The UPIC Upside Down

François-Bernard Mâche

As the original form of the UPIC is now more a memory than a still-available device, and since I may have been its first user, after Xenakis, I will begin by evoking some historic landmarks which characterized the origins of the UPIC system, and justify the way I intended to make use of it. I used the UPIC not only as a graphic synthesizer transforming drawings into sounds, but also the other way around; that is, transforming sounds into workable drawings, and I will explain my reasons for making such a choice.

Xenakis had abandoned Pierre Schaeffer's Groupe de recherches musicales in 1962. He was disappointed by Schaeffer's hostility towards *Bohor* (1962), a piece Xenakis dedicated to him. He was also hurt by Pierre Boulez's criticism of *Eonta* the following year, 1963. Xenakis began teaching that same year in the USA at Tanglewood, and then a couple of years later, at Indiana University, Bloomington. But neither Schaeffer nor Boulez, nor Xenakis's American employers were willing to seriously support his project of a center devoted to music synthesis by digital means. His use of mathematics and references to physics had to remain purely intellectual until he founded the EMAMu (Équipe de Mathématique et d'Automatique musicales), in 1966, with the support of high-level computer scientists, and philosophers like Dufrenne, Francès, Revault d'Allonnes and Levi-Strauss.[1] The EMAMu, first hosted in the École pratique des Hautes Études, was connected to the nuclear physics laboratory of the Collège de France in 1969 thanks to the physicist Louis Leprince-Ringuet. Also in 1969, Xenakis was requested by then-President Georges Pompidou to collaborate with Pierre Boulez on the creation of a new institution to be called IRCAM (Institut de Recherche et de Coordination Acoustique/Musique), devoted

to science allied to music, and they both publicly presented the project. But soon Boulez, being more skilful than Xenakis at dealing with politicians, ousted Xenakis and remained solely responsible for IRCAM.

In 1972 the EMAMu became the CEMAMu, which at last was equipped with a digital-to-analog converter built by the Centre National d'études des télécommunications. The system was a digital drawing table, the same size as the desk on which Xenakis had been elaborating his scores as well as his architectural projects. Here one drew on tracing paper with a special pen, both electric and graphic. The scale of the millimetric surface could be selected, so that the vertical axis could correspond to any interval, and the horizontal axis to any duration. Practically no limits were fixed to the amount of simultaneous time and pitch units, called *arcs*, since one single so-called *page* could comprise up to 2024 arcs. Each page had access to 128 envelopes in one bank, and they could be combined. Similarly, 128 waveforms were stored in another bank. The normal ambitus of a page was 6 octaves, but it could also be fixed to up to 10 octaves, including infrasounds and ultrasounds, or be limited to a very small interval. One could choose either discrete pitch steps or continuous lines. Such a page could be used to elaborate one sound, one sequence, or the whole composition.

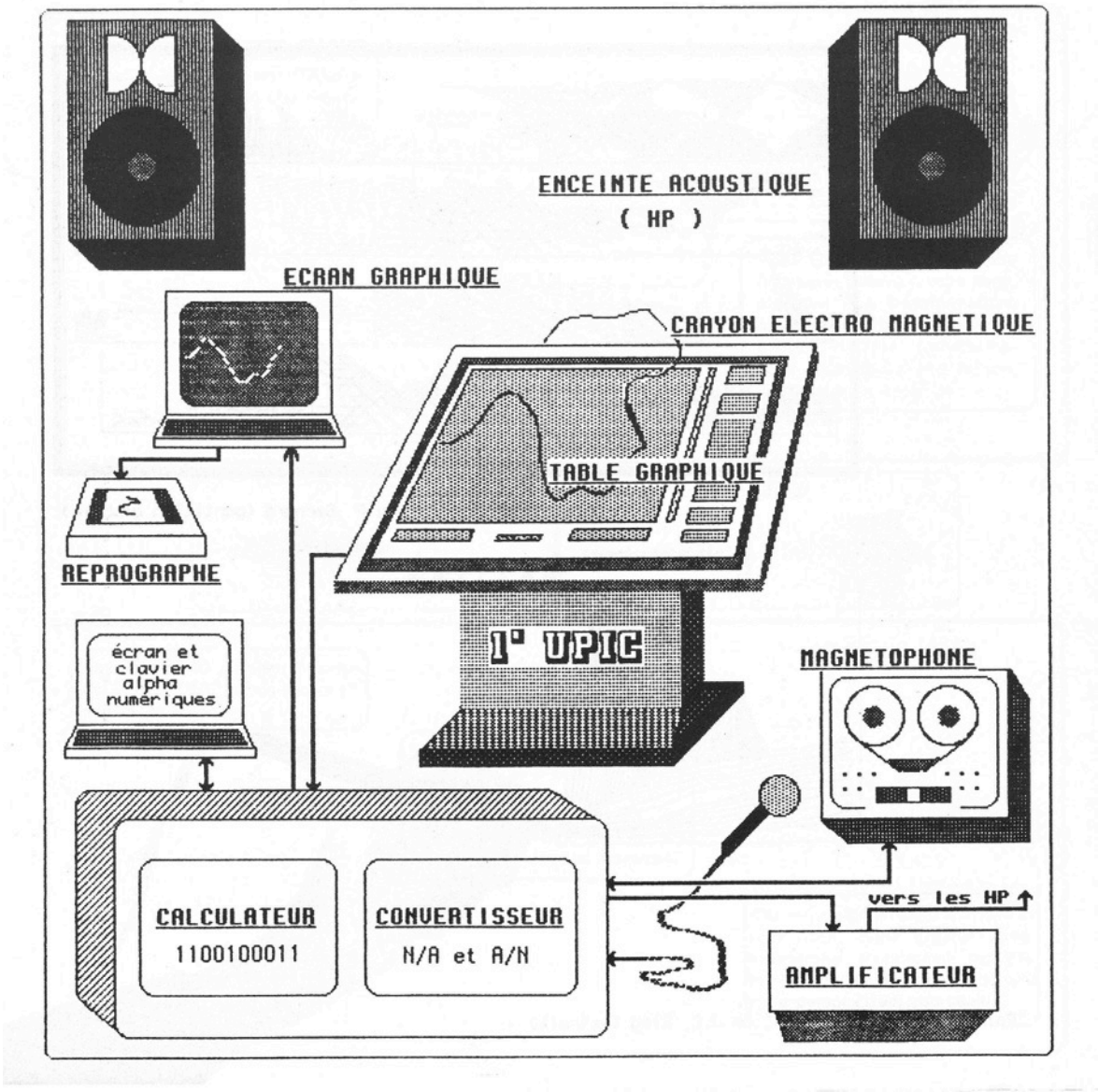

Figure 1: Schematic of the UPIC's setup from an internal document of Les Ateliers UPIC: *L'UPIC du CEMAMu*, n.d., n.p.

The same year, 1972, I had composed *Korwar*, for harpsichord and tape. The tape organized sounds taken from speech (in Xhosa), frogs, birds, boars, whales, and rain. I also published a paper entitled "La musique est une fonction biologique" ("Music is a biological function"). The main themes of this paper were:

• There is no purely acoustic difference between noise and music, or between natural sound and human-made music. What matters is the encounter between thought and sounds, which depends mainly on context.

• The musical atom is neither a note nor any quantum, but a *quale*, a difference similar to the one that exists between phonetics and phonology.

• Music is not basically a message, but a biological function, which is not limited exclusively to the human species, and which probably has its roots in playing.

• Cage is wrong in rejecting any voluntary action on the sounds. Nature only acquires meaning when responding to humankind's respectful action.

The same year, 1972, I shared with Xenakis a monographic issue of the review *l'Arc*, where I had published an article entitled "Xenakis and Nature." We were close friends, but we had different orientations. Xenakis appreciated nature as much as I appreciated rationality, but with different outcomes. I was both willing to support the UPIC and curious to explore its possibilities, someday, in spite of harboring a basic distrust about any systematic approach, such as serialism. My own experience of musique concrète since 1958 had taught me that there is often something more interesting and richer in acoustic, natural sounds, than in synthesized structures that *a priori* follow some fixed system.

In 1977, two years before the commercial release of the first digital sampler, the Fairlight CMI, I started exploring the UPIC; that is, its first version. At that time, it was far away from real-time computing, and long waits were needed before one could discover the sounds that corresponded to the drawings on a page. I particularly realized that remarkable drawings did not guarantee remarkable sounds, or even simply meaningful results, and that they often conveyed misleading illusions.

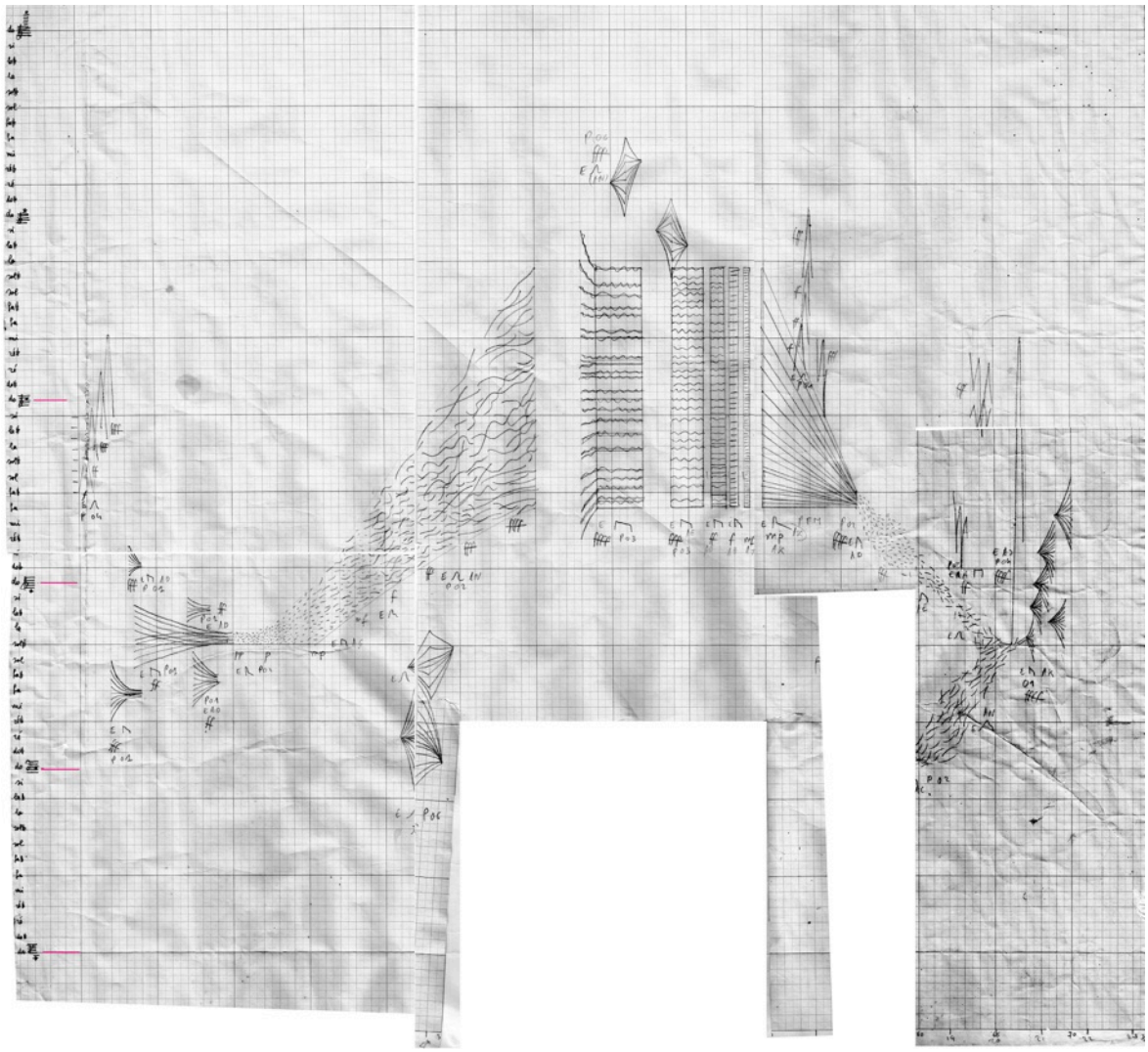

Figure 2: Page 12.12.77 (tracing paper 5 octaves, 1 semitone = 1cm). This was part of my first essay on UPIC, 1977 © François-Bernard Mâche.

In 1978 Xenakis composed *Mycènes alpha*, the first piece entirely composed on the UPIC, which was premièred on the 2nd of August at Mycenae in Greece, where the composer was at last authorized to return, 30 years after his death sentence *in absentia*. We can see in it a fascinating visual analogy to da Vinci's analytical drawing of vortices.

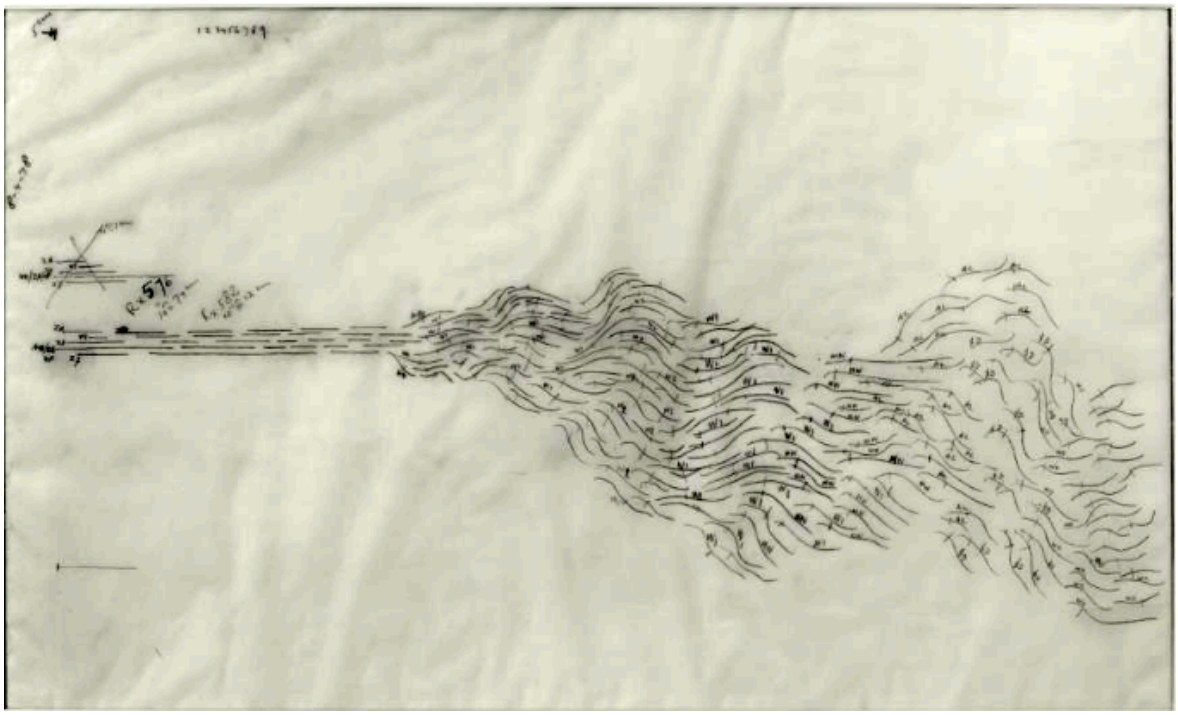

Figure 3a: *Mycènes Alpha*, Iannis Xenakis, UPIC score sketch, 1978 © Archives CIX.

Figure 3b: Excerpt from Leonardo da Vinci's notebooks © Wikimedia Commons.

In 1979 I heard about the first digital sampler. Unfortunately, it was extremely expensive and therefore first reserved for entertainment music. The same or the next year, Publison commercialized its DHM89B2 and KB2000, later nicknamed "the French Infernal Machine 90", (an English name, probably to appear more serious and reliable…),

and met with immediate success. I talked about it to Xenakis, who taught me that the UPIC had an analytical feature which might yield some comparable results.

Figure 4a: Image of the DHM89B2 harmonizer which was the first sampler in the history of music by Publison, 1978 © Soundgas.

Figure 4b: Image of the Three Octave Keyboard KB 2000 by Publison, 1980, source: http://www.preservationsound.com/wp-content/uploads/2013/05/Publison_Infernal.pdf

Among other possibilities, the DHM offered a harmonizer, an envelope generator, an evolutive vibrato, a delay, a reverb, etc. The keyboard allowed separate treatment of pitch and duration; for example, automatically keeping the duration of a sample when transposing its pitch. I used that in the finale of *Aulodie* in 1982, where a soloist synchronizes in unison with the complex rhythms of two recorded tracks.

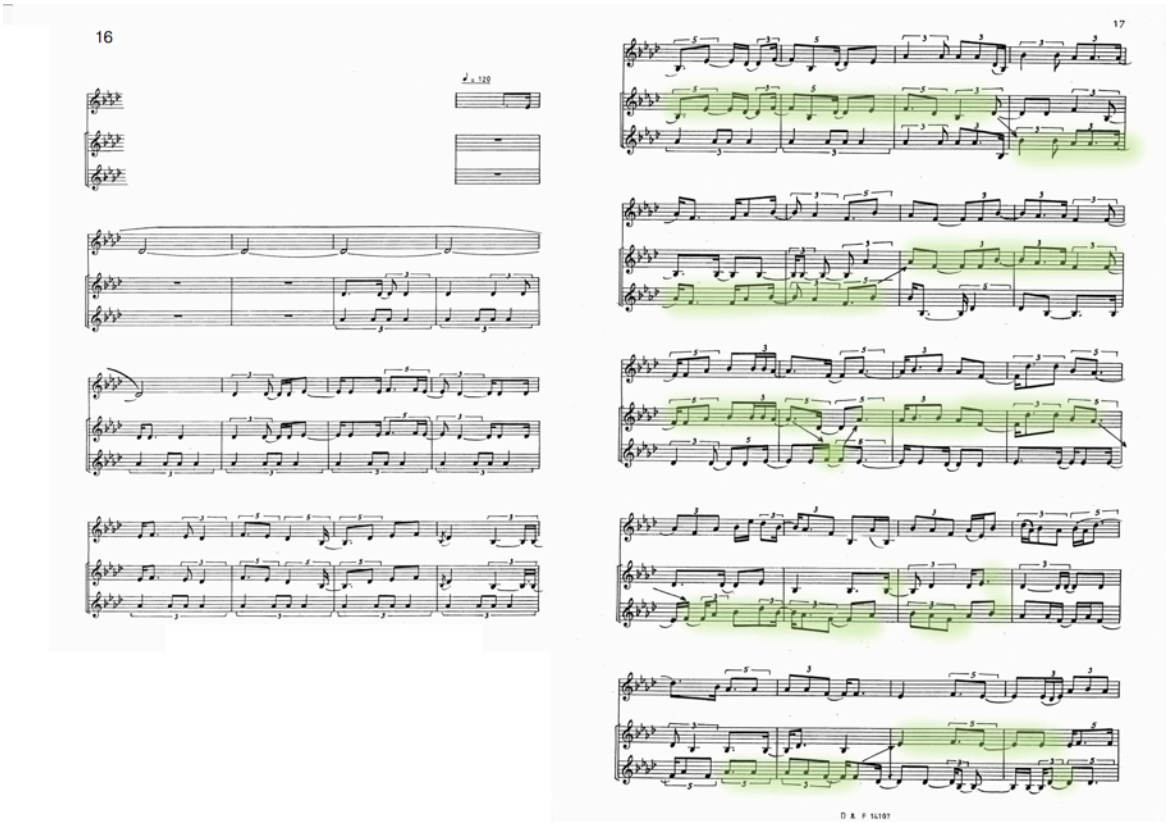

Figure 5 : *Aulodie,* François-Bernard Mâche, finale (page 16 and 17), 1983 © François-Bernard Mâche.

Insert sound file: *Aulodie* excerpt by Ruth Velten, soprano

François-Bernard Mâche, *Aulodie*: Ruth Velten, soprano saxophone, CD Genuine GEN 16424, score: éditions Durand, excerpt: from 7'21" to 7'53".

A few other historic details explain my expectations about the UPIC. In March 1980, Xenakis was the supervisor of my doctoral dissertation: “The Idea of Model in Today’s

Music.*"* Four months later I received a commission to write music to accompany an exhibition near Avignon, whose theme was "Water," and I composed four "*Phonographies de l'eau*," a term I had coined 17 years earlier to refer to art that parallels music just as photography parallels painting. Walter Ruttmann's *Wochenende* (Weekend) from 1930, a talking movie without pictures, was probably the first example of such an art. Already in 1980 the UPIC could function as a crude sampler, respecting the pitch of a sound signal, but allowing some rhythmic invention. One of my *phonographies*, entitled *Proteus* (1980), used this possibility. Unfortunately, I was the only composer interested in such a function, which subsequently disappeared from the newer versions of the UPIC; otherwise it could easily have developed a full sampling capacity.

Insert sound file: Amphibian with given rhythm excerpt (39") from *Proteus*

François-Bernard Mâche: *Proteus*: excerpt from 4'32" to 5'09", unpublished, © FBMâche.

At that time Jean-Claude Eloy composed *ETUDE IV: Points-Lignes-Paysage* (1978–80) on the UPIC, and I composed *Hyperion* (1981) entirely on the same system. At Xenakis's request I was teaching a course entitled *Music composition in the biosphere* at Paris 1 University. In tune with my practice of natural models, I used the ability of the UPIC to extract two features from different sounds: dynamic envelopes and spectrum waveforms. Most of my models were different animals, plus a few non-European instruments like the Ethiopian *bagana*. For the second time I used technology which enabled me to analyze natural models with greater accuracy than pure listening. I had done something similar in 1964, using a Kay electric spectrograph for speech analysis in *Le son d'une voix*, a piece stemming from a phonetic model, which Michael Gielen conducted at the Royan Festival, and that, in fact, anticipated the spectral school by some ten years.

Insert: Hyperion (Sound File) (SK)

François-Bernard Mâche, *Hypérion*: CD Jade 015/12 19 34, excerpt from 0' à 1'58". Unpublished score, © FBM.

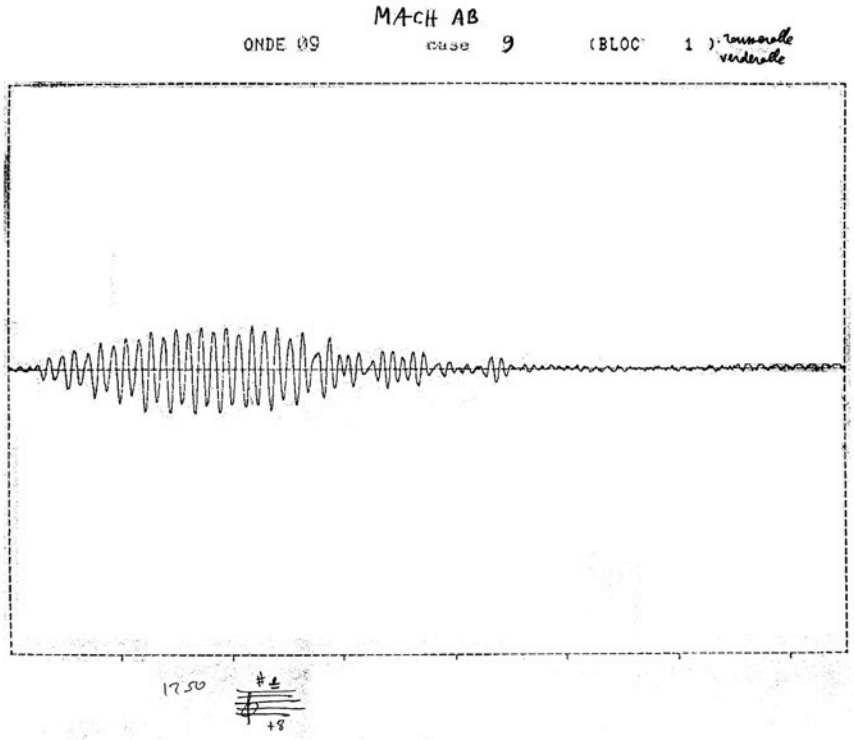

Figure 6a: Very simple spectrum of the marsh warbler (*acrocephalus palustris*), sonogram, © François-Bernard Mâche, n.d.

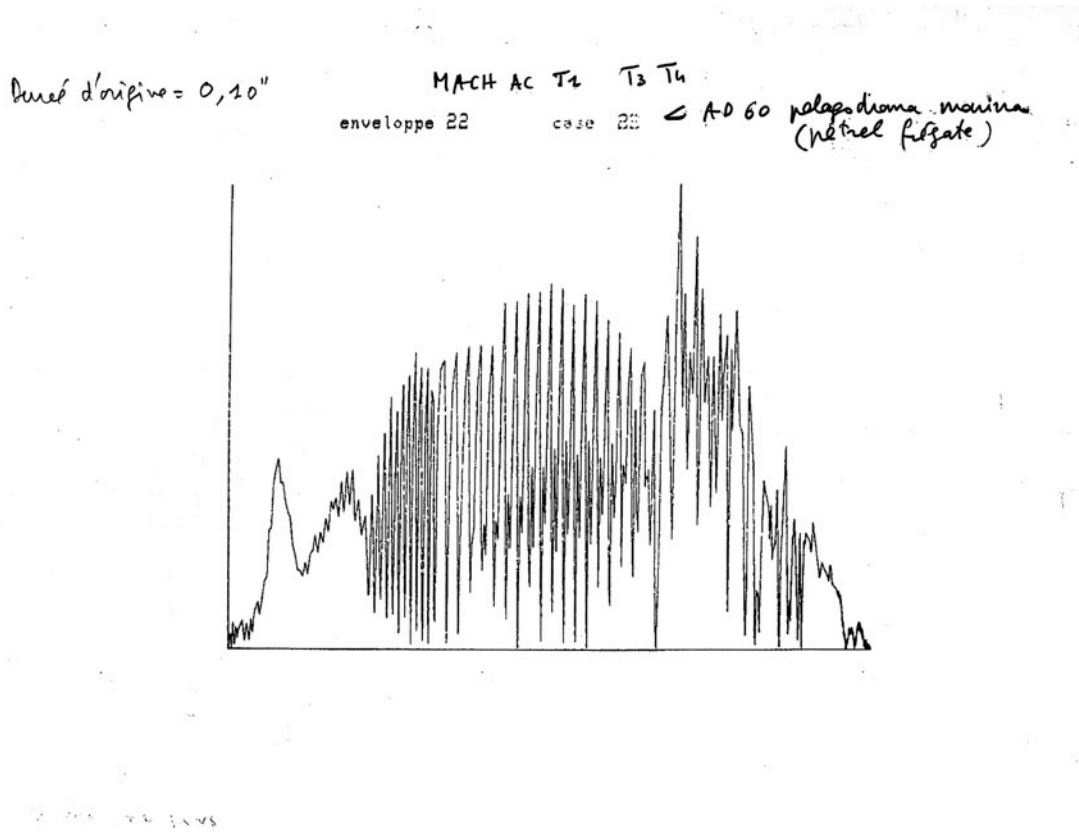

Figure 6b: Complex envelope of the white-faced storm petrel (*pelagodroma marina*), sonogram, © François-Bernard Mâche, n.d.

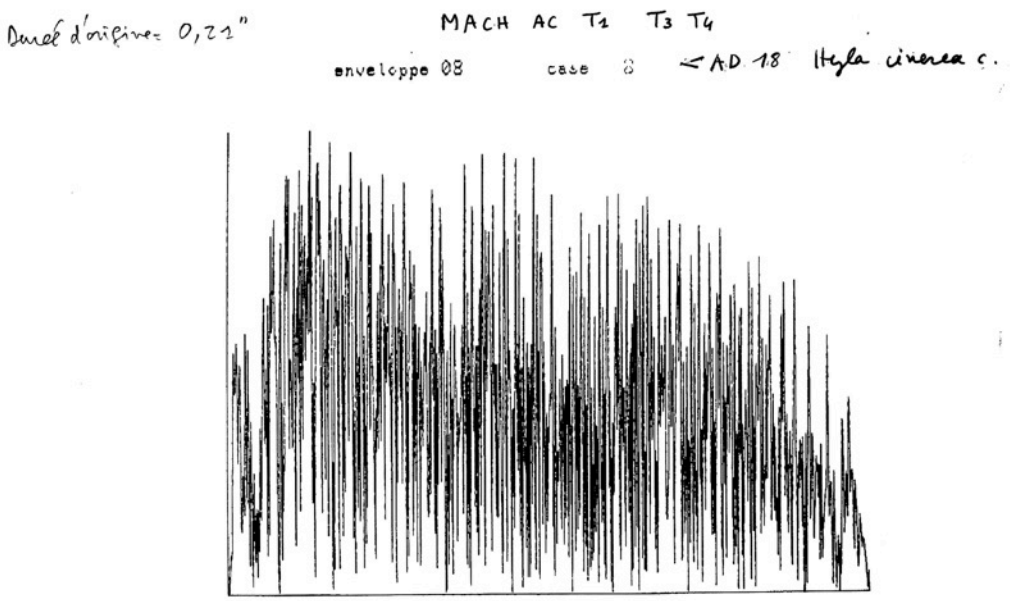

Figure 6c: And an even more complex envelope of the frog (*hyla cinerea*), sonogram, © François-Bernard Mâche, n.d.

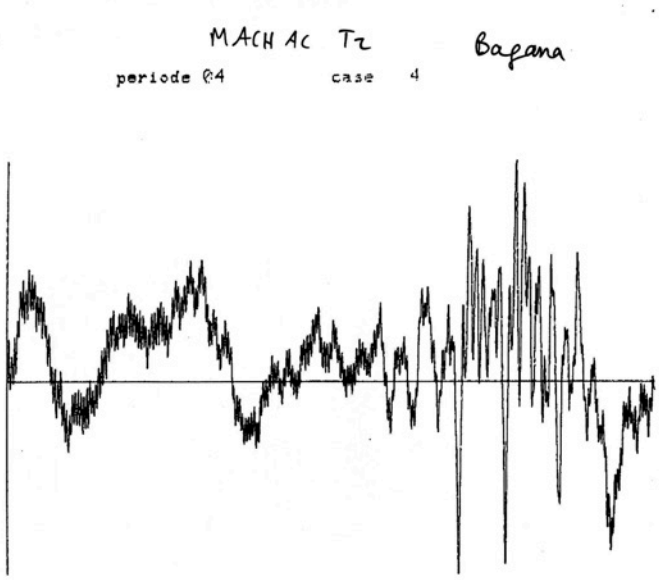

Figure 6d: Waveform of a *bagana*, the great lyre from Ethiopia, sonogram, © François-Bernard Mâche, n.d.

While experiencing some morphing, that is, combining dynamic envelopes and waveforms coming from different analyses, I noticed that using complex envelopes with simple waveforms was much more efficient than the other way round (complex waveforms with simple envelopes). The nature of synthetic timbre did not so much depend on the common view of steady spectrum contents, but chiefly on the multiple small dynamic movements of the envelope. At the same time, Jean-Claude Risset was scientifically developing his analysis of sounds and could describe the same phenomenon with great accuracy, leading henceforth to more subtle synthesis of acoustic instruments. The

beginning sequence of *Hypérion* is made with the simplest sine waveform associated with complex envelopes, and with a background using slow continuous glissandi. This work was premièred at Lille on November 4, 1980 (partial), and in Paris on June 19, 1981 (complete).

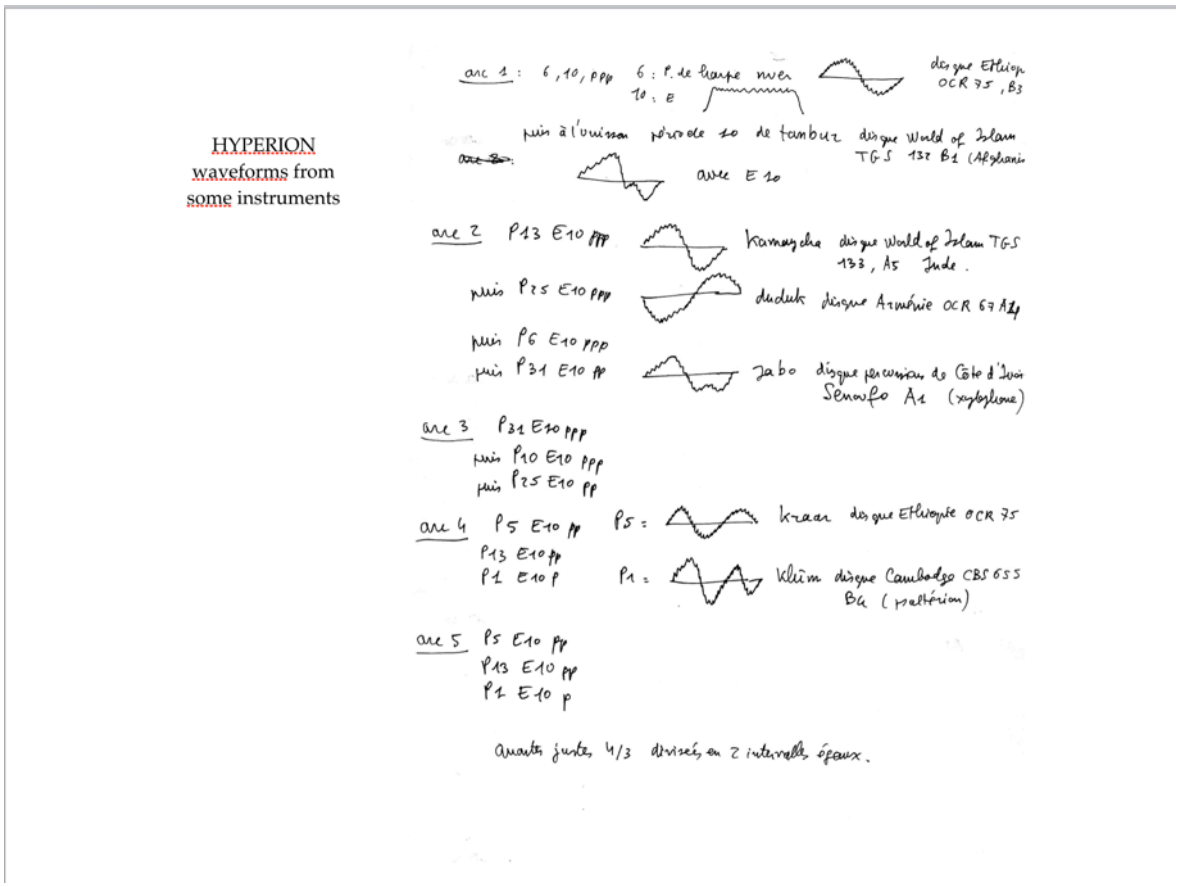

Figure 7: *Hypérion*, François-Bernard Mâche, page 1b (waveforms from "exotic" instruments), 1981 © François-Bernard Mâche.

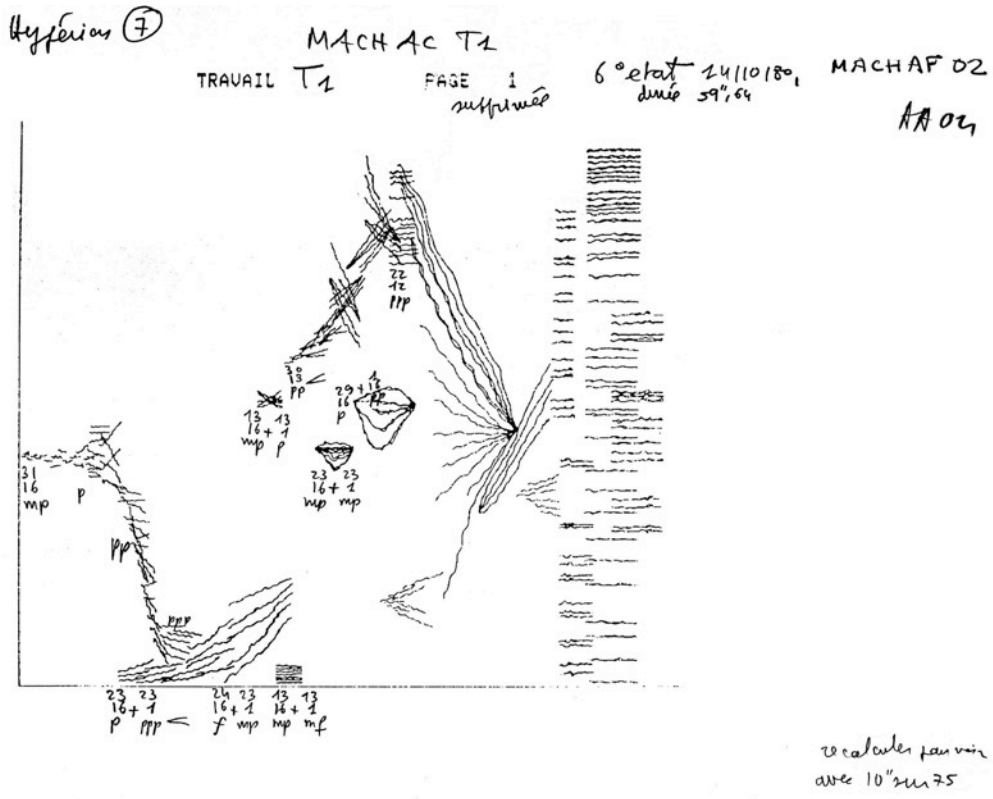

Figure 8: *Hypérion*, François-Bernard Mâche, page T1, 1981 © François-Bernard Mâche.

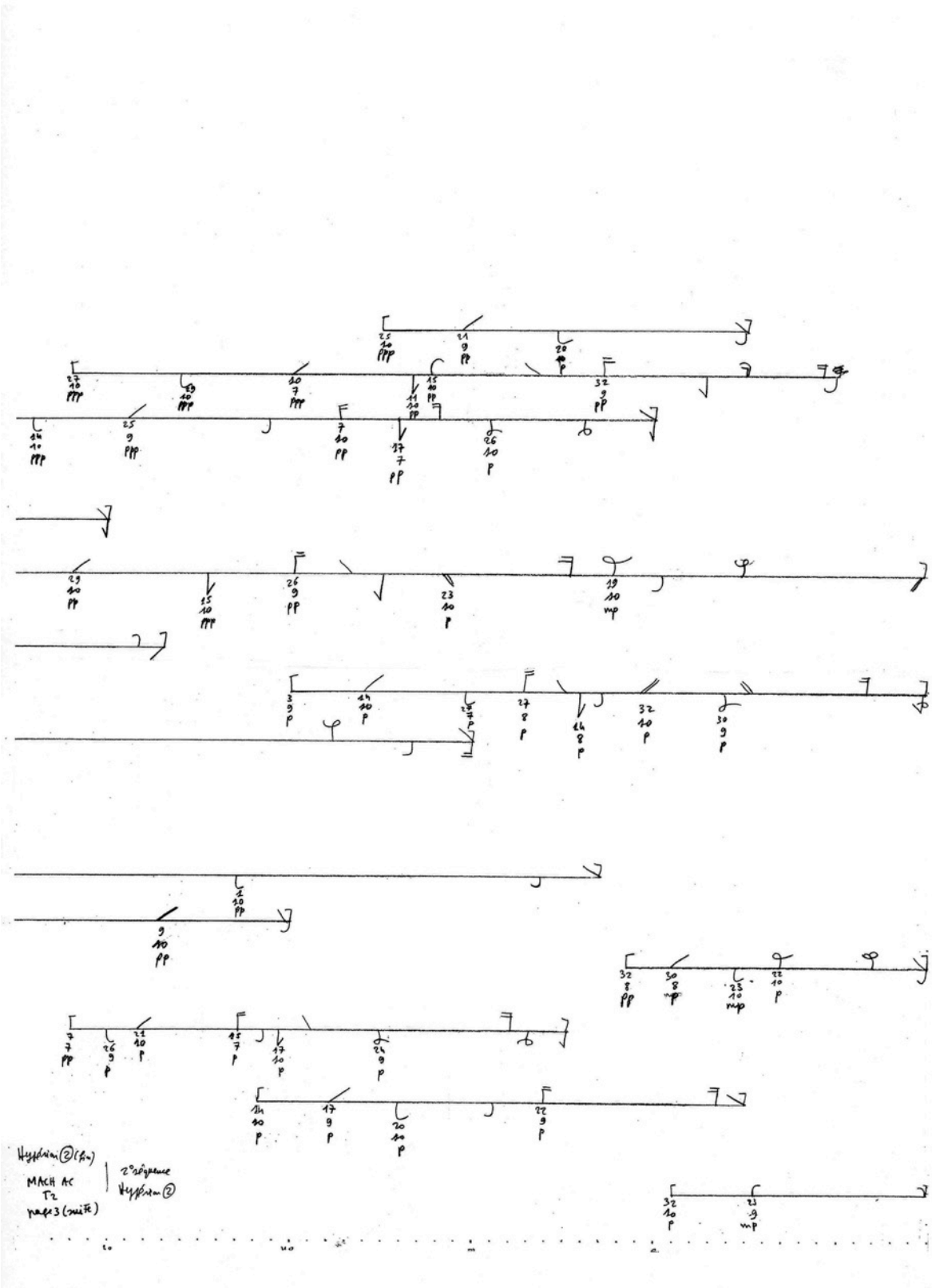

Figure 9: *Hypérion*, François-Bernard Mâche, notation of evolving unisons, 1981 © François-Bernard Mâche.

Three months after *Hypérion*, in 1981, I tried quite a different experience in *Nocturne*, a piece for piano and tape. The electronic tape was made on the UPIC as a complex canon of melodic contours. A basic outline of some 20 arcs was varied at different durations, registers, ambitus, intervals, and waveforms, initiating complex canonic counterpoints between the soloist and the tape, and between different layers on the tape itself. The intervals of the contour could change in many ways, although without ever changing their direction.

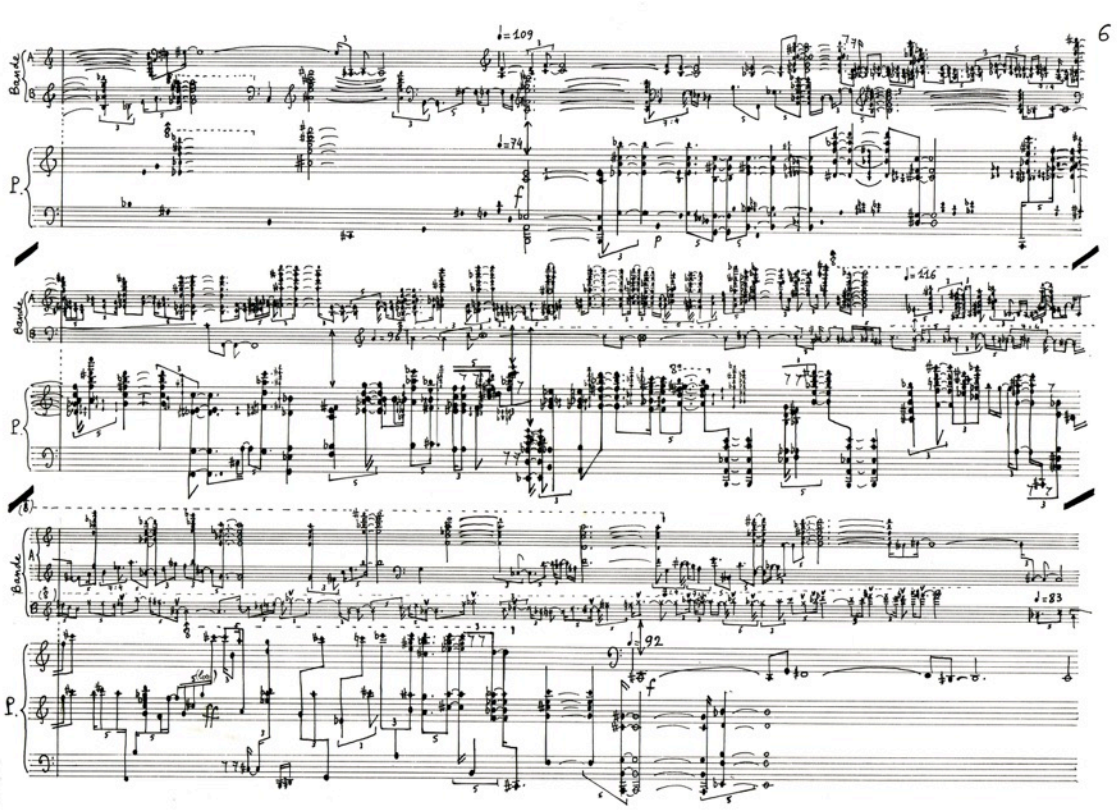

Figure 10: *Nocturne*, François-Bernard Mâche, page 6, 1981 © François-Bernard Mâche.

Insert sound file

François-Bernard Mâche, *Nocturne*: Andrew Infanti, piano, score: éditions Durand, CD Musiques sournoises (2001), excerpt from 5'51" to 6'42".

The idea of such a particular canon had some affinities on the one hand with Xenakis's arborescences, as he developed in *Synaphai* (1969), for example, and on the other hand with Mandelbrot's fractals, which at that time had been fashionable among artists for 10 years or so.

After 1983 I used the UPIC more rarely, in spite of the new possibilities of listening to the results of drawings in real time, which, in fact transformed it into a kind of live instrument fit for the stage. The reason is that samplers were finally becoming affordable, and I thought they could cumulate the benefits of handling any kind of sounds, any scales, with all the flexibility of musical instruments, all while offering the liberty to overcome their limits and routines. Hence, from 1983 on, I rather used the "French Infernal Machine" which I already mentioned above. And as soon as the Mirage could be purchased, I managed to buy one. That was in 1985, which was also the year when Les Ateliers UPIC were founded. I presided over it for several years, and, in France as well as abroad we hosted a great number of training sessions, concerts, residencies for foreign composers, and various educational activities.

Two years prior to this, I had been elected Professor of Musicology, and Director of the Music Department at the Université de Strasburg. There, I managed to raise the funds to buy a UPIC system, and in 1987 I organized a center and targeted curriculum called *Primus*, in order to train *Tonmeister* (sound engineers) capable of reading a score, of possibly writing one themselves, and of managing recording and post-recording sessions, something that did not exist in France at that time. The students also learned to work with the UPIC system. We had it along with a Fairlight VT5 Voicetracker (acquired in January 1986) to transform sounds into midi data. Personally, I owned a Commodore computer (as

of May 1986) and soon got a sampler better than the Mirage, namely an Akai S900, which I used for my pieces *Aliunde* (1987), *Tempora* (1988), and *Kengir* (1991). Among the samples I used, many were borrowed from the UPIC.

Tempora was written for three samplers, each one with a Midi keyboard, and they played animal sounds as well as synthetic or acoustic samples, all working as imaginary instruments. I believed that whole orchestras made of, or including, samplers would soon be available and grant electronic sounds the same possibility of expression that the traditional acoustic instruments had kept. The UPIC itself had already acquired the flexibility of a real-time music instrument. The commonplace of endless crossfades between audio fluxes would no longer be the main way of developing an electronic work. What a deception when I was soon to realize that such a beautiful dream was hopeless! Everything in the electronic business, and specifically in the digital acoustic domain, was ruled by the sole obsession with profit, and with innovation at all costs being the motto (be it smoke, mirrors, or real); this made programmed obsolescence a rule. For many electronic compositions, the only hope for a long survival would be henceforth inevitably brought back to unchanging recordings, since porting to new sampling platforms is hardly possible, and anyhow, even when successful, doomed again to shorter and shorter life expectancy. Most of the time, digital archives will die before their authors. With regards to the UPIC, its current survival in the Université de Rouen, under the form of "UPIX" (for Windows in 2001, and more recently for other platforms like UPISketch for mobile devices), is so far one of the few notable exceptions.

My last commitment for a composition entirely made with UPIC was in 1987, when I started composing *Tithon*. In 1980, on a Greek island, I had the opportunity to make a

close recording of an interesting insect, probably a “wart biter” (*decticus verrucivorus*), which had ventured into my house. Contrary to the monotony of many insects, the song of this one was rhythmically varied and even contained a hidden melody. I decided to adopt it as a model. Here are some extracts of its song and of the treatments I applied to them, thanks to the UPIC and some other devices.

***Tithon* (1980) by François-Bernard Mâche, sound excerpts**:

1. Extract from the original recording (46")
2. Other extract, at a slower pace: minus 1 octave (13")
3. Same kind of rhythmician insect (wart biter = *decticus verrucivorus*) 19"
4. Sound of the hidden melody (30")

The hidden melody
(Audiosculpt)

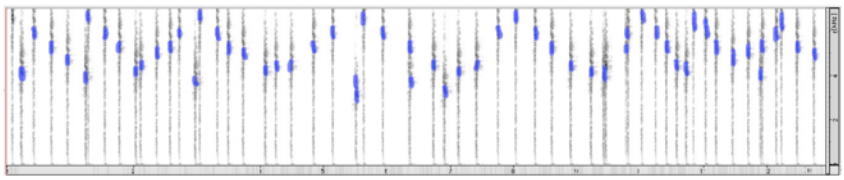

Figure 11: *Tithon*, François-Bernard Mâche, hidden melody emphasized with the software AudioSculpt by IRCAM, 1980 © François-Bernard Mâche and AudioSculpt.

5. Same melody minus 3 octaves. 45"
6. A midi file from the same melody (through Melodyne), (just for fun, for in the end I did not use the melody at all…) 45".

Tithon is not a program music, even if the title refers to a beautiful Greek legend, which I cannot help telling. Dawn is in love with *Τιθωνός*, a beautiful Trojan prince, brother of Priam, and nephew of Ganymedes. He is also in love with her since the day

when she abducted him one morning while he was leading his flock. At that time princes could also be shepherds. Sometime later they had two children, and Dawn started feeling worried about their future. Her husband Tithonos, being a nephew of Ganymedes, had access to Olympus. She decided to beg Zeus to grant Tithonos immortality. Zeus is usually very thrifty with such favors, but he accepted, taking into account the extended, distinguished service of Dawn. The only problem was that she forgot to also require eternal youth for her lover. Day after day Tithonos deteriorated, until he shriveled and shrunk to such an extent that he became a poor grey thing hanging on some sprigs, hereinafter referred to as a "cicada." But he was still in love with Dawn and greeted her loud and clear every morning.

Tithon is not a program music, but nearly every sound originated in insect recordings, and the piece is imbued with different moods, typically blooming in summer, like insects' songs.

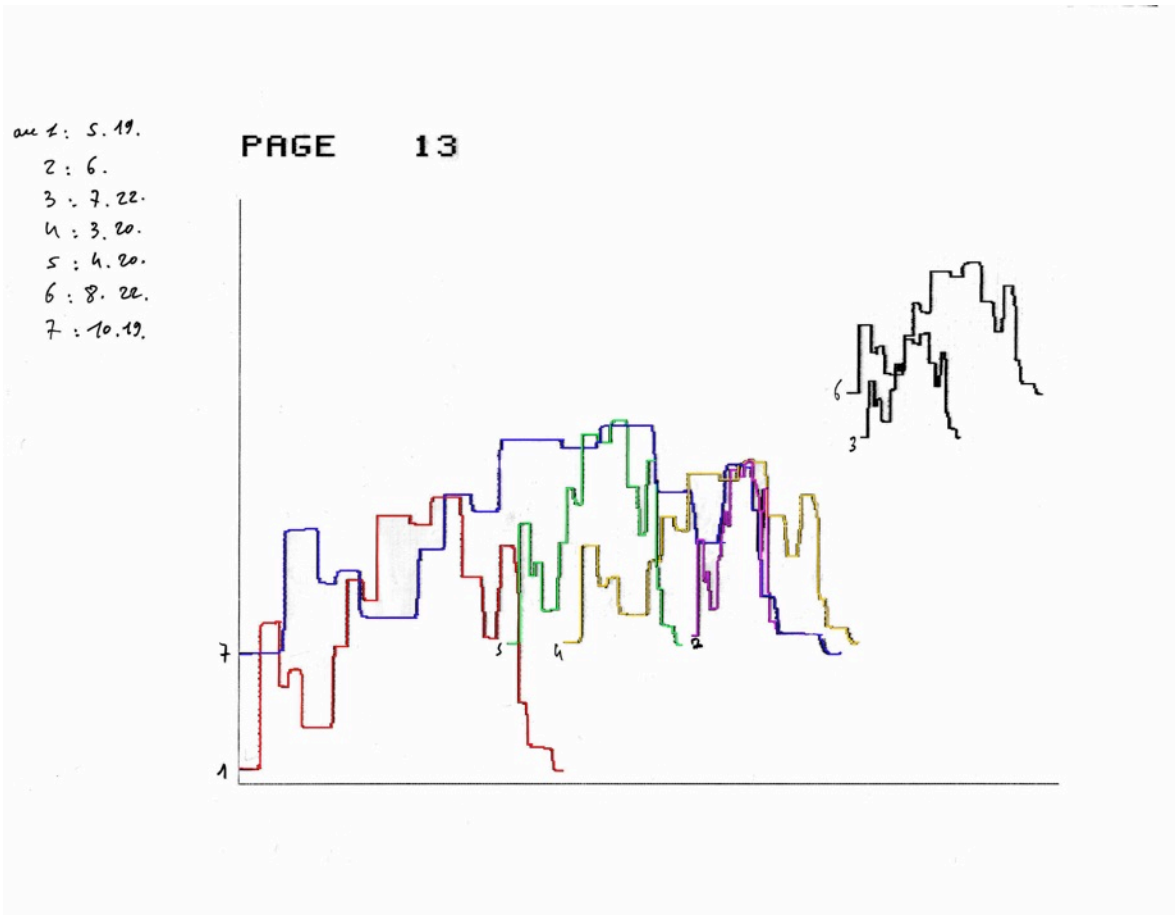

Figure 12: *Tithon*, François-Bernard Mâche, page 13, each of the seven colors represents a particular waveform for the chosen contour, 1980 © François-Bernard Mâche.

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In guise of a conclusion I would like to move from an historic recapitulation to a tentative reflection about the future of what UPIC and the like represent. In spite of their many drawbacks, there are so many benefits in computer music and bioinformatics that I think they will not be abandoned. With data processing, the composer can conceive as a whole the laws of assembly and the sound identity of what is assembled. Instead of dealing with all the limited possibilities and constraints which a music instrument offers, it seems that there are no limits other than those of his/her own competences and imagination. A computer can be commanded to produce such or such sequence of preset sound events

according to laws which will have been formalized in a program, and this program, for example, can itself present all the complexity and the training ability of a neural network. Instead of subjecting writing music to the auditive anticipation of the result of a future performance, one can launch algorithms whose final sound realization is no longer entirely foreseeable. This approach, to this day, having allured more than one follower of musical data processing, presents the double character of a total rationalization — because everything, including indetermination, must be specified in a program — and paradoxically, an adventure where what is produced by the computer has the multifariousness and sometimes mysterious character of one second, factitious, nature. Instead of composing a work, some aim at composing a program suitable for generating an infinity of achievements. One thus explores the algorithms (which one believes to author), arousing an external universe of a strangeness that is sometimes threatening. This approach ends up returning the composer, assuming s/he is not absorbed in the illusion of absolute power), to his/her most traditional, and least rational, responsibilities: personal taste, intuition, experimentation, the aptitude to feel in advance the emotions s/he will organize in the duration,… all capacities without which no choice is legitimate nor even possible among the machine's sometimes innumerable proposals. The formalization of such selection criteria would be possible in its turn only if the knowledge of the human brain were complete, a still remote utopia. Thus, the way followed for one half-century by musical data processing has not been without reminding us of certain aspects of what the revolution of writing music had produced near the end of the fourteenth century. In a somewhat comparable way, some six centuries later, the computer has contributed to prolonging the experimental spirit which had dominated the 1950s and 1960s of the last century, by proposing novel facilities. It is, however, necessary to be disillusioned a little

when certain provisional appraisals are made. The computer certainly enables incredible time-savers. But a short handling error can also sometimes cause the instantaneous loss of several days of work. The complexity of certain software sometimes involves anomalies that the best data processing specialists struggle to identify, even with the help of their best repair software.

Furthermore, paradoxically, sound synthesis transformed the production of amazing sonorities into a kind of standardized category. Those, as a result, lost so much of their attraction that they could be used as a negative argument in favor of some reactionary aesthetic choices. Whereas it is easy to simulate an organ or a vibraphone almost to perfection, synthetic string instruments, however, often appear caricatural. And in any case, the results always come out of loudspeakers, with the constraints and characteristics inherent in these transmitters. Data processing seems more dedicated to providing prostheses to acoustic instruments than to replacing them, and it is C.A.D. (computer-aided design) which is undoubtedly one of the best possible uses of computers, wisely retrogressed from the role of demiurge to that of secretary. They can help outline and write scores, without the listener even suspecting their intervention. Even on this level, commercial availability of innumerable software programs for harmonization, orchestration, arrangement, and composition, can unfortunately support, along with some dose of amateurism, a certain idleness of mind. By spreading an illusion of creativity which tolerates sleepy imagination and careless listening, it often causes sound floods where the best is drowned amongst the worst. Matching the irresponsibility of the listener, transformed into a passive and inattentive consumer, looms the irresponsibility of composers fascinated by the complex proliferation of sounds of which they control neither the birth nor the evolution. In other cases, on the contrary, their irresponsibility consists in

getting a completely formalized control of a production process, without worrying much about the thought, or the absence of thought, which will result for those who are being addressed.

The composer, as a data processing specialist, is ultimately always constrained to admit that music is completely formalizable and only at the cost of a sometimes-dangerous reduction. The principal challenge that data processing confronts, by facilitating certain tasks, is to have to reflect about the difficulties inherent in a given work, even about its very finality. Ultimately, music, like any art, rests on *desire*, much more fundamental than intelligence. Data processing gives the opportunity to check what the ancient Greeks already knew: Eros, born much earlier than Zeus and Athena, nevertheless always remains young. Data processing, be it with UPIC or any other tool, should remind artists that they should be philosophers rather than technocrats.

Personally, I have always tried to combine my interest in powerful computer resources with a vision broader than technology or language. The latter maintain the musician (creative and listener) in the circle of social relationships and social emotions, while music also has a more mysterious function of harmony with nature, not only with feelings, but also with the consciousness of the limits and the natural requirements, to harmonize with invention, in order to avoid the divorce between humankind and nature. Music can contribute to sparing us certain disadvantages of hybridization with "artificial intelligences."

ENDNOTE

[1] Founding members of the EMAMu were the mathematicians Marc Barbut, François Genuys, and Georges-Théodule Guilbaud; the philosophers Mikel Dufrenne and Olivier

Revault d'Allonnes; the psychologists Paul Fraisse and Robert Francès; and the anthropologist Claude Lévi-Strauss. [SK]

F-B.Mâche, Sept. 28, 2018