MY WAY

Iannis Xenakis

HOMMAGE TO JAPAN

First of all, I would like to begin by rendering hommage to Japan which I visited for the first time over thirty years ago and which then inspired a text[1] that I would like to evoke once again:

"Cities in Japan, such as Tokyo and Kyoto, offer a visual demonstration for an artist.

"In urbanism as in art, the thinker must abandon his static conceptions, reminders of the Renaissance, and, instead, take care of the phenomena and effects created by masses, using the laws governing large numbers. In short, he must deal with statistics and retreat to a calculus.

"In contrast, the luminous advertising on large buildings is controlled by the law of greatest volume. Huge, spherical, conical, cylindrical structures are illuminated, creating a spatial cinerama which proves that soon visual art will invade the streets of large urban centres.

"Tokyo is a true city of light and not only a city where gas lamp-posts have been replaced by fluorescent lamp-posts.

"The Japanese people are living a polyvalence that make them alert and curious about everything that is new. After the assimilation of art, of culture and religion from China, there follows today a thirst for knowledge that makes the Japanese attentive to any discovery. We are far from the hypnotic and *blasé* state of Europeans who have said everything and are waiting for no more. This explains, perhaps, the extreme kindness in human relations. At each meeting, it is a renewal of acquaintances which is expressed by a long and respectful ceremony of salutations.

"One day a gentleman introduced himself and invited me to visit Kyoto and Nara. I was very much touched by this kind offer, but I objected that, not knowing the language nor anybody at all, my trip would be unrewarding. He immediately offered to accompany me as guide. He made me live Japanese style in Kyoto and showed me around the city. I could not but compare this attitude to the indifference and the

self-sufficiency of Westerners who destroy one of the greatest richnesses in man, namely, the possibility to give selflessly. But this was not an isolated case. In particular, two of my friends, one of whom is a young poet and critic and the other a young architect, both *avant-garde*, have facilitated my experiences, during practically my whole stay in Japan, as brothers would have done"

These few paragraphs are from an article I wrote which was published in 1962. As a conclusion to this preliminary hommage, I invite you to now listen to an excerpt from a piece I wrote around another trip to Japan in 1970, *Hibiki Hana Ma*.

—>**excerpt: biwa sounds from *Hibiki Hana Ma*** (between 4´- 7´)

A MOSAIC OF QUESTIONS

Now, I would like to speak to you about the vision I have developed concerning my work. In 1976, I summarized this vision in the following manner[2]:

"In my work, I have strived like a mosaic artisan, unconsciously at first, then in a more conscious way, to fill this philosophical space with an intelligence which becomes real by the colored pebbles which are my musical, architectural and visual works and my writings. These pebbles, at first very isolated, have found themselves brought together by bonds of relationships, of affinities, but also by opposition, gradually forming figures of local coherencies and then vaster fields summoning each other with questions and then the resulting answers. Mathematics plays an important role in the beginning as a philosophical catalyst, as a molding tool for forming auditory or visual edifices, but also as a springboard toward self-liberation. Several questions are interrelated and create intersections belonging to the same philosophical domain. For example: causality-determinism-continuity, indeterminism (chance)-existentiality-determinism, etc. This is also why a work (answer) can, in itself, respond to a whole group of questions. It's a bit like being in the presence of sound-as-questions, rich in harmonics and considering one ar another harmonic as being the fundamental, following the quest at a given moment.

"The visual theatrics of the *Polytopes* deal with questions and answers musically set and resolved, but here with lasers, electronic flashes and in space. What is remarkable to ascertain is that these questions can be found in all areas of musical or visual composition; in other words, from the general form (macrocompostion) down to computer-generated sound synthesis and numeric-analogical conversion

(microcomposition), but also passing by all the intermediary stages along the way. "The paths from both the top and bottom make but one".

"I was saying that all the work I have done over the years is a sort of mosaic of hierarchical coherencies. At the hierarchy's summit I'd place philosophy.

"Philosophy, but in what sense? In the sense of the philosophical impulse which pushes us toward truth, revelation, research, general quest, interrogation, and harsh systematic criticism, not only in specialized fields but in all possible domains. This leads us to an ensemble of knowledge which should be active, in the sense of "doing." Not passive knowledge but knowledge which is translated into creative acts. I repeat, in all possible domains.

"Following the methods which I will now examine, one can divide this coherency roster, mosaic, this table, into three categories or three chapters. The first is the method which allows us to obtain this active knowledge through creativity—which (through theoretical demonstration) implies inference, meaning reason, logic, etc. Following these criteria, there are aspects of activity and knowledge which are partially inferential, entirely inferential and experimental, and others which remain unknown.

"I'd put the arts in the "partially inferential" region. The arts take part in inference. Consequently, we construct and tie things together in a reasoned manner and can demonstrate them up to a certain point. On the contrary, the human and natural sciences, physics, mathematics, and logic are experimental as well as entirely inferential. It is necessary to build a theory and to verify this theory by experimentation. In the artistic domain, we can partially build by inference, but experimentation is not immediate. There is the problem of aesthetics and there is no possible demonstration of the aesthetic value of these things. I leave the door open to any methods which have not yet been discovered.

"As a corollary to this artistic discrimination, it can be said that the arts are freer since they take part in the inferential operation as well as in the experimental one. It is perhaps ambitious to say it, but the arts could possibly guide other sectors of human thinking. In other words, I would place the arts at the head of man's activities in such a manner that they would seep through *all* of his daily life."

I presented this vision before a jury of specialists when awarded the

"Doctorat d'Etat" in France in 1976. It clearly summarizes why I finally chose to pursue art, despite my engineering studies and love for science.

ITINERARY

Now, I would like to take this opportunity to retrace my past. Because I could easily get diverted on a long discourse on this or that subject, I have chosen, for your comfort, to interject certain exerpts from texts which have marked specific steps in my intellectual development. But let's first start at the beginning: from my childhood, then my involvement in World War Ⅱ and the Civil War in Greece, forcing me finally into exile in France.

I was five or six years old when my mother died. I was then sent to a private boarding school on an island in the Cyclades. At the time, I loved to read about astronomy and spent most of my time in the library. Then, thanks to one of my cherished teachers, I discoverd Homer and the ancient Greek authors: the philosophical path suddenly opened before me. I later settled down in Athens where I pursued reading my favorite ancient authors. Alone, of course, this could only be a solitary quest. I visited the Marathon and cried on the tomb. Parallel to these activities, I attended the Polytechnic School since I loved mathematics and had received outside encouragement to become an engineer. Personally, I was not really interested in becoming an engineer, I just wanted to study math and physics. Then there was music: little by little, I realized I didn't really want to learn to play the piano or any other instrument, but I did want to study composition, to learn how music is made, how it is structured, new ways to articulate it.

In 1940 I successfully passed my examinations at the Polytechnic School; the Italians invaded Greece the day the results were posted on the board. There was unprecedented national collaboration against the Italians. The Greeks defeated the Italians. Then came the Germans. The situation grew more and more difficult. The Germans stole all the food and people began to starve. Together with other students like myself, I first joined the nationalist movement protesting against the occupation. We organized meetings and demonstrations－that was all. The movement was a rather superficial sort of resistance. The left led by the Communist Party, which didn't have many members at that time, fought for much more realistic aims. They organized huge demonstrations in which hundreds of thousands of people participated. Throughout

Europe, only in Greece did we have demonstrations like that. The experience was to be of major importance for my music. The realistic and determined policy advocated by the Communist Party convinced me, and I joined. As a result of the armed fight that began soon after, we ousted the Germans, and then the British appeared. They strove to suppress this fantastic resistance movement. First they resorted to political means. Then began a new fight, against them. In December 1944 the British launched an attack against our positions in Athens. The fight lasted about a month. They bombed us from planes and even pointed guns from the Acropolis. Even the Germans had not done that. In this battle, I was seriously wounded. I was hit by the bullet of a Sherman tank. After hiding underground for a while, I fled Greece and finally ended up in France.

In Paris, I got a job with Le Corbusier. I discovered architecture with Le Corbusier; as an engineer, I knew how to calculate, therefore, I did both. This is quite rare both in the architectural and musical domains. Everything started to fit together, I was also asking myself musical and philosophical questions at the time. Everything I had not learned in school or which circumstances previously prevented me from understanding, I became aware of, quite alone, combining elements from the past. Actually, it came quite naturally, thanks to the influence of ancient Greek civilization and in particular, Platonic civilization.

Greek music and the European avant-garde

Musically speaking, the questions I was asking myself at that time converged towards an attempted synthesis between traditional Greek music and new contributions from the European avant-garde. At that time, I wrote[3]:"As Greeks, not only do we have the same problems as for European music, we also have to deal with the specific question of demotic music. What is the meaning of demotic music? Up until now, we know that it belongs to a tradition shaped by misfortune, destruction and renaissance as well as through the huge efforts made by a population which fought without ever having seen the light. Musically speaking, is it as valuable as, for example, Mozart, Bach or Wagner melodies? [Shifting from Greek music to European music or vice versa is difficult.]They are parallel worlds, often in confrontation. Which is the right way? Which is the true music? European, baroque music, serial music, electronic music, jazz, demotic music? Is there any link between all these different musics, or are they

irreconcilable?”This is what I wrote at the time, but, motivated by a sort of foreboding of what kind of music I was yet to compose, I added[4]: “I am certain that there is a link. It is a question of the base and contents of music itself: sound. Music is made up of sound messages. of sound signals.”

Stochastic Music

To put this idea in concrete form, I delved into my knowledge of mathematics and, in particular, probability. In order to go beyond the cultural diversity of various musics, it was necessary to compose a music *ex nihilo*. I paraphrased Parmenides who stated:“To think and to be are the same thing,” by stating my version:“To be and not to be are the same thing.” Before I was born there was nothing. Now I exist for the time being and I know that I exist－that’s all. After death, I will disappear and the world will again cease to exist. The consciousness of nothingness is attractive for a living being but it also means the relativity of life itself and the equality of existence and non-existence. That was the theory and to translate it into practice I thought of probabilities. Music that used only probabilities would be the extreme case of having rules that weren’t rules.

This thought enabled me to develop a radical criticism of the avant-garde music at that time, serial music. In an article published in 1954, I attacked the very principle of the series itself as well as the methods of serial composition which I qualified as “linear polyphony.” I further stated that[5]: “Linear polyphony destroys itself by its very complexity; what one hears is, in reality, nothing but a mass of notes in various registers. The enormous complexity prevents the audience from following the intertwining of the lines and has as its macroscopic effect an irrational and fortuitous dispersion of sounds over the whole range of the sonic spectrum. There is consequently a contradiction between the polyphonic linear system and the heard result, which is surface or mass. This contradiction, inherent in polyphony, will disappear when the independance of sounds is total. In fact, when linear combinations and their polyphonic superpositions no longer operate, what will count will be the statistical mean of isolated states and of transformations of sonic components at a given moment. The macroscopic effect can then be controlled by means of the movements of elements which we select. The result is the introduction of the notion of probability, which implies, in this particular case, combinatory calculus. Here, in a few words, is the possible escape route

from the "linear category" in musical thought".

That is what I wrote in 1954. However, choosing a music which dealt with sound masses, clouds of sound, galaxies of sound as well as the integration of probability calculations also enabled me to integrate other elements, new ones, having no reference back to a specific musical tradition. A few years later, in another text, I stated[6].

"Other paths led to the same stochastic crossroads－first of all, natural events such as the collision of hail or rain with hard surfaces, or the song of cicadas in a summer field. These sonic events are made out of thousands of isolated sounds; this multitude of sounds, seen as a totality, is a new sonic event. This mass event is articulated and forms a plastic mold of time, which itself follows aleatory and stochastic laws. If one wishes to form a large mass of point-notes, such as string pizzicati, one must know those mathematical laws, which, in any case, are no more than a tight and concise expression of chains of logical reasoning. Everyone has observed the sonic phenomena of a political crowd of dozens or hundreds of thousands of people. The human river shouts a slogan in uniform rhythm. Then another slogan springs from the head of the demonstration; it spreads towards the tail, replacing the first. A wave of transition thus passes from the head to the tail. The clamor fills the city, and the inhibiting force of voice and rhythm reaches a climax. It is an event of great power and beauty in its ferocity. Then the impact between the demonstrators and the enemy occurs. The perfect rhythm of the last slogan breaks up in a huge cluster of chaotic shouts, which also spreads to the tail. Imagine, in addition, the interjections of dozens of machine guns and the whistle of bullets adding their punctuations to this total disorder. The crowd is then rapidly dispersed, and after sonic and visual hell follows a detonating calm, full of despair, dust, and death. The statistical laws of these events, separated from their politic or moral context, are the same as those of the cicadas or the rain. They are the laws of the passage from complete order to total disorder in a continuous or explosive manner. They are stochastic laws."

In-time and outside-time

The excerpt I just quoted is from my book originally published in 1963 (*Formalized Music*). This book also comprises explanations on my applications of Markovian stochastic music, on my first works entirely composed with a computer

(based on a stochastic program I developed myself), as well as my musical applications of another mathematical concept, game theory. But other elements concerning another important problematic can be found in this book which I developed after the introduction of probability; namely, the distinction between structures "in-time" and "outside-time." At that time, I tried to justify what I was doing. I had to find answers to such questions as: what is time, what is pitch, what is the relationship between the two, how do the two of them relate to intensity and the other properties of the sound with which I was making calculations?

I started with the simplest question: what is time? First I tried to find out how man's perception of time evolved. Primitive societies such as the Australian aborigines would have been suitable ground for research, but this didn't occur to anybody. Luckily, my wife Françoise, who was working in psychology at the time, called my attention to the experiments of Jean Piaget; he examined the development of the perception of time and space in children. Piaget's book provided me with my first justification that I was right to do calculations with time. He proved that the perception of time stops developing at the age of twelve. Up until the age of six one can't see this process clearly, but between six and twelve, I think there are three stages. He showed that time has an ordering structure and consequently that it has a group structure. I concluded from all this that time is nothing but a kind of structure. And because it is a structure it can be counted, expressed with real numbers, and shown as points on a straight line. Then I said that, if all this were true of time, it must also be true of pitch. And so it is: pitches can also be ordered. But then the statement must be valid for intervals as well because they are the consequences of, or the judgement on, our perception of pitches. The same applies to intensity. What is it that lies outside this circle? Timbre. We can't say that between two timbres only one path can be traced. Timbre lacks an ordering structure, although in certain cases, and partially, it can be ordered. That, then, was the first step. The second: I suddenly realized that it is not true that music is only time, as Stravinsky claims in his book (Messiaen is also of a similar opinion; that is, that music is nothing without time). In fact music is basically outside time and time only serves for it to manifest itself. Whatever we think is, by definition, outside time because it is in our memory and doesn't disappear with the passage of time (unless we forget it). We have no power over the time-flow but we feel it passing: the

notion of time is also outside time. Notions—such as time interval, ordering structure—are all in our mind, they don't disappear. Consequently, in music, the question of form, structure, harmony, counterpoint and so on are all outside time. If we take a duration—let us say three seconds—where are those three seconds? In the music I wrote yesterday, in the music I am going to compose tomorrow? It has nothing to do with the passage of time. Consequently we have to find a way to mix the properties of sound on a more abstract level without having to think about melody, time, harmony, etc. As a first step, we choose sets out of sound elements and play with them. That's the minimum level, as in mathematics.

Polytopes

Throughout the 1960s, I also explored other means. It would be impossible for me to discuss all of them here, in the context of this conference. But I would like to say a few words about the projects that brought me back to architecture and which I continued to explore during the 1970s: the Polytopes. Personally, I have never written on the subject which is why I will now quote some concise excerpts from the book my friend, Olivier Revault d'Allonnes wrote on my Polytopes[7]:"From the Greek word *poly*, meaning"many, lots of, several, big number of ;" and from *topos*, meaning "place, location, room, ground, region, territory." In the manner Xenakis employs the word, there is room for several interpretations: in one sense, we have the idea of *several places*, and in another sense, *lots of room*. ... Of course, the concept of a large space is intimately linked to that of a multiplicity of sites/locations. Although the word's meaning is automatically obvious for a Greek, it can not be found in any dictionary of either ancient or modern Greek. The word has, in fact, been invented by Xenakis, as are most of the titles of his musical works: *Pithoprakta, Terretektorh, Hibiki Hana Ma, Morsima-Amorsima*, etc. Here, one could delve into countless commentaries: beginning with his calculation of the window panels for the Convent at La Tourette (1954), Xenakis already began exploring a new sense of *rhythm*. For the Philips Pavillon (1956), the analogy between the ruled surfaces of the architectural monument and the mass effects of glissandi in his musical works is apparent. In his musical works, such as *Nomos gamma* or *Persephassa*, his quest for spatialisation is inseparable from his innovation on the purely sound level. Eventually, Xenakis exegetes may some day be able to precisely explain how the architect and musician meet in the man. But already,

several points can be determined: 1) His *Polytopes* are key works in this new art combining space and time, where space is the time-enhancing ordinate; 2) the distinction between architecture and music, and even the (social?) break-down between the work of musicians and architects is perceived by Xenakis as a constraint, even an oppression; 3) the idea of a "total spectacle," of a festival of all the senses, haunts Xenakis, even if he never attempted other realizations of this type in his later works. It is as though a sort of utopia animates the man and manifests his dream of such a radical modernity where various available technologies could reconcile the intelligible with the sensible, by ordering under his impulse and controlling through intelligence the fluctuation of visual, sound or other qualities."

Arborescences

Chronologically speaking, we are now in the 1970s when, along with the Polytopes and a multitude of other ideas, I developed a new concept which I called "arborescences," or "cloning." The idea of arborescences is closely linked to causality, repetition and consequently, variation. We start with a point in space. This can be pitch versus time, space or any other variable. In order for it to exist, the point has to continually repeat itself. In this way, a line is formed which can have any shape. Any point on the line is formed which reproduces itself and brings about an arborescence. In this way, eventually, a bush comes about. Starting from a mere point, we have created a bush or even a tree. This can occur freely but also according to rules and can become as complicated as lightning or the veins in the body. Let us assume that we have such a tree in the pitch versus time domain. We can rotate it, transform it; the rotations can be treated as groups. But even if we leave groups out of account, we have an object which we can transform. We can use the traditional transformations of the melodic pattern: we can take the inversion of the basic melody, its retrograde and its retrograde inversion. There are of course many more possible transformations because we can rotate the object at any angle. The bush, however, is of course not a simple melodic pattern but is much more complex than that. And there are other ways of transformation, such as lengthening or contracting. "This is the idea of arborescences. I will add that this idea cropped up in an instant, I don't know how. I just caught myself doing it. I often have experiences like that. What's really difficult is to recognize the possibilities they offer, to realize we have discovered the germ of something new. Revelation can come at any

time."

L'UPIC

Now, I would like to discuss my work concerning sound synthesis. Around the mid-1970s, I developed in my research center, the CEMAMu, a system called UPIC. The UPIC system consists of a large board, on which you can design different lines with a ball-point pen, and of a computer, to which both things－the board and the pen－are linked. If I designed a line on the board, this line would be interpreted by the computer, at first in two-dimensional space: pitch-time. So, if you draw a parallel to the time-line, the corresponding sound would have a steady pitch and a given duration in time. If you draw any curve, it means that pitch is moving in a continuous way. If you draw many lines it is like having a kind of polyphony. Now you can ask a question about those lines: what intensity do they have? Therefore, for each line you have to design an intensity envelope on the same board. So, suppose that again we have just a horizontal line, the pitch of this note is sustained. If you design on the same board an intensity form for instance starting from zero, going up very sharply and then slowly decaying, you will have a kind of percussive sound. You can design other envelopes, a square one (with which you would obtain a sound held without any variations in intensity) or a very complex curve. So any curve could be considered an envelope when you designed it and when you gave the specific order to the computer how to interpret this curve. For the time being, we have a note which is a pitch, starting and ending－that is, with a given duration and also having an intensity envelope. Now you may ask what is the timbre of the sound. You have also to design it. If you draw in the same way a kind of curve, one period of it, then you obtain an electronic sine wave sound. When you feel yourself very imaginative, you can design one period of any curve, and again it would give you your timbre. Therefore you have defined a note which is a pitch, in time, an envelope and also a timbre. Now if you design many notes in the same way, creating for each one its own envelope and its own timbre, it is like having a full orchestra. Finally, the board is much like a page of a score. On it, you have several lines and for each line you have defined the envelope, the timbre and the elementary waveform.

Dynamic Stochastic Synthesis

Under the sound synthesis chapter, I would also like to evoke a new method I proposed at around the same time, a method which is still radically different from those used even today in most electronic music studios. Here, I will elucidate only the theoretical premises of this method, and to do so, will read you excerpts from a text which is also published in *Formalized Music*, dating from the mid-1970s[8]:

"The physico-mathematical apparatus of acoustics is plunged into the theories of energy propagation in an elastic medium, in which harmonic analysis is the cornerstone. The same apparatus finds in the units of electronic circuit design the practical medium where it is realized and checked. The prodigious development of radio, and TV transmissions has expanded the Fourier harmonic analysis to very broad and heterogeneous domains. Consequently, any attempt to produce a sound artificially could not be conceived outside the framework of the above physico-mathematical and electronic apparatus, which relies on Fourier series.

"Two majors difficulties compel us to think in another way: 1) The defeat by the thirst of the new languages of the theory according to which harmony, counterpoint, etc., must stem, just from the *basis* formed by circular functions. E.g., how can we justify such harmonic configurations of recent instrumental or electro-acoustic music as a cloud of gliding sounds? Thus, harmonic analysis has been short-circuited in spite of touching attempts like Hindemith's explanation of Schönberg's system. Life and sound adventures jostle the traditional theses, which are nevertheless still being taught in the conservatories (rudimentally, of course). It is therefore natural to think that the disruptions in music in the last 60 years tend to prove once again that music and its "rules" are socio-cultural and historical *conditionings*, and hence modifiable. 2) Since the war, all "electronic" music has failed, in spite of the big hopes of the fifties, to pull electro-acoustic music out of its cradle of the so-called electronic pure sounds produced by frequency generators. Any electronic music based on such sounds only, is marked by their simplistic sonority, which resembles radio atmospherics or heterodyning. Only when the "pure" electronic sounds were developed, which were much richer and much more interesting (thanks to Edgar Varèse, Pierre Schaeffer and Pierre Henry), could electronic music become really powerful.

"Perhaps the ultimate reason for such difficulties lies in the improvised entanglement of notions of finity and infinity. For example, in sinusoidal oscillation

there is a unit element, the variation included in 2π. Basically, therefore, we have a mechanism (e.g., the sine function) engendering a finite temporal object, which is repeated for as long as we wish. This long object is now considered a new element, to which we juxtapose similar ones. In doing this we expect to obtain an irregular curve, with increasing irregularity as we approach "noises." To summarize, we expect that by judiciously piling up simple elements (pure sounds, sine functions) we will create any desired sounds (pressure curve), even those that come close to very strong irregularities—almost stochastic ones. This same statement holds even when the unit element of the iteration is taken from a function other than the sine. In general, and regardless of the specific function of the unit element, this procedure can be called *synthesis by finite juxtaposed elements*. In my opinion it is from here that the deep contradictions stem which should prevent us from using it.

"We shall raise the contradiction, and by doing so we hope to open a new path in microsound synthesis research—one that without pretending to be able to simulate already known sounds, will nevertheless launch music, its psychophysiology, and acoustics in a direction that is quite interesting and unexpected. Instead of starting from the unit element concept and its tireless iteration and from the increasing irregular superposition of such iterated unit elements, we can start from a disorder concept and then introduce means that would increase or reduce it. This is like saying that we take the inverse road: we do not wish to construct a complex sound edifice by using discontinuous unit elements (bricks: sine or other functions); we wish to construct sounds with continuous variations of the sound pressure directly. We can imagine the pressure using stochastic variations produced by a particle capriciously moving around the equilibrium positions along the pressure ordinate in a non-deterministic way; therefore we can imagine the use of any "random walk" or multiple combinations of them."

That is what I wrote at that time and which, in fact, enabled me to later develop dynamic stochastic synthesis and the GENDYN program.

Sieve theory

Towards the end of the 1970s, I re-exploited an earlier idea which I called the "sieve theory." Sieves pose the problem of scale. Here, I would like to read you an excerpt from a text published in 1967 which already exposed the problem[9]:

"In 1954 I denounced *linear thought* (polyphony), and demonstrated the contradictions of serial music. In its place, I proposed a world of sound-masses, as group of sound-events, clouds, and galaxies governed by new characteristics such as density, degree of order, and rate of change, which required definitions and realizations using probability theory. Thus stochastic music was born. In fact this new, mass-conception with large numbers was more general than linear polyphony, for it could embrace it as a particular instance (by reducing the density of the clouds). General harmony? No, not yet. Today these ideas and the realizations which accompany them have been around the world, and the exploration seems to be closed for all intents and purposes. However the tempered diatonic system—our musical *terra firma* on which all our music is founded—seems not to have been breached either by reflection or by music itself. This is where the next stage will come. The exploration and transformations of this system will herald a new and immensely promising era."

That is what I wrote in 1967 and, as I told you, the problem of sieves, meaning, of scales, was again manifest ten years later. Here follows an excerpt from a text I wrote about my piece *Jonchaies* (1977)[10]:

"This work entails a study of what I call scales. I do differentiate *modes* (which are realities in-time) and *scales* (which are comprised of static data outside-time). A scale is a choice of pitches in an approximative continuum, following a principle independant from its treatment in-time. For example, the white keys of the piano constitute a scale. Such a scale, in this case, a major scale, is the result of several centuries which moulded it. In music, it is extremely important to pose the question of scale; in fact, very few composers do it, except, at times, Messiaen. When the question of scale has been resolved for a piece in a satisfactory manner, half of the compositional problems have been resolved. When the word scale is pronounced, a formalization becomes necessary and the possibility of a mechanization of the problems posed by the construction of such scales can be approached thanks to computer science. In order to achieve this, personally, I apply the sieve theory. The sieves are filters of sorts which retain only certain points or degrees of pitches within a continuum. However, I do not only apply them to pitch scales, but also to scales of durations, of timbres, of densities, of degrees of order and of disorder, of intensities, etc. in short, scales of any or all of the constituent parts of sound.

"All of this is, of course, theoretical. Indeed, concerning aesthetics, I prefer referring back to the finished score or to how the work sounds. An aesthetic convention is inevitably a convention about some subject; therefore one should be cautious about aesthetic valorizations, as long as the composer is not an imitator or a monkey! But it is true that most are seduced by the fact that it is easier to copy than to invent."

During the 1980s, I continued to explore the sieve idea. But then, the object was to obtain new sounds from the traditional instruments of the orchestra. Clusters based on specific scales offer one solution. I've discovered that it's through non-octaviating scales of the whole spectrum that different orchestral timbres can be created. You need many instruments to produce chords and clusters of that kind, and the woodwind, brass and the strings act like three personalities helping to make the novel colors move in masses.

Today

I have to admit that it is true that currently, I've no new theory to put forward. In the past I developed theories and tried to compose in accordance with them. Each theory was sound and unique. Today, I draw upon them in a sporadic and sequential manner. Theories are now dominated by the general approach, the architecture of the composition itself.

In order to justify this if I must, or explain it to you if I may—and this will be my closing statement—I would like to repeat to you what I told Balint Varga at the end of the 1980s[11]:

"Why no new theories? I don't know. All those years served as a kind of training. I can now work with the theories intuitively—they've become an innate part of my thinking. Most of the time, I don't need rules or functions for composing. They're in my blood. And that's a danger. Because I'm stuck. What has happened is, perhaps, that I concentrate on the general line of a piece rather than on specific rules. That's not something you can master in a rational way. It doesn't mean, however, that intuition isn't rationalized. I think intuition is something rational; it's highly complex and at the same time something of which we're unaware. Most of our intuitive ideas can not be analysed. 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. You try, like a predator, to catch whatever comes up from below into the domain of consciousness. You have to be very critical and decide what's worth keeping. The rest you throw away or knock on the head, and down it goes again."

NOTES

1. "The Riddle of Japan."
2. Xenakis in *Arts/Sciences: Alloys*, pp.6ff.
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