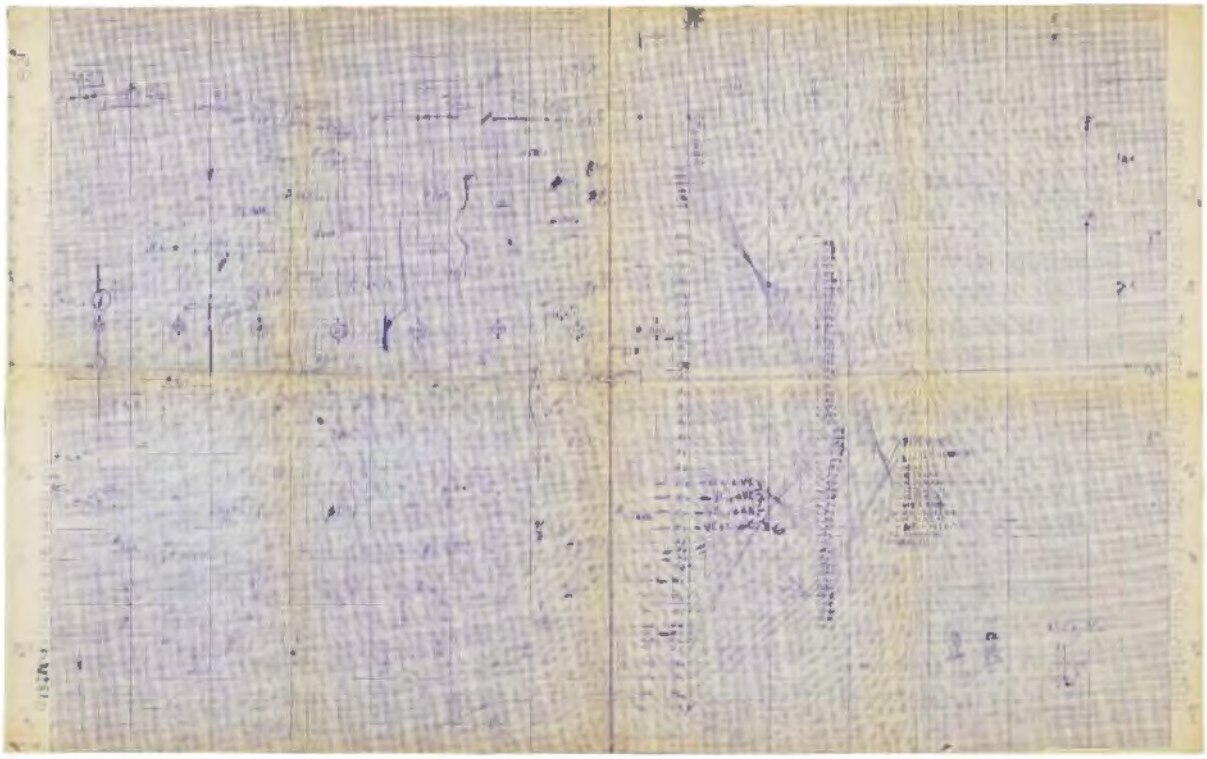
21 Xenakis's first job with Le Corbusier was calculating the resistance of reinforced concrete pillars for the first low-income housing project in post-World War II France: the Unité de Habitation in Marseille. See Xenakis, *Music and Architecture*, 3–17. In addition, one of Xenakis's early works for chamber orchestra, *Achorripsis* (1956–57) is constructed entirely on this premise. See Xenakis, *Formalized Music*, especially Chapter I, "Free Stochastic Music," and Chapter V, "Free Stochastic Music by Computer."

22 Varga, *Conversations with Xenakis*, 24.

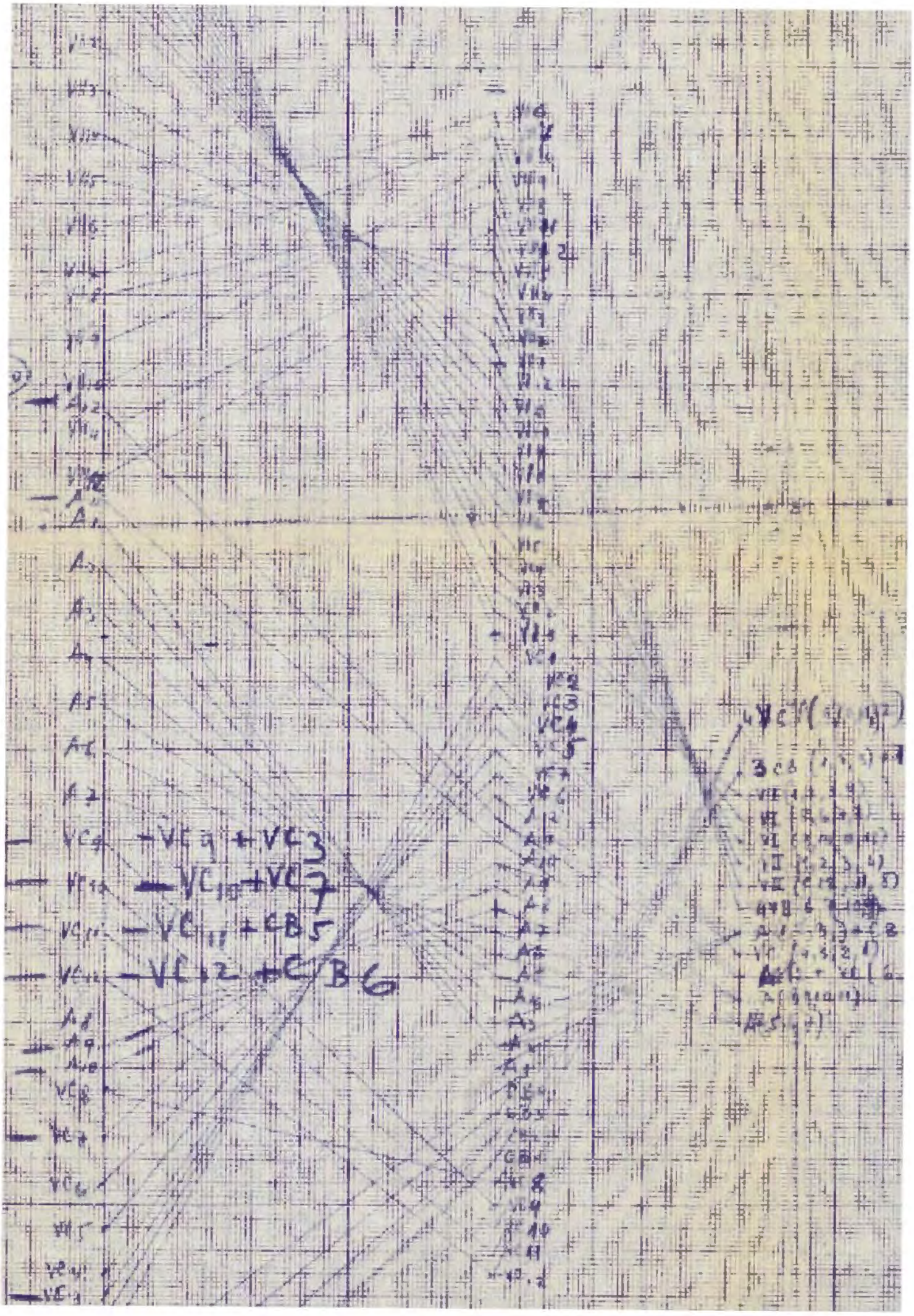
23 Charles Z. Bornstein personal archives, New York: DAT 1 IX. Private communication with the author, 2002.

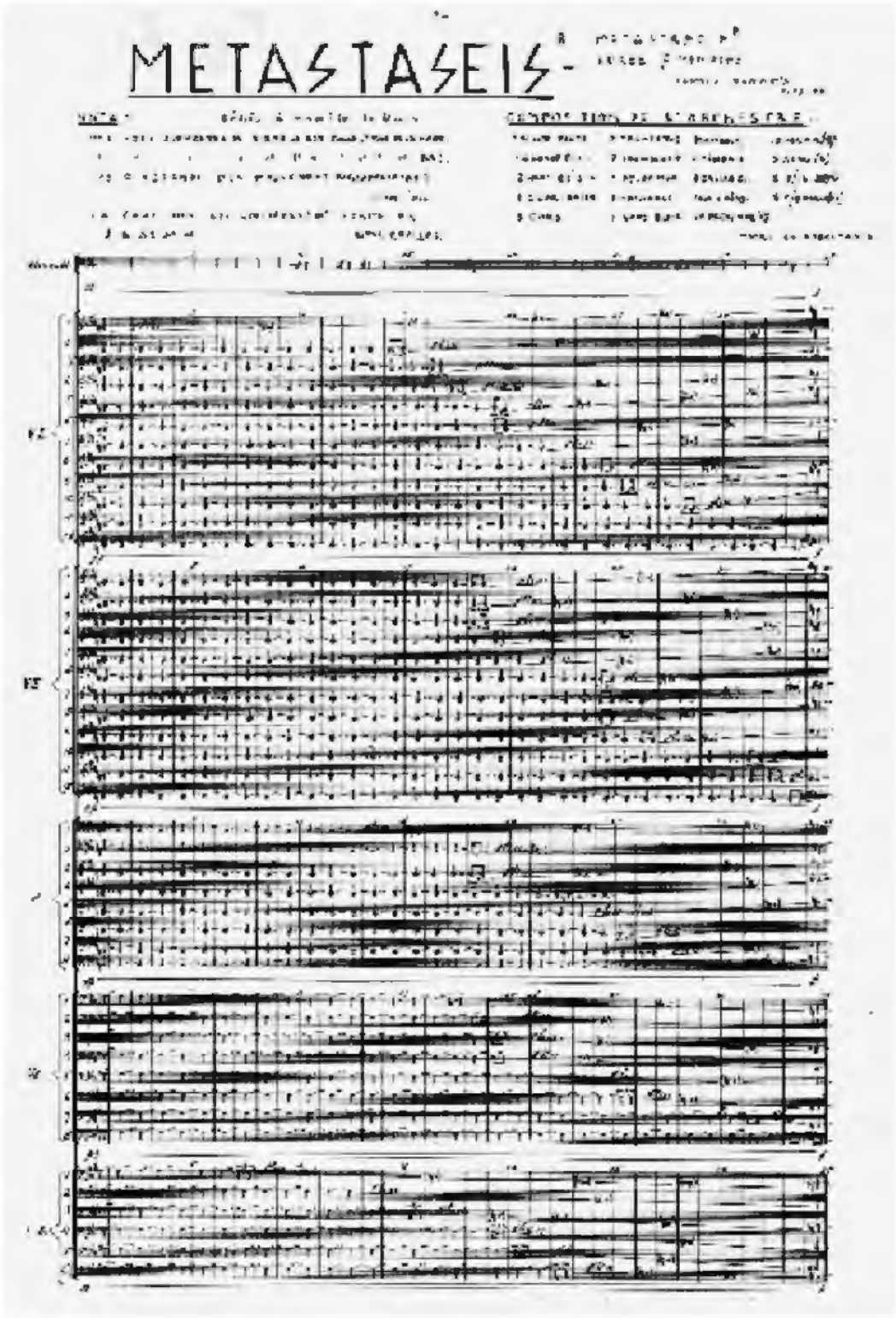


PL. 57
Study for Philips Pavilion, 1956

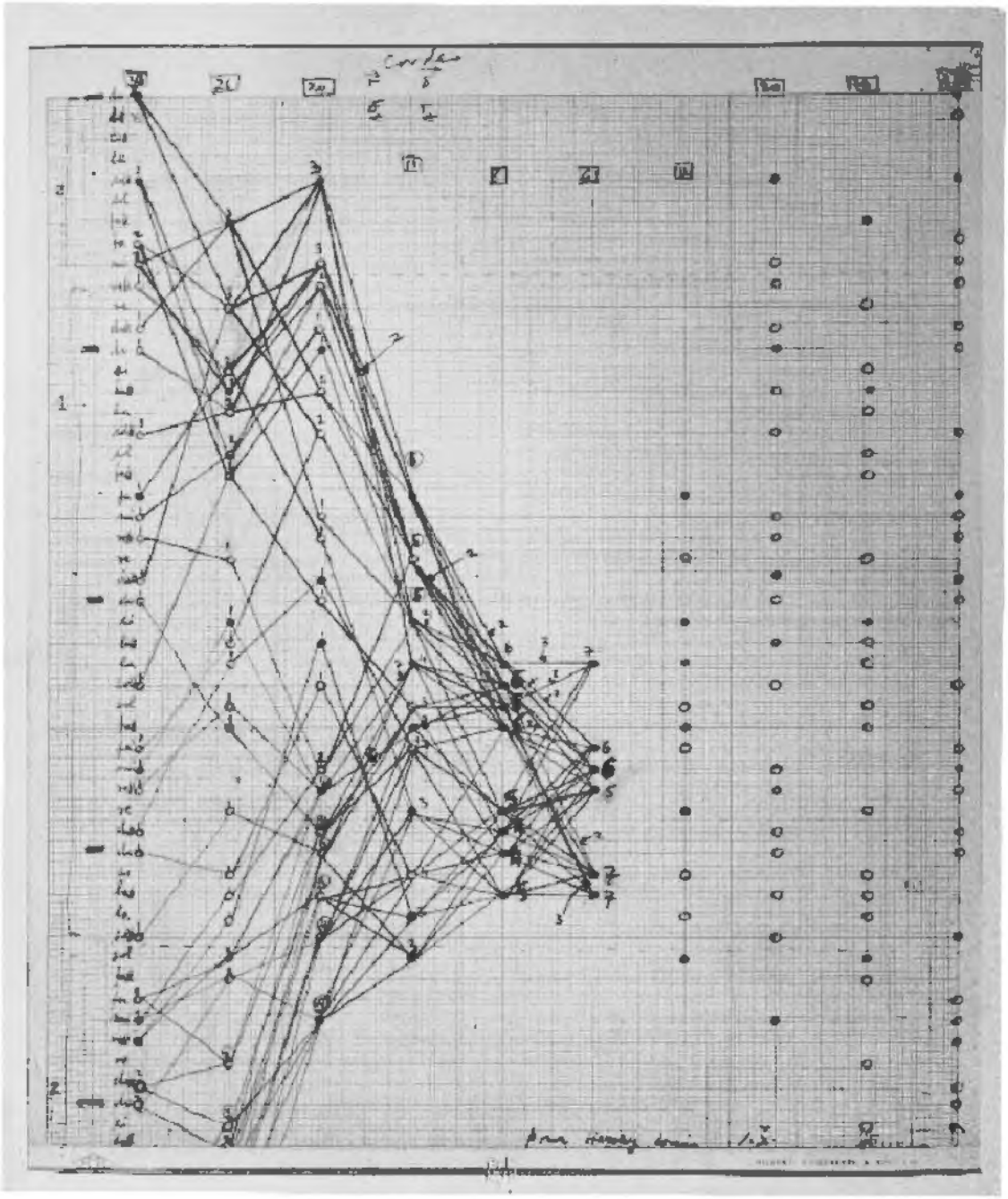


PL. 58
Study for *Metastaseis*, c. 1953





PL. 59
Metastaseis (first page of orchestral score), 1953–54



PL. 60
Study for *Metastaseis*, c. 1953

process. Points on a line could also be removed from their continuous context and laws of discontinuity could be applied. Probability distributions, thanks to Xenakis, created new, unheard-of rhythmic patterns which, when applied to architecture, evolved into one of the most elegant architectural attributes of any façade: undulating glass panes.[24]

These too have become a ubiquitous feature of nearly all of Xenakis's architectural projects, beginning with the Secretariat in Chandigarh and all subsequent projects under Le Corbusier, up until his ultimate architectural realization, that of his own summer home in Corsica, which is composed entirely of undulating glass panes.[25]

From mathematical calculations, to philosophical musings, to sketches, to technical drawings, to graphic "shorthand," to elaborately notated scores, each and every one of his documents bears not only the contents but also the elegant beauty of the original idea behind it. The genesis from idea to artwork is manifest every step of the way. Over time, Xenakis's "hand" becomes just as recognizable as Xenakis's "sound," and on some subliminal level, the two may be innately linked. Only time will tell, as the performance history of Xenakis's works is just beginning to evolve from the first dedicatees to the next generation.[26]

Originally, Xenakis's phrase "music to be seen" was his way of describing the total spectacle of his itinerant polytope, his *Diatope*, which was commissioned for the opening of the Centre Pompidou in Paris in 1978: the music (his electronic work *La Légende d'Eer*) and concurrent light and laser show, both given within the architecture, he created specifically for the occasion [PL. 38]. For

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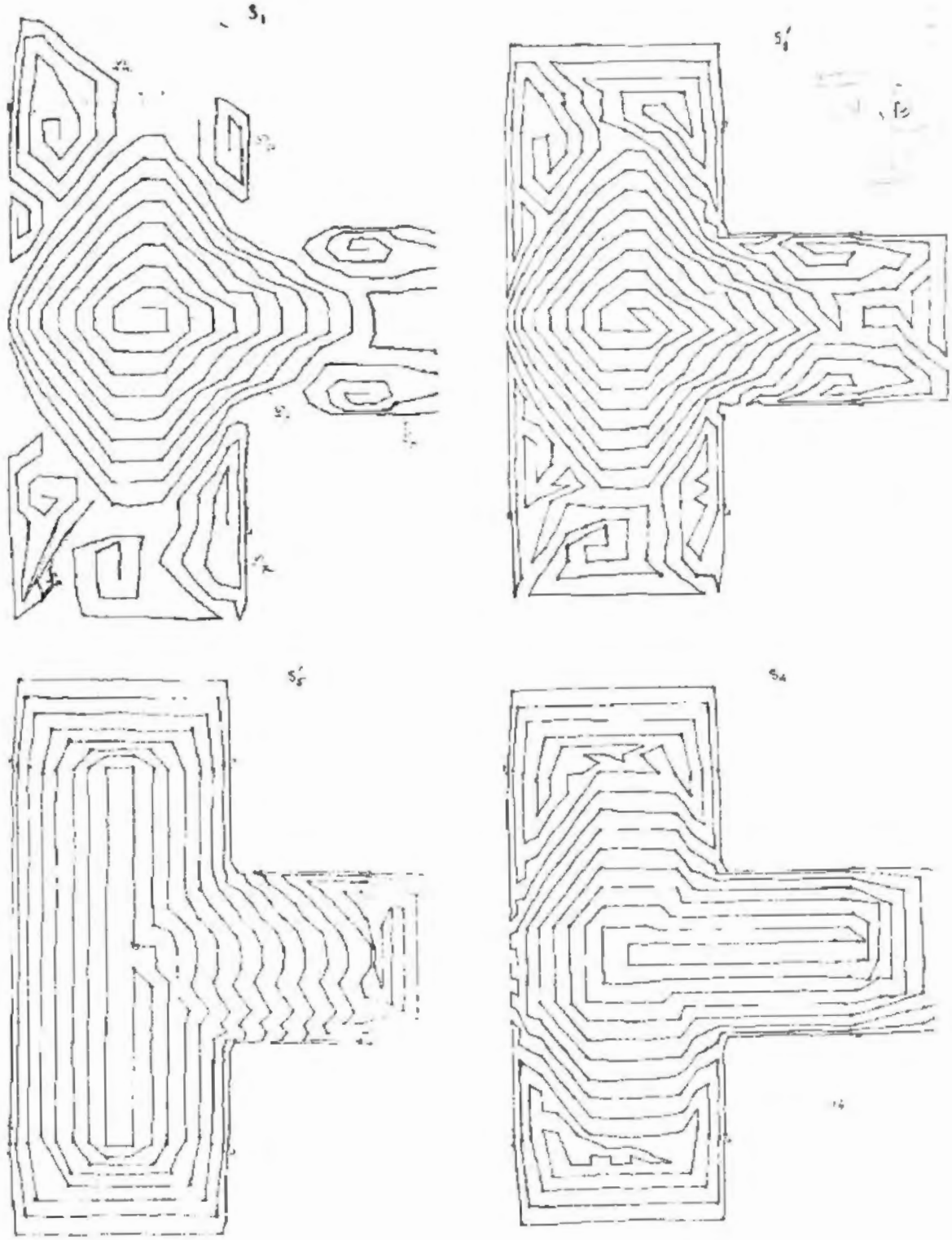
24 "When I designed the undulating glass panes of the Convent de La Tourette I was making use of the results of my research into rhythmic patterns." Varga, *Conversations with Xenakis*, 127.

25 Xenakis, *Music and Architecture*, 194–195.

26 The second volume in the "Xenakis Series" at Pendragon Press will address precisely this issue of: the transmission of performance practices in Xenakis's often technically challenging scores. See *Performing Xenakis*, ed. Sharon Kanach (Hillsdale: Pendragon Press, forthcoming in 2010). This volume comprises some thirty testimonies from musicians of fourteen different nationalities, from his original dedicatees to the youngest generation of professional musicians just now approaching Xenakis's music.

PL. 61
Polytope de Cluny, 1972–73



PL. 62
Study for *Polytope de Cluny* (light trajectory diagrams), c. 1972

Xenakis, "musical composition, which addresses the ear, leads us to visual composition, which addresses the eye,"[27] and both rely entirely on abstraction, "the means whereby the human mind understands."[28] When commenting on Xenakis's sketches [PL. 62] for some light sequences for his earlier *Polytope de Cluny* (1972) [PL. 61], for which the composer created the nomenclature of figurative names ("circles," "spirals," "rivers," "torrents," etc.), the philosopher Olivier Revault d'Allonnes stated:

> Xenakis tells us not what [these images] are, but what they could, what they should be, if only we could liberate ourselves from the constraints of vocabulary, of geography, of logic, of daily life, in order to be able to dream along with him of all the virtual rivers possible, only once we have transgressed these constraints. [...] In short, it is a creation.[29]

Xenakis readily admitted that he often "deviated" from the very rules he imposed on his creative and compositional process, by reason of aesthetic freedom and choice.[30] In his sketches, working with structures of relations or abstract concepts *outside* time[31] (versus actual music which transpires *in* ontological time), his hand was able to venture into previously uncharted territories. Such queries also led him to attempt an axiomatization of his art in his theoretical writings. Later, as technology developed accordingly, Xenakis sometimes replaced his hand-rendered deviations with a computer, which he would program to generate a plethora of solutions from which to choose.

> An additional advantage of using a computer as compared to manual exploration is that the composer may become bold and investigate developments or audacities stemming from [the composer's] basic systems...[32]

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27 Iannis Xenakis, "Les chemins de la composition musicale" in *Kéleütha* (Paris: L'Arche, 1994), 29.

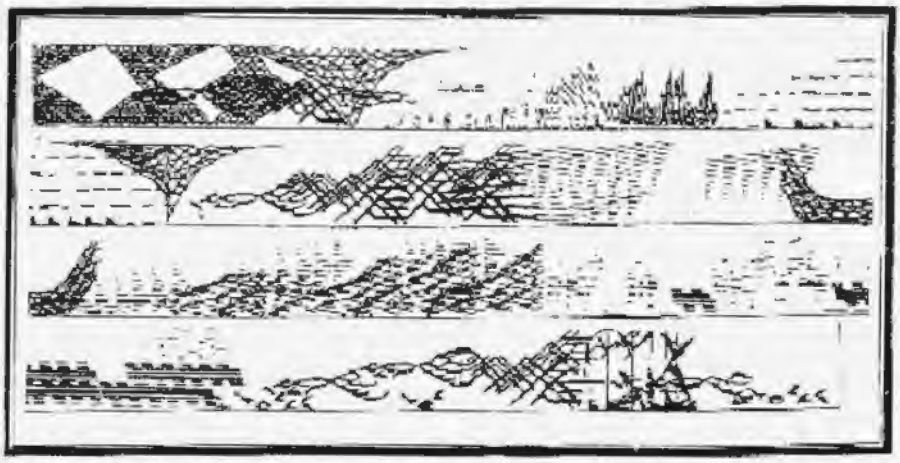
28 Varga, *Conversations with Xenakis*, 173.

29 Olivier Revault d'Allonnes, *Xenakis: Les Polytopes* (Paris: Balland, 1975), 86. Also quoted in English in Xenakis, *Music and Architecture*, 231.

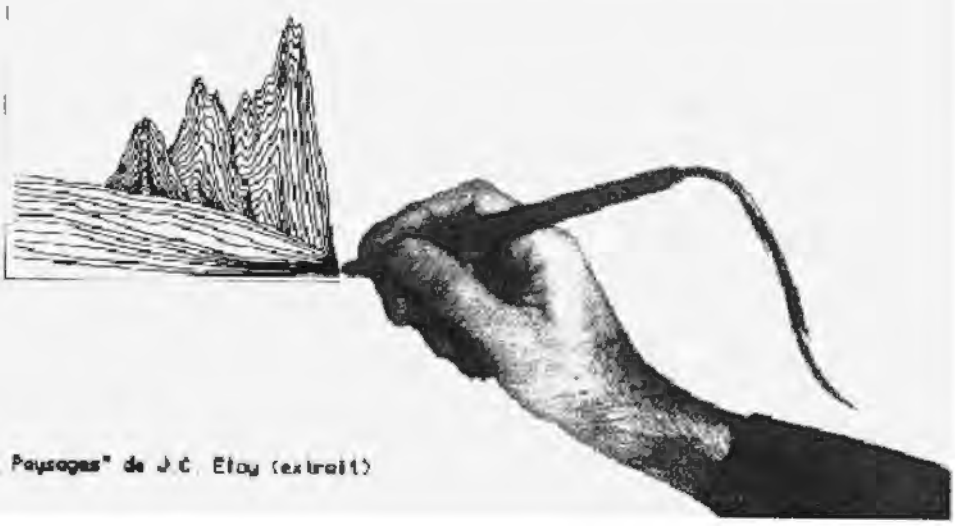
30 See Varga, *Conversations with Xenakis*, 201–202.

31 For further information on Xenakis's concept of "outside-time" organization, see Xenakis, "Towards a Philosophy of Music," in *Formalized Music*, 180–200.

32 Xenakis, *Music and Architecture*, 268.

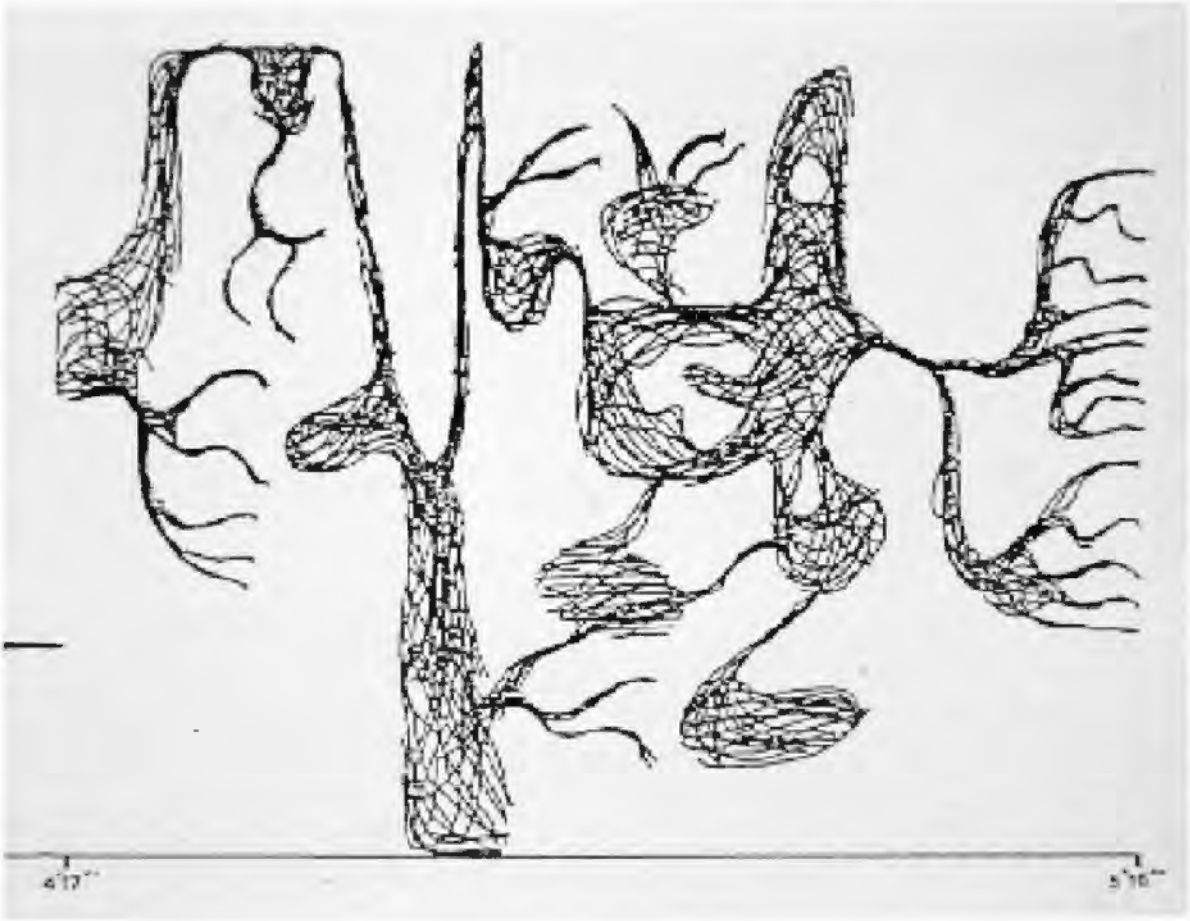


"Hoa Sa" de P. Bernard (partition globale)



"Points, Lignes, Paysages" de J.C. Eloy (extrait)

PL. 63
Page from *L'UPIC du CEMAMu: Ordinateur à Composer Conçu par Iannis Xenakis*, c. 1987



PL. 64
Mycènes Alpha (panel from UPIC score), 1978

The "seeing is hearing" paradigm finds it *summum* in Xenakis's conception and creation of the UPIC.[33] In 1965, with a group of researchers and friends including mathematicians, statisticians, and computer science experts, Xenakis founded the CEMAMu, a music research lab where the first (then) high-definition digital to analog sound converters in the world were produced.[34] A little over ten years later, in 1977, the first UPIC machine was built. In essence, this "instrument" was conceived as a musical drawing board (Xenakis never lost the habit of working standing up, in front of an architect's desk), where all parameters of sound (including micro-elements such as waveforms, envelopes, etc.) as well as the music itself (from pitches and durations to the macro-level architecture of an entire work) are all determined by the hand. Drawn with an electrostatic pen on a special large board, linked to a computer that automatically digitized and stored the graphic elements, this information could then be heard immediately in playback, and either saved as such or revised by further gestures of the hand. The actual design process could (and can, now with sofrware versions of the same concept) be intuitive (freehand) or use more sophisticated original graphic material (which still needed to be copied by hand on the original table). All of the mathematical calculations behind the process from hand to ear are thus delegated to the machine, thereby liberating its users to create music to be seen.

Although Xenakis searched for universal structures that not only permeate but also govern our natural world, he was never interested in simply replicating such structures as literal translations, nor did he proceed by means of metaphor; he tested these new truths on different levels, in different playing fields, all ultimately leading to their formulation as metaphysical statements, a "metamusic," comprising a philosophical thesis and a global architecrure in each artwork.[35] Even though each of his works can be appreciated without previous knowledge of its underlying philosophical question, that question's

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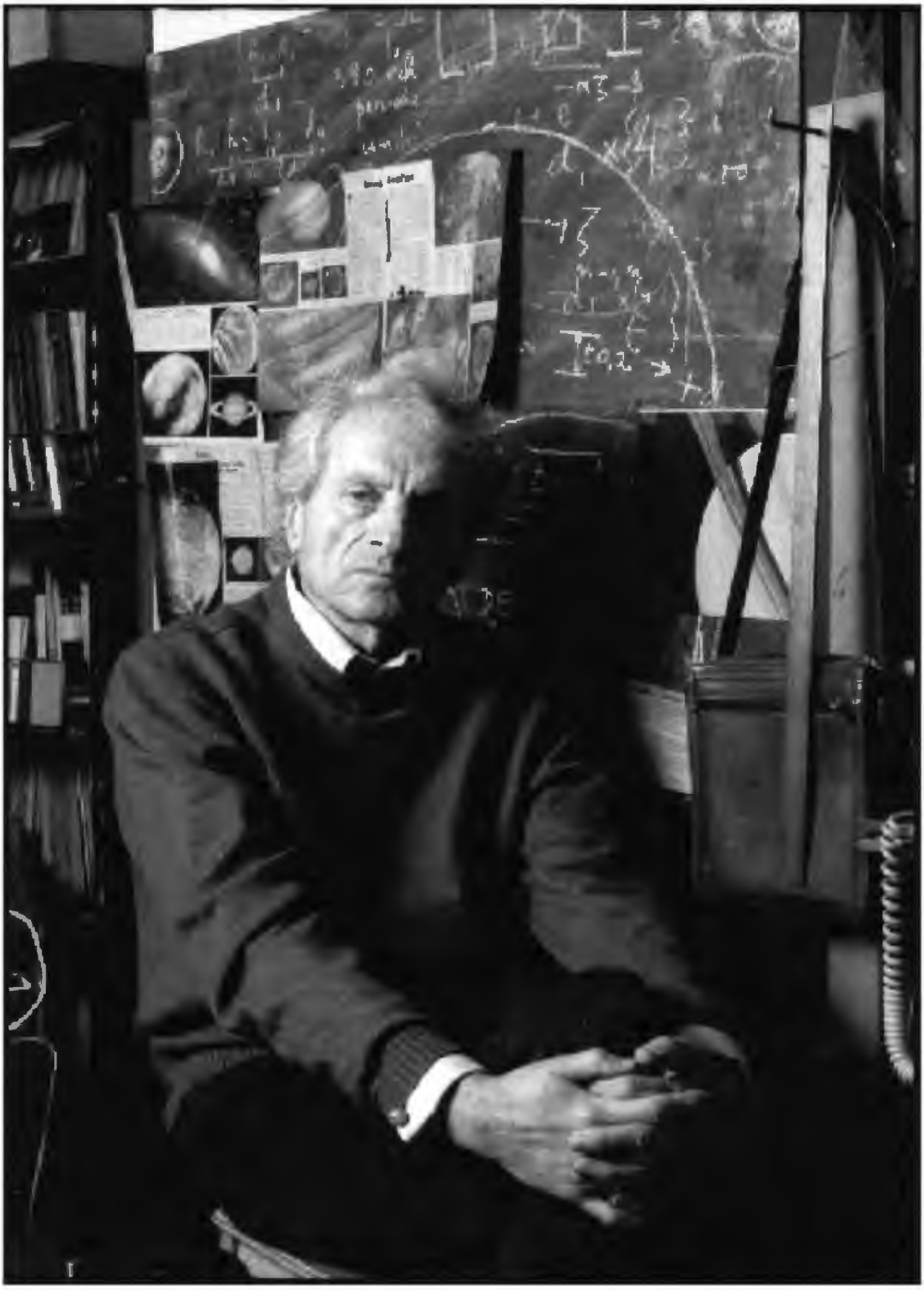
33 UPIC - Unite Polyagogique Informatique du CEMAMu (*polyagogic* being a sort of plural of *pedagogic*). See Varga, *Conversations with Xenakis*, 121. The first work ever composed using the UPIC was Xenakis's *Mycenes Alpha* (1978).

34 At the time, high-definition equaled 52,000 samples per second and sixteen bits per sample.

35 See Xenakis, "Towards a Metamusic," in *Formalized Music*, 180–200.

mere—albeit hidden—existence may explain why his music never leaves one indifferent. Each of his creations represents a point of dialectical merger between, on the one hand, mathematical and scientific thought and, on the other hand, intuition: "I think intuition is something rational: it's highly complex and at the same time something of which we're unaware"[18]—a fusing of science and art.

18. Varga, *Conversations with Xenakis*, 200.



PL. 65
Iannis Xenakis, c. 1995

Meteorites

Mâkhi Xenakis

To write this short remembrance, perhaps it's best to be in Corsica, as I am today, for my recollections here show this very particular man in another light. He chose Corsica in 1951 as the place where he would renew himself every summer, alone with my mother and me. Corsica replaced Greece, where from 1947 to 1974 he was not permitted to travel because of his former political activities. In Corsica, he could calm his fears and shed his anxiety for a month, in a hand-to-hand confrontation with the wildest aspects of nature that he could find.

The more I speak about him with my mother these days, the more we become convinced that, although during the rest of the year my father showed every evidence of a very erudite and rational mind, linking music, architecture, and mathematics, the main motor of his acts was linked to a deep wound, a profound suffering that grew familiar to us and whose traces we find in most of his music. This suffering certainly stemmed from the tragedies he lived through during the civil war in Greece, but also from his childhood. When he was five, his mother, in the course of giving birth to a baby girl, died. Brutally deprived of his family cocoon, he was obliged to construct himself alone.

I believe that he struggled to exorcize the stunning shock of this death through his music and during every instant of his life.

One of the things he said to me most often was, "*Mà*, do you realize that we're meteorites; almost as soon as we're born, we have to disappear?"

As I write these lines, I have close by me one of his many small notebooks, where he jotted down with his finest pen an idiosyncratic

juxtaposition of notes, mathematical equations, sketches, and Greek letters.

> September 1951: How to introduce voices, cries of pain, sobs, into music?
> September 1952: I must continue to strip down sound and rhythm. To reduce them to their most primitive expression… To find composition in its secret hiding place at the deepest level of primitive art. The opposite of modern diversity and complexity! The origin of music, that's what must be put back into place… Relearning to touch sound with our hands – that's the heart, the essence of music!

This enthusiasm, this permanent quest for the primitive force in art, takes me back again to images of him in Corsica.

Sitting cross-legged, he would pore over a book of Plato or mathematics. He sometimes stared at the sky, searching for that particular moment when he could at last, in extreme hand-to-hand combat, draw close to the untamed elements of nature, so as to nourish and renew himself in them.

He's standing now, facing the raging sea, his face radiant, peaceful at last, reflecting a particular serenity that signifies that this moment won't escape him any longer.

We'll be able to go out in the kayak now. The gigantic waves break over us with a terrifying roar; we are completely immersed in their white spray. We can't breathe. Everything is white, deafening.
And again I hear his voice, barely audible among sounds that have become suddenly deafening, "upright, upright, upright!!!" And the movement of our oars accelerates, to maintain the boat against the waves, or we will capsize and may be shattered against the rocks…

The thunder rumbles, we've taken refuge in our tent. And again his face is radiant, peaceful. He uses his watch to calculate meticulously the number of seconds between the brutal bursts of lightning that tear apart the night and the explosions of thunder as they grow closer and closer to us. When the storm is at last directly above our heads he leaves the tent, half-naked; he runs and disappears little by little into this grandiose spectacle of sound and apocalyptic light.

In the early morning, when dew covers every particle of the arid countryside, he crouches for hours, scrutinizing each very particular spiderweb. A multitude of parallel stretched lines sketch out complex architectures comprising cut-off cones, convex and concave surfaces conjoined—they are the natural ancestors of the Philips Pavilion and the polytopes...

So many other memories surge forth now, and each of them takes me to these overwhelming, founding moments, to this man who was my father, and to the violence and the special force that I find in his music today.

—August 2009

LIST OF WORKS

Draft of "On the Centenary of the Premiere of Der Meistersinger," n.d.
Handwritten manuscript
11 x 8 1/2 inches
Collection of Françoise Xenakis

PL. 9
Iannis Xenakis (far right) with his two brothers and uncle Sophocles, 1933
Postcard with inscription
4 x 6 inches
Collection of Mâkhi Xenakis

PL. 4
Iannis Xenakis as a Greek resistance fighter (third from right in truck), c. 1944
Archival exhibition print
5 x 5 inches
Collection of Françoise Xenakis

Iannis Xenakis in Le Corbusier's Studio, c. 1947
Archival exhibition print
4 x 6 inches
Collection of Françoise Xenakis

PL. 7
Study for *Metastaseis*, 1953
Pencil on paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 58
Study for *Metastaseis*, c. 1953
Ink on paper
19 11/16 x 29 1/8 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 60
Study for *Metastaseis*, c. 1953
Ink on Paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 14
Study for *Metastaseis*, c. 1953
Pencil and color pencil on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Study for *Metastaseis*, c. 1953
Ink and color pencil on paper
Four sheets, 11 3/4 x 8 1/2 inches each
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 59
Metastaseis (first page of orchestral score), 1953–54
Archival exhibition print
21 x 12 5/8 inches
Courtesy of Boosey & Hawkes, New York

PL. 13
Study for *Metastaseis*, 1954
Ink on paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 8
Study for *Pithoprakta*, c. 1955
Archival exhibition print
19 x 23 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 16
Study for *Pithoprakta*, c. 1955
Archival exhibition print
19 x 23 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 57
Study for Philips Pavilion, 1956
Ink on paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 15
Pithoprakta, 1956
DVD of drawings and calculations for *Pithoprakta* and musical performance by the Luxembourg Philharmonic Orchestra, conducted by Arturo Tamayo in 2008
10:35 minutes
Courtesy Iannis Xenakis Archives, Bibliothèque nationale de France, Paris and Timpani Records

Letter from Le Corbusier to Iannis Xenakis, November 14, 1957
Typewritten document, signed by Le Corbusier
10 1/2 x 8 1/4 inches
Collection of Françoise Xenakis

Cover of *Gravesaner Blätter* no. IX, 1957
Archival exhibition print
8 1/2 x 5 7/8 inches
Collection of Sharon Kanach

Gatefold page from "Le Corbusier's Electronic Poem-the Philips Pavilion," in *Gravesaner Blätter* no. IX, 1957
8 1/4 x 15 3/4 inches
Collection of Sharon Kanach

PL. 5
Iannis Xenakis with Le Corbusier en route to the Philips Pavilion, c. 1957
Archival exhibition print
7 x 5 inches
Collection of Françoise Xenakis

PL. 19
Le Corbusier, Louis Kalff, and Iannis Xenakis with scale model of the Philips Pavilion, c. 1957
Archival exhibition print
6 x 6 inches
Courtesy of Fondation Le Corbusier

PL. 18
Study for Philips Pavilion (interior sound diagram), c. 1957
Color pencil on spiral notebook paper
8 x 6 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Lucien Hervé
Philips Pavilion, c. 1958
Archival exhibition print
7 1/2 x 5 inches
Courtesy of Fondation Le Corbusier

Lucien Hervé
Philips Pavilion, c. 1958
Archival exhibition print
18 1/2 x 11 7/8 inches
Courtesy of Fondation Le Corbusier

Lucien Hervé
Philips Pavilion, c. 1958
Archival exhibition print
7 x 5 2/3 inches
Courtesy of Fondation Le Corbusier

PL. 17
Philips Pavilion, c. 1958
Postcard
4 x 6 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 55/56
Notebook, 1959
Spiral-bound notebook
12 3/8 x 9 5/8 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 11
Convent of La Tourette (elevation), c. 1959
Archival exhibition print
14 x 21 inches
Collection of Françoise Xenakis

PL. 1
Iannis Xenakis in his studio, Paris, c. early 1960s
Archival exhibition print
35 x 35 inches
Collection of Françoise Xenakis

PL. 41
Cosmic City (aerial perspective), 1963
Ink on paper
8 3/4 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Iannis Xenakis: Musiques Formelles (Editions Richard-Masse), 1963
10 1/2 x 7 3/4 inches
Collection of Sharon Kanach

PL. 42
Study for Cosmic City, c. 1963
Ink on paper
11 3/4 x 8 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Study for Cosmic City, c. 1963
Blue ink and red pencil on notebook paper
5 1/2 x 4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 43
Study for Cosmic City, c. 1963
Ink on paper
11 3/4 x 8 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 20
Vector matrix for *Achorripsis*, c. 1964
Permanent marker on wax paper
20 x 64 inches
Collection of Sharon Kanach

PL. 23
Study for *Terretektorh* (distribution of musicians), c. December 1964–January 1965
Color pencil and ink on paper
Two sheets, 9 x 12 inches each
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 22
Study for *Terretektorh* (distribution of musicians), c. December 1964–January 1965
Color pencil and ink on paper
12 x 9 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 24
Study for *Terretektorh* (distribution of musicians), December 20, 1965
Ink on paper
9 x 9 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Xenakis: Metastasis, Pithoprakta, Eonta, 1965
LP album
12 1/8 x 12 1/8 inches
Collection of Françoise Xenakis
Courtesy of Le Chant du Monde

PL. 54
Terretektorh (page from orchestral score), c. 1965–66
Archival exhibition print
33 x 11 1/2 inches
Courtesy of Éditions Salabert, Paris

PL. 3
Study for *Terretektorh*, c. 1965–66
Color pencil on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 53 / COVER (DETAIL)
Study for *Terretektorh*, c. 1965–66
Color pencil on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 49
Study for *Terretektorh*, c. 1965–66
Pencil on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 48
Study for *Terretektorh* (glissandi), c. 1965–66
Pencil on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 26
Polytope de Montréal (plans, elevations, axonometrics), 1966
Blueprint
14 x 21 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 29
Study for *Polytope de Montréal* (light score), c. 1966
Color pencil on paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 27
Study for *Polytope de Montréal* (distribution of musicians), 1967
Archival exhibition print
8 7/8 x 13 inches
Courtesy of Boosey & Hawkes, New York

PL. 28
Polytope de Montréal, 1967
Archival exhibition print
11 3/4 x 11 3/4 inches
Collection of Françoise Xenakis

PL. 25
Study for *Polytope de Montréal*, c. 1967
Ink on paper
9 1/2 x 12 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Xenakis, 1969
Album insert
23 x 11 1/2 inches
Collection of Sharon Kanach
Courtesy of Editions Costallat & Erato Records

Iannis Xenakis on site, Persepolis, Iran, August 29, 1971
Archival exhibition print
7 x 10 inches
Collection of Françoise Xenakis

PL. 32
Polytope de Persepolis, 1971
Archival exhibition print
7 x 10 inches
Collection of Françoise Xenakis

PL. 33
Study for *Polytope de Persepolis* (site plan of performance), c. 1971
Ink on paper with written annotations by Françoise Xenakis
11 1/2 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Xenakis: Persepolis, 1972
LP album
12 1/8 x 12 1/8 inches
Collection of Françoise Xenakis
Courtesy of Philips Prospective 21e siècle

PL. 62
Study for *Polytope de Cluny* (light trajectory diagrams), c. 1972
Six pages from *Xenakis: Les Polytopes* (Paris: Balland, 1975), 11 1/2 x 11 1/2 inches each
Ink on vellum
Collection of Sharon Kanach

PL. 30
Polytope de Cluny, 1972–73
Archival exhibition print
11 1/2 x 9 inches
Collection of Françoise Xenakis

PL. 61

Polytope de Cluny, 1972–73
Archival exhibition print
6 x 9 inches
Collection of Françoise Xenakis

PL. 31

Polytope de Cluny (laser light show), 1972–73
Archival exhibition print
9 x 9 inches
Collection of Françoise Xenakis

Study for *Cendrées*, c. 1973
Archival exhibition print
Two sheets, 4 x 16 1/2 inches and 10 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Study for *Cendrées*, c. 1973
Archival exhibition print
11 3/4 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Cendrées (working score), c. 1973
Archival exhibition print
13 3/4 x 10 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 21

Study for *Erikhthon*, c. 1973
Ink and pencil on paper
Two sheets, 4 x 16 1/2 inches and 10 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 50

Study for *Erikhthon*, c. 1973
Ink and pencil on paper
Two sheets, 4 x 16 1/2 inches and 10 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 52

Erikhthon (pages from orchestral score manuscript), 1974
Archival exhibition print
Two pages, 17 1/2 x 12 1/2 inches each
Courtesy of Éditions Salabert, Paris

PL. 2

Iannis Xenakis on site, Mycenae, Greece, 1974
Photograph
7 x 7 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

Xenakis: Eonta, Herma & Evryali, 1975
LP album
23 x 11 1/2 inches
Collection of Françoise Xenakis
Courtesy of BVHAAST Records

Iannis Xenakis: Les Polytopes (Balland), 1975
11 1/2 x 11 1/2 inches
Collection of Sharon Kanach

Musique Architecture (Casterman), 1976
8 1/4 x 5 3/4 inches
Collection of Sharon Kanach

PL. 6
Iannis Xenakis, Seiji Ozawa, Olivier Messiaen, and their families in the Xenakis home, Paris, c. 1977
Archival exhibition print
5 x 8 inches
Collection of Françoise Xenakis

PL. 51
Study for *Jonchaies*, c. 1977
Ink and pencil on paper
11 3/4 x 16 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 40
Diatope (light score), 1978
Color pencil and permanent marker on computer printout
15 x 20 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 38
Diatope, 1978
Archival exhibition print
7 1/2 x 8 1/4 inches
Courtesy of Bruno Rastoin

PL. 39
Diatope (laser lights), 1978
Archival exhibition print
8 x 12 inches
Courtesy of Bruno Rastoin

Program for *Diatope*, 1978
7 1/4 x 8 1/4 inches
Collection of Sharon Kanach

PL. 64
Mycènes Alpha (UPIC score), 1978
DVD of hand-drawn UPIC score of *Mycènes Alpha* with corresponding, computer-generated music from a 2001 recording
10:00 minutes
Courtesy of Françoise Xenakis and Mode Records

Program for *Polytope de Mycènes*, 1978
8 x 9 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 35
Polytope de Mycènes, 1978
Archival exhibition print
8 x 12 inches
Collection of Françoise Xenakis

PL. 34
Study for *Polytope de Mycènes* (site plan of performance), c. 1978
Pen on paper
8 1/2 x 11 3/4 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 37
Study for *Polytope de Mycènes* (performance matrix), c. 1978
Ink and pencil on paper
8 1/2 x 11 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 36
Study for *Polytope de Mycènes*, c. 1978
Pen on paper
11 1/2 x 11 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 44
Study for Cité de la Musique, 1984
Ink on paper
12 1/2 x 9 1/2 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 45
Cité de la Musique (aerial perspective and elevation), 1984
Ink on vellum
9 x 12 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 46
Studies for Cité de la Musique, c. 1984
Ink on paper
20 x 20 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 47
Studies for Cité de la Musique, c. 1984
Ink and pencil on paper
14 x 21 inches
Iannis Xenakis Archives, Bibliothèque nationale de France, Paris

PL. 63
L'UPIC du CEMAMu: Ordinateur à Composer Conçu par Iannis Xenakis, c. 1987
Booklet
16 1/2 x 8 1/4 inches
Collection of Sharon Kanach

PL. 65
Iannis Xenakis, c. 1995
Archival exhibition print
25 x 17 1/2 inches
Collection of Françoise Xenakis

PL. 10
Atrium of Convent of La Tourette showing undulating glass panes, 2004
Archival exhibition print
5 x 7 inches
Collection of Sharon Kanach

PL. 12
Convent of La Tourette (west and south façades), c. 2004
Archival exhibition print
5 x 7 1/2 inches
Collection of Sharon Kanach

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Photographs by Wouter Hagens [PG. 27]; Adelmann [PL. 1]; Andersen [PL. 65]; Sven Sterken [PL. 12]; Bruno Rastoin [PLS. 38,39]; and Sharon Kanach [PL. 10].

LIST OF RECORDINGS

Concret PH, 1958
2:44 minutes
Electronic Music, 2000
Courtesy of EMF Media

Metastaseis, 1953–54
Performed by Orchestre Philharmonique du Luxembourg and Arturo Tamayo
7:41minutes
Xenakis: Orchestral Works, Vol. 5, 2008
Courtesy of Timpani Records

Pithoprakta, 1956
Performed by Orchestre Philharmonique du Luxembourg and Arturo Tamayo
10:35 minutes
Xenakis: Orchestral Works, Vol. 5, 2008
Courtesy of Timpani Records

Achorripsis, 1957
Performed by Orchestre Philharmonique du Luxembourg and Arturo Tamayo
6:44 minutes
Xenakis: Orchestral Works, Vol. 5, 2008
Courtesy of Timpani Records

Polytope de Montréal, 1967
Performed by Ensemble Ars Nova de l' O.R.T.F. and Marius Constant
6:37 minutes
Iannis Xenakis, 2003
Courtesy of Edition RZ

Polytope de Cluny, 1972
24:26 minutes
Electronic Works, Vol. 2, 2008
Courtesy of Mode Records

Persepolis, 1971
Remixed by Daniel Teige, 2003
50:57 minutes
Iannis Xenakis, 2003
Courtesy of Edition RZ

La Légende d'Eer, 1977
Performed by Cologne West German Radio Symphony Orchestra
47:02 minutes
La Légende d'Eer, 2003
Courtesy of Naïve Records

Terretektorh, 1965–66
Performed by Ensemble Ars Nova de l' O.R.T.F. and Charles Bruck
15:08 minutes
Iannis Xenakis, 2003
Courtesy of Edition RZ

Erikhthon, 1974
Performed by Orchestre Philharmonique du Luxembourg, Hiroaki Ooï and Arturo Tamayo
17:31 minutes
Iannis Xenakis, 2005
Courtesy of Timpani Records

Mycènes Alpha, 1978
9:54 minutes
CCMIX: New Electroacoustic Music from Paris, 2001
Courtesy of Mode Records

Ivan Hewett studied music at Oxford University and went on to study composition at the Royal College of Music. Through the 1980s and '90s he taught music history and theory at Birkbeck College, University of London, and was a regular contributor to the *Musical Times*, *Prospect*, and other magazines. Since the late '90s he has taught at the Royal College of Music, and in 2003 published *Music: Healing the Rift* (Continuum). He is currently the *Daily Telegraph*'s Chief Music Critic and a presenter on BBC Radio 3's new music series "Hear and Now."

Sharon Kanach is the translator of Iannis Xenakis's *Arts/Sciences: Alloys* (1985) and of the revised and enlarged edition of his *Formalized Music* (1992). She is the co-author (with Iannis Xenakis) of *Music and Architecture* (2008) and co-editor (with Makis Solomos and Benoît Gibson) of the projected nine-volume Critical Edition of the composer's writings and unpublished papers. As General Editor of the "Xenakis Series" at Pendragon Press, Kanach is currently compiling *Performing Xenakis* (2010), a new volume of thirty essays from Xenakis champions from fourteen different countries. Since June 2007, Kanach has been acting vice-president and artistic director of the newly refounded Centre Iannis Xenakis in Paris (formerly CCMIX and Ateliers UPIC, originally created by Xenakis in 1985). She oversees the publication of Xenakis's scores at Editions Salabert – Universal Music Publishing, and actively collaborates with Mode Records, New York, in compiling Xenakis's complete recording œuvre. Kanach also presides over the "Xenakis Project of the Americas," a not-for-profit entity based in New York City which operates under the auspices of the Brook Center for Music Research and Documentation at the CUNY Graduate Center.

Carey Lovelace is a journalist, critic, curator, and playwright. She has written for publications including *Art in America*, *Artforum*, *Flash Art*, *Harper's*, *International Herald Tribune*, and *The New York Times*. From 2003 to 2006 she was co-president of the U.S. chapter of the International Association of Art Critics. Among the exhibits she has curated is the 2008 *Making It Together: Women's Collaborative Art + Community* at the Bronx Museum of the Arts. Lovelace holds a BFA in music from California Institute for the Arts, where she studied music composition with James Tenney and Leonard Stein. She also studied composition in Paris with Iannis Xenakis, Olivier Messiaen, and John Cage.

Mahki Xenakis is an artist, author, and the daughter of Iannis and Françoise Xenakis. She was born in Paris in 1956. While living in New York City in the late 1980s, she had a decisive encounter with Louise Bourgeois, which led to the publication of *Louise Bourgeois, l'aveugle guidant l'aveugle* (1998; translated into English in 2008 as *Louise Bourgeois. The Blind Leading The Blind*, Actes-Sud/Lelong). She has since published five other volumes with Actes-Sud. Her artworks are in the collections of the Fond National d'art contemporain, the Centre Pompidou, Manufacture nationale de Sèvres, and the Bibliothèque Nationale de Paris. She lives and works in Paris.

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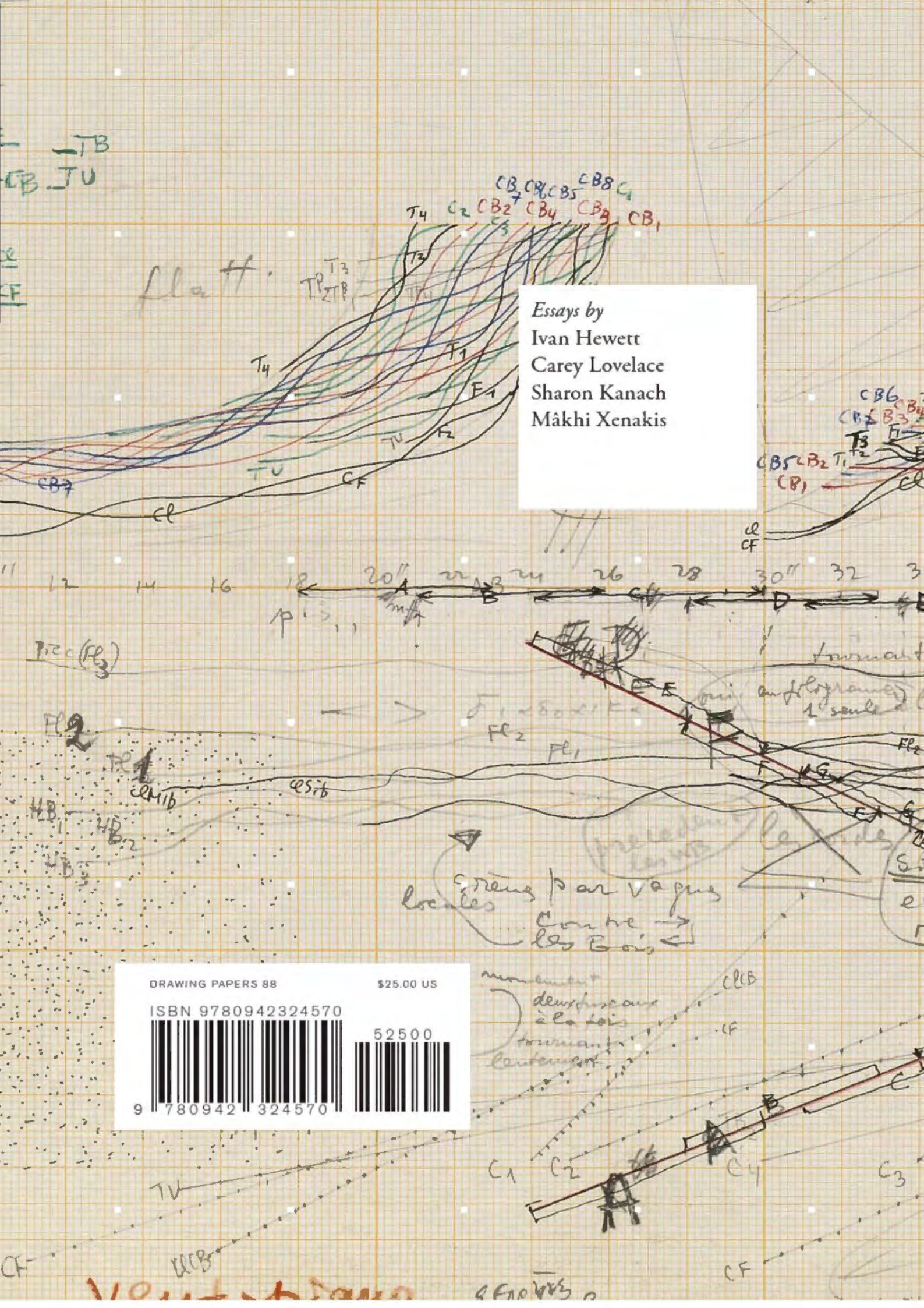

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