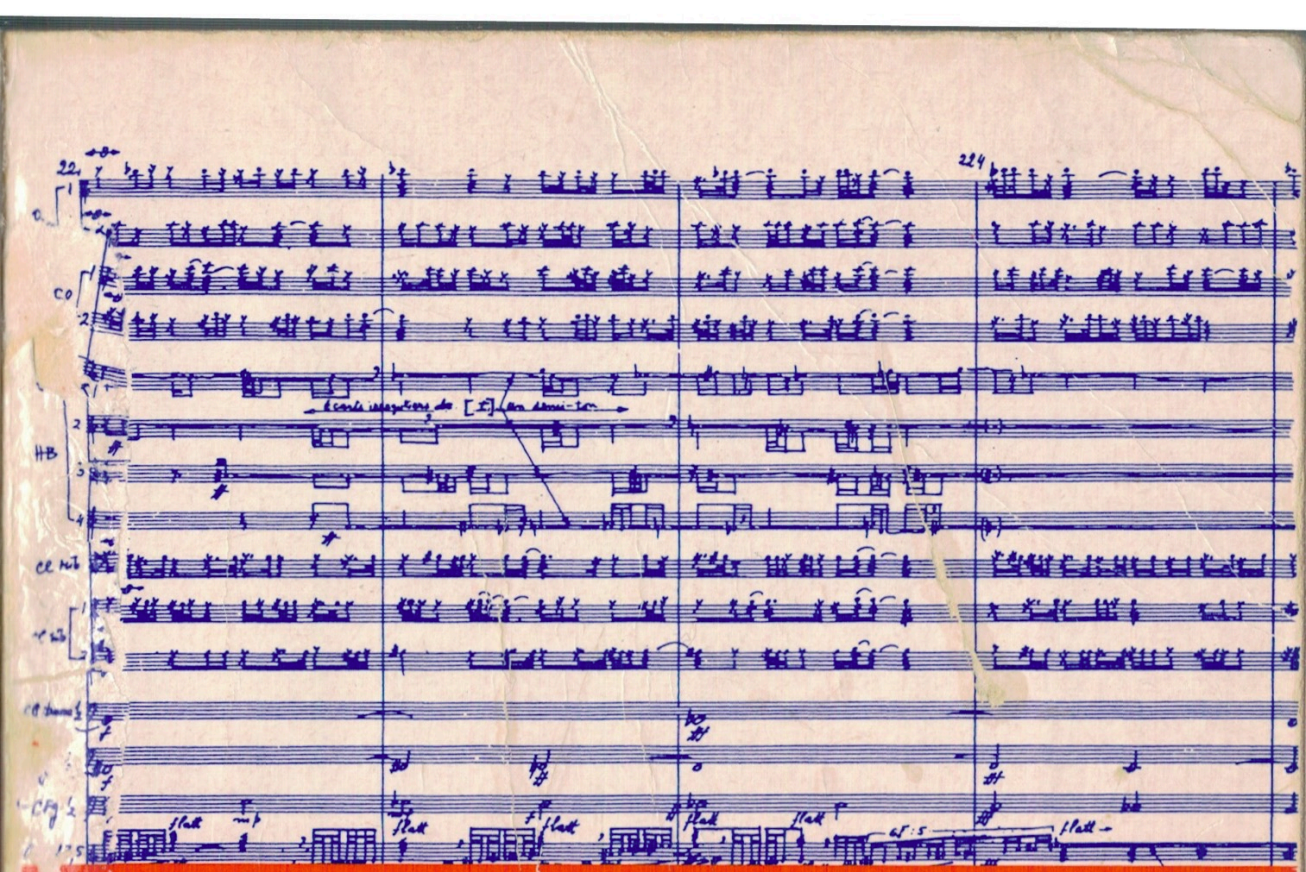

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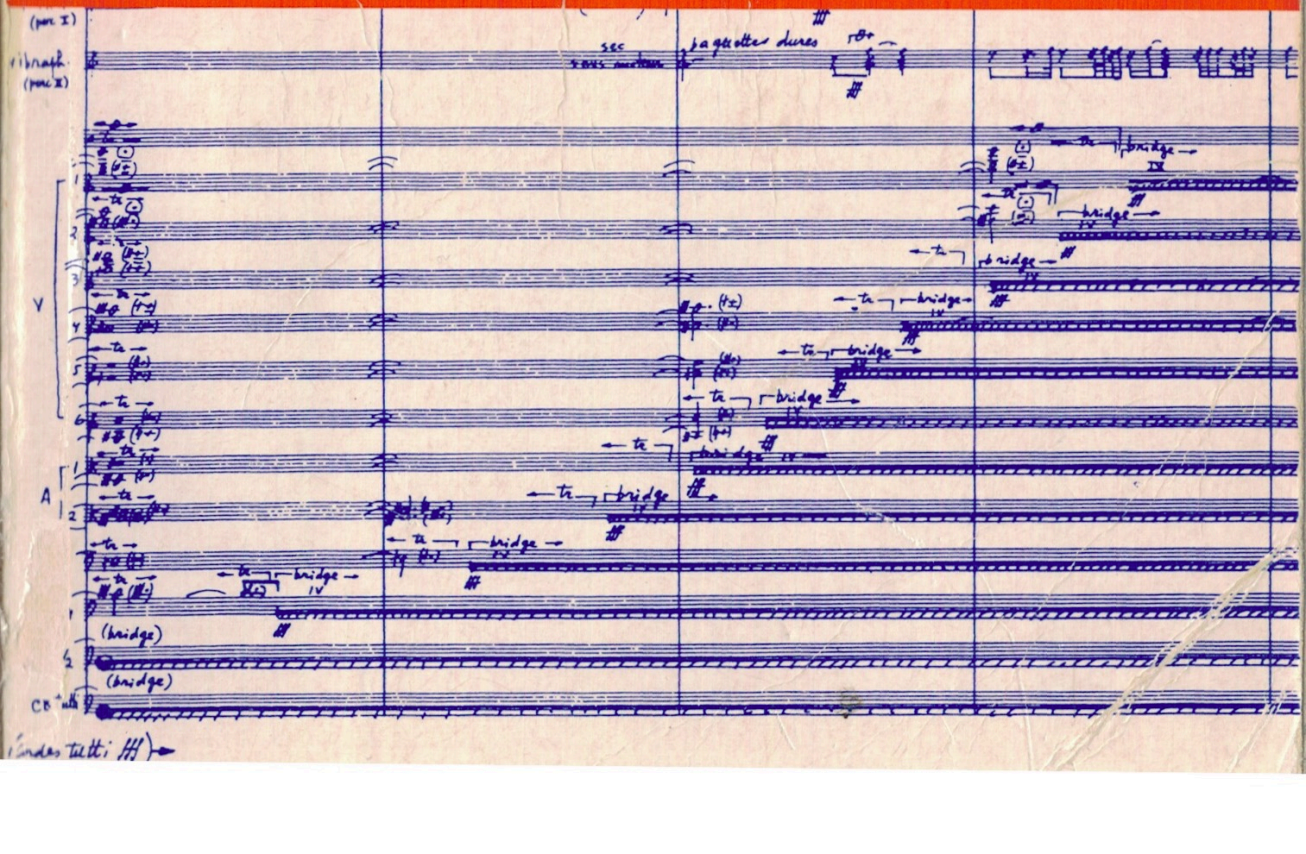
Conversations with Iannis Xenakis

Bálint András Varga



Conversations with **Iannis Xenakis**

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For Susan Bradshaw and Paul Griffiths
in friendship and gratitude

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Preface

This book is a portrait of Iannis Xenakis. Indeed, it is his self-portrait: I simply provided the canvas. The twelve hours we spent together, in January 1980, provide enough perspective for me to draw a sketch of him by way of introduction.

Xenakis struck me as an extraordinary person – a pure and genuine man who never hesitated to risk his life for his convictions and who will bear the outer and inner wounds of that battle until the end of his life.

He had to start all over again at the age of twenty-five; few creative artists can have suffered so much in that lonely labour. His quiet determination eventually defeated his isolation, but it has not succeeded in overcoming his inner insecurity, which by his own account has not abated since his youth.

The key words in his life are 'to act' and to do something 'different'. There may come a time when he will be regarded as the spiritual symbol of the end of the twentieth century: his whole being faces forward, into the future – seeking, wanting, longing for the new. In our day he realizes more consistently than anybody else a fruitful fusion of the natural sciences and of music. He is music's mathematician, engineer, chemist and physicist, resisting emotion with an almost monk-like act of self-discipline, cutting off roots in the past only to find stronger relations with it through other channels – Greek philosophy, architecture and literature, indeed, ancient Greek civilization as a whole.

He is a man of contradictions. His music is often brutal, never lyrical, but even today, despite himself, he can burst into tears on hearing a sentimental melody. He loves his country passionately but has stayed in France since his rehabilitation: he knows that conditions for his work are more readily available there. He pursues his goals unflinchingly, but is never for a moment certain of what he is doing. His feet are solidly on the ground, but his imagination is as daring as that of any science-fiction writer.

My personal impressions were predominated by the stillness that surrounded him. I first mistook it for calmness, but the hours spent with him in Paris made me realize that he lives in a world entirely of his own (he calls it a 'well') and he listens within himself.

All this I was only able to put into words after my return home to Budapest. For, as we met day by day, he unwound more and more, his smile and laugh turning almost friendly. That laugh would on occasion place events and ideas he related into unexpected perspective, toning down the tragic character of some of the stories and making once firmly held truths seem mere youthful follies. Sometimes, however, he would stare straight ahead for a long time, and I did not dare break the silence, but waited for him to return to the present.

The openness with which he characterized himself, or dissected his contemporaries, was disarming. It may well turn this book into something of a chronicle of our times.

I could never get used to the wound that mars his face: the glass eye looking blankly at me above the scar. Again and again I would catch myself talking to that eye. I would then quickly look at the other one, in the naive belief that it would make him forget my tactlessness. He may, of course, never have noticed any of this.

For six days I walked with my case containing a tape-recorder, a microphone and cassettes, from my hotel near the Place Pigalle towards his studio. En route I was accompanied by the quiet whispers of elegant prostitutes (*'Monsieur?'*) until they suddenly disappeared and I had arrived in a different, 'clean' neighbourhood. I would soon enter the apartment house on the top floor of which Xenakis spends a large part of his working life. The spacious room with the extremely high ceiling must at one time have been an artist's atelier. The walls were lined with simple shelves, containing tapes, music, heaps of paper and, of course, books. From the armchair where I sat I was confronted by two photographs: on one, Hermann Scherchen, Xenakis' patron and 'father confessor', held his arms open in a Christ-like gesture; the other showed the conductor in rehearsal, a few weeks before his death. To the right, at the far end of the room, stood a blackboard

with mathematical calculations scribbled on it in chalk. By the window, a piece of furniture that looked like a music stand but was taller and more robust: Xenakis' 'desk'. To the left of my armchair there stood a ladder, next to it a thick rope tied with many knots hanging from the ceiling. There was also a low table, bearing a jumble of magazines, prospectuses, festival programmes and letters, as well as a few chairs, an upright piano, a tape recorder and other electronic equipment.

It was not our first conversation. We had first met at the Warsaw Autumn Festival in September 1978. The interview I recorded then, lasting nearly sixty minutes, appeared a year later in my book *Muzsikusportrék* ('Musical portraits'). I was fascinated by the originality of Xenakis' thought and requested there and then some time for a longer and more detailed conversation. The result is this small book which appeared in Hungarian in time for a concert devoted entirely to his music, on 6 October 1980, in Budapest. The Warsaw interview had already clarified some of the basic concepts in Xenakis' thought: instead of paraphrasing him here I have, where appropriate, quoted in full from that interview.

These conversations are the outlines of a (self-)portrait, and serve as an introduction to the world of Iannis Xenakis. They can and should be read together with his own two crucial books, *Musiques formelles* ('Formalized music') and *Musique. Architecture*, but certainly not in place of hearing his works.

1 Biography

You're not the only Greek composer born outside his home country. Alexander Hrisdinis comes, like you, from Romania, and Anestis Logothetis comes from Bulgaria. How did the Xenakis family come to Brăila?

They emigrated in the last century, at a time when many Greeks settled in wealthier countries. There have been, however, Greek settlements in Romania from as far back as anyone can remember, initially by the Black Sea, but above all in Sulina and Constanza. Bulgaria maintained close ties with Byzantium from the seventh or eighth century. There were also Greek colonies on the Krim peninsula up until around the sixth century (I'm not very good with dates), until their expulsion by the Tartars; also in Odessa and other areas of south Russia.

My paternal grandfather came from the island of Euboea, my mother's father came from Limnos, in the northern part of the Aegean. My paternal grandmother's family came from Asia Minor; she also wasn't actually born there but near Gallipoli. My father left Romania in 1912 and volunteered for the Greek Army to fight against the Turks.

I first encountered the name Xenakis in Crete. I suddenly discovered it on an ancient coffee machine during a walk through the streets of Heraklion. After that I came across it again in Athens, near the Acropolis, on a doctor's sign.

Yes, the name originally came from Crete and is quite common there. From there it spread over the Aegean archipelago and then across the Peloponnese to Izmir. My great-grandfather was born on Naxos, his ancestors were from Crete.

What did your father do for a living?

He was a businessman.

Did he have any connection with music?

He loved music. He admired Wagner. Originally he wanted to become a priest, but was advised against it. I don't think he would have been a good priest because of his temperament, though that wasn't the deciding factor. He had to earn money. In those days, large families with lots of children were the norm and my father, being the eldest, had to provide for the family. After the death of my grandfather he took on responsibility for the family; he had to marry off his sisters and finance his brothers' education, and so on. So, he became a businessman.

Brăila, the town of my birth, had at that time 75,000 inhabitants, many of them farmers. We even had a tram, which was, admittedly, drawn by horses. A little later it was electrified.

As a child, you heard a lot of gypsy music and folk music in Brăila, but you couldn't get very enthusiastic about it.

I don't like this music because it awakens very sad memories in me. My mother died when I was about five years old, and when I hear this type of music on the radio and in coffee-houses it always reminds me of my mother.

You must have been about five when your mother gave you a flute as a present. You liked the sound, but you have never learnt this instrument.

I know, my mother hid the mysterious present behind her back and then suddenly brought it out and began to play it. As a result, the flute gained a certain magic in my eyes. My friends and I also built ourselves instruments. We built violins out of cane. I think that in these countries it is an old custom for children to imitate their parents using home-made instruments.

After my mother's death my father didn't know what to do with his three sons. He decided to send us to boarding school. At first he thought of England or Switzerland, but that would have been too expensive. So he finally settled on Greece.

He found a newly opened school on the island of Spetse, called Anarghyrios. It was founded by a Greek who came from the island; he later emigrated to America. Lessons were in Greek, but we also learnt English, and the sports faculty was orientated towards a British way of teaching. The school was led by two directors: one Greek, one English. Perhaps that's why my father decided on this establishment.

I was the first of my brothers to go there; the others came a year later. I was miserable there. I was lonely, spoke Greek with a foreign accent, and the others had already started their intellectual development. My schoolfriends thought I was stupid; I was teased and tormented. As I had no one to turn to, I immersed myself in books. Suddenly I was top of the class. I spent the evenings in the library reading books on astronomy – Flammarion's *Popular Astronomy* and other similar literature. Of course, the library was quite badly stocked.

Could you read French?

Yes, quite well in fact. I read the novels of Jules Verne and other French writers in the originals. I wasn't so good at English, although I acted in some performances of Shakespeare's plays. I also took on roles in Greek dramas – I was quite a bad actor though.

What else did I do? I played sport; on the one hand, because young people like exercise and, on the other, because the English director of the school thought sport was very important. I loved the sea; I taught myself to swim and won first prize in swimming competitions. I was also good at athletics and could have won the 400 metres but because I'd overexerted myself so much with swimming, I collapsed a few meters from the finishing line.

Running was also a kind of punishment there. We weren't punished by being made to copy out some text or other, we were made to run for fifteen, thirty or even forty-five minutes, depending on the magnitude of the crime. I must have been a real terror because I used to run forty-five minutes each day.

If you wanted, you could go with the director to the sea and run there. The countryside two kilometres away from the school was

beautiful. There were pine trees on the beach nearby with a small spring by the name of 'Ligoneri' (little water). This excursion took place each day, summer and winter, and sometimes I went along.

Your early youth in Greece is for me shrouded in a dark mystery. With reference to your musical development, as far as I understand, you first heard Bach when one of your teachers played it on the piano, and you became acquainted with opera through the music you inherited from your mother. You also listened to the music of Johann Strauss, Bellini, Beethoven and the music of the Greek Orthodox church. However, I'm sure I'm mixing these events up chronologically.

As you say, I first heard Romanian folk music and gypsy music. Then in Greece I heard Greek folk music, which is completely different, and Byzantine church music, as we had to go to church every Sunday. I didn't like any of these in particular, but they all had an influence on me. In fact, I wanted to get away from these influences – and so I tried to fight them.

That's very interesting. Can you expand on that?

EPISODE NO. 1

This defence mechanism remains with me today. Because of this I write completely original music. I know it sounds ridiculous, but sometimes a sentimental melody can move me to tears. However, I don't want to be moved.

Why not?

Because music shouldn't be listened to in this way. These feelings were planted in me because of my experiences as a child. It reminds me of my family and my time at school. Also it's not the music itself that affects me so much, but simply its subjective colouring.

In my view, the same music will evoke quite different reactions in two or three hundred years, because the terms of reference of

the listener will be completely different. I am sure that Bach's compositions had a completely different effect on his contemporaries than on today's audience. It is not that the music itself is laden with emotions. The music does not dictate that we must be happy here or sad there. The reaction is defined by the society in which we grow up. European music says something completely different to a Chinese audience than to a European one, and we hear Chinese music with totally different ears from the Chinese themselves. But that's obvious.

I reacted against music because I felt I was too sensitive. Music could even bring me to tears. It was silly. But it still happens today. I have realized that emotions can envelop me in connection with other things as well – such as architecture, sculpture or poetry. This became clear when I was fifteen or sixteen, in other words during adolescence, when one undergoes deep, dramatic changes. It was then that I decided to concentrate seriously on music – first of all by learning to play an instrument.

*

What did school give you in the way of musical experience?

We studied solfeggio, notation, and did some singing, but there was no instrumental tuition at all. Our music master was Swiss, a bad teacher but quite a good pianist. In the evenings, when we were preparing for the next day, we could hear him playing in another room: the music flooded the whole building. It impressed me and I declared I wanted to play the piano as well. However, I didn't learn from him but in Romania, where I spent my holidays up until 1938.

I also carried out some physical experiments. Having discovered some books on electricity and the spread of electromagnetic waves (very simple books) I tried to imitate the experiments of Branly,[1] to produce static electricity and to capture lightning.

In other words your interest in science and music occurred early on, simultaneously.

Apparently, yes. As I mentioned earlier, I read a great many books by Jules Verne. Not only by him – I read other books as well, of course – but Jules Verne particularly captured my imagination. I was free in the summer and could do whatever I wanted. And since I could think of nothing else I studied and did some experiments.

I also studied music, but the lessons were boring, not much use. I didn't like the teacher at school who replaced the Swiss pianist, so I didn't ask him for lessons. And at any rate music was more like a dream for me than anything else. I didn't think about it consciously. I listened to it when the radio was on, and attended the gramophone sessions organized by the British headmaster. It was then that I first heard the Brandenburg Concertos and some works by Beethoven. I remember once passing one of the common rooms for pupils and suddenly, through the open doors, hearing Beethoven's Fifth Symphony. I had no idea, of course, what it was, but the effect the music had on me was unexpected and very powerful. So the radio played an important part in acquainting me with classical music. Contemporary composers were not broadcast.

We also studied Greek church music at school, alongside traditional Greek dances. In those years Greek music was played more frequently, and more authentically, than today.

Did you sing at all?

At school? Yes, I did. I remember singing Palestrina and liking it very much.

When I was fourteen or fifteen something in me changed. I neglected my studies. I was still among the better pupils – although no longer top I was certainly close to it. But while I continued to feel at home in mathematics and physics, my attention was suddenly drawn to ancient Greek philosophy and psychology. Luckily I had a very good teacher in those subjects, who taught them in their historical context and also gave us an idea of their development.

EPISODE NO. 2

At the age of thirteen, quite suddenly, I discovered God. It happened at Brăila. I was walking along the sandy bank of the Danube, opposite the town, and I had a revelation. I went home and told my father: I know that God exists.

Later, however, under the impact of books and my own experiences (for instance I happened to have a pocket edition of Plato with me at one of the first demonstrations in Athens when I was arrested by the police, but I also read Marx, Engels and Lenin), I realized that there was no God. I had to draw the same conclusion from my studies of the ancient world: I felt it was impossible that there should exist a new God as well.

Now I am an atheist. The notion of God has done a lot of harm to human freedom. Its influence persists even today, and continues to enslave, so my position on the matter is uncompromising.

Of course, this does not prevent me from liking church architecture or religious painting. There are some beautiful Christian churches in Greece, built on mountaintops, on the sites of temples to Apollo. They are mostly churches dedicated to the prophet Elias, the prophet of light. (Incidentally, Elias and Ilias are the same word.) Many Christian saints have replaced the old gods. The Virgin Mary, for instance, is close to Artemis, and even closer to Pallas Athene. In Byzantium, the Virgin was the great marshal, *strategos*, of war.

*

At the age of sixteen, after finishing your studies at secondary school, you left Spetse and moved to Athens. You continued your musical studies but prepared for the entrance examination at the Polytechnic School.

Yes, because I didn't yet know that music was so important to me. Deep inside it was, but I was somehow not conscious of that. However, I wanted to continue my studies – after all I had to earn my living later on. I was interested in mathematics and physics so I tended towards those subjects. I never wanted to become an

engineer or an architect; I was, I repeat, interested in mathematics and physics.

At the same time I also took piano lessons from a beautiful Greek girl. Of course I was in love with her, but she wasn't nice to me. Nor did I make any progress with the piano. Either I was a bad pupil or she lacked talent, I don't know which. I think the latter. Finally I left her, especially since I realized I wanted to do composition.

I was afraid of the conservatoire, where they taught music 'seriously', and made no attempt to enrol. In fact I think that was probably a good thing ... It was around this time that I met Aristotle Koundourov, a pupil of Ippolitov-Ivanov,[2] and took lessons from him. He taught me harmony and counterpoint and we also dabbled in orchestration. One of the things he wanted me to do was learn Mozart's Requiem by heart. All the parts. And I did. That was when the war came.

Did you also compose little pieces?

No.

Only exercises for Koundourov's classes?

Yes. During the war I wrote some melodies to poems by Sappho. I tried to find the kind of music that would suit that poetry.

In other words you only composed melodies, without imagining how they would sound on any instrument.

That's right.

No harmony – just one voice.

Yes. That would have been too difficult. Then, during the Resistance, practically no studies were possible.

It was also around the age of sixteen that I consciously discovered for myself the riches of ancient civilization: literature, philosophy, architecture, history. I became engrossed once again

with ancient Greek, which we had studied at school but not thoroughly enough. It was my aim to be able to read the classics in the original.

Finally I developed for myself a special world which had nothing to do with life around me.

You were a sensitive child and had had a lonely and unhappy life – it was natural that you should have taken refuge in an imaginary world where you felt at home. You must have felt nostalgic for the old Greece, the age of Pericles.

Yes. I felt I was born too late – I had missed two millennia. I didn't know what there was for me to do in the twentieth century. But of course there was music and there were the natural sciences. They were the link between ancient times and the present, because both had been an organic part of ancient thinking.

I discovered Plato and read almost all the dialogues – the *Republic*, the *Banquet* and the shorter ones too. I didn't read much Aristotle but a great deal of Thucydides and Xenophon. And I devoured the poets, mainly Sappho, whom I particularly liked for the musical quality, the imagery and language of her poems. I read them in the original Aeolian dialect.

I also studied historical writings on ancient Greece and visited the sites of great historical events. I remember making several visits to a mound in Marathon which has a relief at its foot that was made by Aristocles in the fifth century BC. The original is in the Archaeological Museum of Athens. It shows a soldier, standing, in archaic style. There's a quotation from Aeschylus' *The Persians* carved into the stone. It goes something like this: 'The Athenians have destroyed the power of gold-bearing Medes.' I made pilgrimages there and projected myself into that age . . .

You told me about those years in our Warsaw conversation: you made excursions on your bicycle, listened to the wind, the crickets and the sound of the rain on your tent.

Exactly. I suddenly fell in love with Nature – the sea, the colours, everything. Often I would set out without any food, drink or

money. After cycling a long time I would feel thirsty, look for a spring and drink the water. I enjoyed that kind of life immensely.

And that life-style ended with the Italian, then the German occupation of Greece. When did you join the Resistance?

At the end of 1941. In 1940 I successfully passed my examinations at the Polytechnic School; the Italians entered Greece the day the results were posted on the board. The university closed immediately and reopened only about a year later.

There was unprecedented national collaboration against the Italians. They had been hated even before the occupation, because of their atrocities in Abyssinia and also for the bombing of Thessalonica before war broke out, for which we had not forgiven Ciano.[3] The Resistance was also strengthened by the Italians' crime of sinking a shipful of pilgrims going to Tinos [there is a monastery there dedicated to the Virgin]. Although the fascist dictator Metaxas[4] tried to hush it up, and lied about the identity of those who had sunk the ship, the truth came out. The Greeks defeated the Italians – that's why the Germans went in.

To begin with they were friendly. I remember they were smiling when they first appeared on the streets of Athens. The situation, however, grew more and more difficult. The Germans took all the food with them and the people began to starve. The winter of 1941–2 was hard throughout Europe; we had no heating and thousands died of starvation and exposure. Dead bodies lay in the streets and lorries transported them to mass graves. The famine assumed such proportions that, in agreement with the Germans, the Allied Powers sent us wheat – otherwise, hundreds of thousands of people would have died.

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 demanded a daily allowance of oil and bread and protested

against Greek workers being taken to Germany to work in German factories. They organized giant demonstrations in which hundreds of thousands of people participated. In the whole of Europe, only we had 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.

In the meantime, the cadets of the right-wing military academy were stationed at the Polytechnic School, so the enemy was within the walls of the institution. Many of them were later linked to the SS.

How did you survive the winter of 1941–2?

With the help of my father. He had moved from Romania to Athens directly before the war. He had lost everything in Brăila – his house, his money. Being a businessman, however, he had some money left outside Romania. He found it difficult to get employment in Athens. He did know some ship-owners, because in Brăila he had specialized in sea transport, and when he moved to Greece he signed bills under highly disadvantageous conditions. He was nearly ruined later because of that, but we had money and survived.

In the beginning my two brothers and I fought in the Resistance together; later, I was on my own.

You were armed?

Not in the beginning. There was no armed resistance in Athens, to start with. We carried out underground activities organizing help for the armed fight outside the city. This lasted until December 1944.

That was when the 33-day siege of Athens began.

That's right. The situation was like this: at least 70 per cent of the population took part in the struggle led by the national liberation front, EAM. Never before in its history had Greece been so united. We, the younger generation, hoped not only that the war

would one day end; we wanted social changes – a more just society. We wanted the land to be cultivated, the mines to be exploited more effectively, to get rid of foreign influence, to be free.

As a result of the armed fight we ousted the Germans, and then the British appeared. They strove to suppress this fantastic resistance movement. First they resorted to political means. Unfortunately the leadership of the Communist Party weren't sufficiently experienced to assess the situation properly. When a coalition government was formed they made so many concessions that they lost almost all their positions. They had the centre of Athens in their hands but when the British demanded the partisans should down their weapons, the party, rather than refuse, procrastinated. The partisans surrounded the city but – who knows why – the Communists wouldn't let them in. They concluded no agreement with the British while they were still strong, nor did they attack. They let all their advantages disappear. 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 put guns on the Acropolis. Even the Germans had not done that. The British wanted to annihilate the Communists, and almost succeeded in doing so. Even so, in 1946 the party was so strong that they would certainly have won 50 per cent of the votes at those first elections. However, Zachariadis, who had been freed by the Americans from a German concentration camp, declared that the party wouldn't run in the elections. It was tantamount to political suicide. In 1947, when I left Greece, a civil war broke out which lasted two years. Later came the Colonels, and the fascist rule, which had begun in 1936, ended only nearly forty years later, in 1974.

You were wounded in January 1945.

Yes, I was hit by the shell of a Sherman tank. But by then I had also blown up a few of them.

What was it that finally induced you to emigrate?

In 1947 the government made a first attempt at organizing an

army against the Communists. Previously, suspects had been demobilized, but from 1947 they were sent to concentration camps, to the island of Makronisos and elsewhere. I knew nothing about that. I reported to the army in the hope that they would find me unfit because of my injury but the committee declared me healthy and I was sent to a military camp. It was full of spies, who soon began to point the finger at me. It was then that I heard of the concentration camps and discovered that many of my comrades who disappeared had been taken there. I escaped, hid two or three months in Athens (in the meantime a military tribunal sentenced me to death), and fled to Italy.

It was, I think, in the same year, 1947, that you obtained your diploma at the Polytechnic School.

Yes, I got a degree in civil engineering.

So you succeeded in fleeing to Italy and from there to France. But why did you not go on to the United States as you had intended?

I don't know. I was in a desperate situation. Can you imagine what it meant to have fought for years for an ideal, to have seen people die around you – and then to see how those ideals were senselessly, hopelessly, defeated?

Did you have any friends or acquaintances in Paris?

Yes. They took me to a refugee organization. You see, I had no papers. I had nothing. I arrived with a false name, on a false passport. I had a unique opportunity to completely change my identity. I don't know why I didn't avail myself of it. Strange. After all, all I needed was two witnesses.

Would you tell me what your false name was?

Konstantin Kastrounis. He came from the Dodecanese. In those years only people from that part of Greece were allowed to leave

the country and go to Italy, because during the war the islands had been part of Italy. My father had paid a large sum for that false passport – but it was so false that when I went to the French embassy in Rome to ask for an entry visa (because I didn't feel like staying in Italy), they said a stamp was missing and it was invalid. Go to the Greek embassy, and as soon as you get it we will give you a visa, they said. Thank you very much, I replied, and turned to the Italian Communist Party for help. They got me across the French border, with the aid of a communist frontier guard.

I arrived in Paris on 11 November 1947. It was a holiday and there was a general strike. I was met at the station by a friend who took me to a hotel. Paris was then for me a kind of continuation of ancient Greek civilization (because of the ideas of freedom, because of architecture, scientific and philosophical thought). It was also a haven.

Incidentally, between 1944 and 1947 approximately a hundred Greeks had received French scholarships, in accordance with an intergovernmental agreement. I had also applied to the French Institute in Athens but was refused – You are stamped, they told me. So I did get to France, but with my father's assistance, by a different route, and without a penny.

I had to look for a job. My Greek friends recommended me to many engineers – after all, I was one myself. I wasn't interested in architecture. However, I received no job until finally I was employed by Le Corbusier, because some acquaintances of mine from the Athens Polytechnic were working in his studio. They were then planning the Marseille housing unit, and I was given the task of computing the sizes of concrete elements.

EPISODE NO. 3

How is it you weren't interested in architecture, even though beautiful buildings could move you emotionally?

At that time it was my opinion that, after classical Greek architecture, there was a decline. I was left cold by Byzantine

architecture and regarded the Western styles – the neoclassical style, and others – as hybrids.

How about Romanesque and Gothic?

I didn't know Romanesque architecture and I didn't like the Gothic. Because it was Gothic. The Greeks, you know, always thought of themselves as special, with regard to both the East and the West. Even today we say we're going to Europe when we leave the country. And we identify the Gothic style with the Europe that in the Middle Ages threatened Byzantium. Before the Turks it was the Franks who were the occupiers. They also were regarded as religious enemies, like the Turks, because they were Catholic. Neither the Venetians, who had also captured Byzantium, nor the Franks were any better than the Turks: all destroyed large parts of the city. They were alien to us, and so was the Gothic style. It is alien to me, too, because that's what I was taught at school and also because the books I've read have led me to the same conclusion.

And what was it that so attracted you to ancient Greek architecture? Purely aesthetic considerations, or also the fact that they were documents of an age you admired?

I don't know. I wasn't thinking consciously of architecture. I simply liked it.

*

The twelve years you spent in the studio of Le Corbusier brought basic changes in this field.

Yes, he opened my eyes: he was the one who taught me to think in architectural terms, and he directed my attention towards contemporary architecture.

You must also have come under the influence of Le Corbusier's interest in science, in mathematics. Perhaps you also read his writings, on the harmony of mathematics, the serenity it exudes. Le Corbusier spent

weeks in Greece studying the architecture there, but he also turned his attention to the skyscrapers in the United States. That must also have influenced you.

No, I must admit that I read practically none of his writings, nor did we have time for conversation: we had to work. It was not from his books but from practice that I became acquainted with his ideas about architecture. Anyway, my free time was taken up entirely by music. As far as the harmony of mathematics was concerned, ideas like that were not new to me, having read Paul Valéry's *Eupalinos ou l'Architecte* in which the harmony of the temple, designed by the architect, reminds him of his love. Valéry's little book, written as a dialogue, just as Charles Morgan's *Sparkenbroke* which I read after I was wounded, were characterized by the same longing for harmony as the writings of ancient thinkers. The main thing I learned from Le Corbusier was the way he solved problems and his attitude to architecture. It was thanks to him, as I said before, that I discovered contemporary architecture for myself.

At first I only did computations in his studio; later I took part in the actual designing work. I remember asking if I could work with him in the realization of a project and he gladly agreed. There was also an intermediate stage where I was an adviser in technological questions. Here I also had a chance to change designs if I didn't like them.

Do you mean you modified Le Corbusier's designs?

No, those of his collaborators. Under the pretext that their ideas were not technologically feasible, I changed their solutions. Such things occurred more and more often and finally I felt I could try my hand at it myself. When I raised the idea with Le Corbusier, he said: Very good, there's something for you here – a monastery.

That was the Couvent de la Tourette.

That's right. He imagined it as something geometrical, simple, with a pure line – that's why he involved me in the project.

How much of it is your design?

A good deal. The general shape is Le Corbusier's, while the internal structure was developed by me, based on discussions with the monks. The façade of the cells is actually a copy of the Marseille housing unit and is the work of Le Corbusier, while the glass panes under the rows of cells and the church are almost exclusively my work. The same applies to the round chapels with the 'guns of light' and 'machine-guns of light' that stick out of them. I positioned them so as to catch the light of the sun during equinox.

In Nantes I designed the kindergarten on top of Le Corbusier's building . . .

. . . and in India you also cooperated in the building of Chandigarh.

Yes, I designed some parts of the parliament and the general structure of the secretariat. That preceded La Tourette: it was in India that I had the idea of the undulating glass panes – I mean the panes that were to make the façade of the convent so characteristic. Incidentally, Le Corbusier mentioned my role in this in his book *Modulor 2*.[5] I was perhaps the only one of his collaborators to be singled out by name. Then came the Philips pavilion, at the Brussels World Fair, when we quarrelled.

Why?

In the beginning he was sincerely interested in my designs and liked them. When the monks wanted to see him in connection with the convent, he referred them to me. Go to Xenakis, he said, he's the one who designed it. He did the same thing with the Philips pavilion. Later, however, when he saw that my work was being recognized by other people as well, I think he became jealous. Then he suddenly claimed to have done everything himself. I reproached him for it but he pretended not to have heard. I was shocked and distressed by his behaviour – after all I admired and loved him, and couldn't believe him capable of such a thing – and I did something silly: I wrote to Philips and declared that the

pavilion was my design. The firm contacted Le Corbusier who replied that he had headed the studio for forty years and that every idea was his, and the Philips pavilion was no exception. I told him that he was doing to me the same as the architects of the United Nations headquarters in New York had done to him, in stealing his designs. I remember Le Corbusier giving a press conference in his studio in the early 1950s, when he tried to prove that the general shape of the building was his idea but that he had lost the plans during his six months' stay in New York. Now he was doing the same thing to me, I told him. So he asked me: What do you think you invented? All these shapes are well known! Yes, I said, that's true. These shapes are well known. But you, too, have used the same flat surfaces and columns and rectangles that architects have been employing for thousands of years. The important thing is not that they have existed before, but how they are being used.

Our discussion, then, was not about whether he had designed the pavilion or not. What he wanted to prove was that my work had no significance. Finally he wrote an article in *Le poème électronique* declaring that the Philips pavilion was my design.

So you won.

Yes. But he didn't circulate that publication widely . . .

What was the significance of the Philips pavilion for you, from an architectural and musical point of view?

That was the first time I'd done something completely by myself – something entirely different, with new surface solutions. I had proved for myself that I was able to create something in the field of architecture that hadn't existed before. In the Philips pavilion I realized the basic ideas of *Metastasis*: 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 *Metastasis* this problem led to glissandos, while in the pavilion it resulted in the hyperbolic parabola shapes.[6]

It was my intention to continue on the same course. When Le

Corbusier was asked to design the sports complex in Baghdad, I designed the stadium. At that time he was devoting more and more of his time to his paintings, to homespun materials, and to the problems of his private life. Thus I was left rather alone. Only three of us were working in the studio, where he spent just a few hours a week.

I exploited this freedom to experiment again with something new. The shape of the stadium was similar to that of the Philips pavilion, but it was also different because I was using different methods. Le Corbusier was afraid that we would argue again and rejected my project. He looked for something to criticize and claimed, for instance, that I had exaggerated the size of the building. He drew an outline of Notre Dame in Paris and one of my stadium, to scale, and put one on top of the other. You see, he said, your stadium is as big as Notre Dame. The question is, I replied, what we want to put in the stadium! If we want room for fifty thousand spectators, even Notre Dame proves too small! Le Corbusier eventually proposed another design, more classical in style, but the whole project was dropped after the Iraqi revolution.

Le Corbusier made it clear on several occasions that he liked what I was doing, and he was also interested in my work as a composer. In *Modulor 2* he published a page of *Metastasis* and emphasized the part I played in designing the Couvent de la Tourette. In 1959, however, it became impossible to work with him: he paid us too little and he didn't grant us recognition. Then he did something very nasty. He returned from his holidays before we did and put everything that he found in the studio – all our papers and equipment – in a cellar. Perhaps he was afraid we'd take everything if it came to a break between us? When we appeared in the studio he declared that he wouldn't work with us any more. Our contact ended in this ugly manner, after twelve years. A few years later he invited me to the inauguration of the Couvent de la Tourette and mentioned my part in it in his speech. Perhaps he was wanting to initiate a rapprochement because he was obviously sorry about the whole incident and, basically, he liked me as I liked him. The differences between us were fundamentally those between two generations.

As far as your compositions are concerned, the twelve years you spent with Le Corbusier, from 1948 to 1960, brought immense changes. In the late 1940s you were still uncertain about where you were heading – you were looking for a teacher, a master to have guidance from – while by the end of that period you had already developed your own personal style and had written some important works. What sort of music did you compose in those first years in Paris?

In my loneliness and isolation I tried to hang on to something – after all, my old life and new circumstances, my old image of the world and the new experiences, all these were in conflict. I wanted to find out who I really was. In that process, traditional Greek folk music appeared to be a safe point, and I was also interested in Greek church music, as well as the folk music of Romania and other nations. As far as Greek folk music was concerned, I relied partly on my memory and I also listened to records and read books. One such book was the one by Samuel Baud-Bovy, the Swiss musicologist who wrote about the music of the Dodecanese; others discussed the folk music of the Peloponnese and other areas in Greece. All that influenced my own work as a composer – and there was also the example of Bartók.

In other words, you wrote folk music arrangements and art music inspired by folk music?

Something like that but not quite. I wrote arrangements and also pieces which had nothing to do with folk music, and which also ignored the rules of traditional harmony and counterpoint. At the same time I tried to renew my studies where I'd left off and went to see Nadia Boulanger. I asked her to give me lessons. She turned me down, saying I wasn't mature enough and that she was too old to start from scratch with a boy my age. But she was friendly and said if I wrote something I could take it to her and she would look at it. Perhaps it's just as well she didn't take me on – in that malleable state of mine the influence of a strong personality like hers might have been damaging. She might have deflected me from finding the independent path I was groping towards.

And how about Honegger?

Honegger? That was interesting, I must tell you about that. He taught composition at a course run by the Ecole Normale. There was no entrance examination and you had to pay a fee for the lessons. His method consisted of the pupils playing their compositions for him to comment on, and then they would discuss them in front of the class.

After a while I volunteered a piano piece I'd written. He asked me to play it, and when I had finished he said: But there are parallel octaves here! Yes, I know, I replied, but I like them. He became more and more angry and finally said: This is no music! Perhaps the first few bars are – but no, even they are not music! I said nothing but stopped attending his classes.

When was that?

I forget the exact date – it must have been around 1949.

So you composed Greek folk music arrangements and such 'unorthodox' music side by side?

Yes. I didn't show him the arrangements, perhaps because I felt they weren't quite ready yet. The truth is, I mix these things up a bit, but if you want I can check.

EPISODE NO. 4

Xenakis rose and produced some thick folders from a bookshelf. Suddenly, unexpectedly, he came face to face with himself of thirty years before. There came to light, for instance, a manuscript.

Oh [he exclaimed] this is the trio I wrote for Annette Dieudonné, for voice, piano and flute. It was Nadia Boulanger who suggested I take lessons from this lady, a professor at the Conservatoire. I went to her classes a few times but when she saw that the rules of traditional harmony were like fetters for me she said I'd better see Messiaen. And that's what I did.

Another piece of paper showed a Bach fugue with the structure shown in different colours on squared graph paper. This was also a product of the student years.

[*Manuscripts from 1955 and then from December 1949*] I wrote that *Air populaire* for Milhaud, who had taken over from Honegger who was ill. I wrote his comments into the score to serve as reminders: 'Chords at last!' 'Interesting melody!' 'Monotonous melody but the rhythm is varied.' 'You are on the right path.' 'Based on the metre of Sappho and Bartók.'

Xenakis here noted that he had originally followed Sapphic metre but then changed it; that's how Bartók's name came up. Interestingly enough, Milhaud later completely forgot that he had ever taught Xenakis but liked his music, praising him for being the only one to oppose serialism.

Dove of Peace *was the title of a composition awarded a diploma at the Fourth World Youth Festival in Bucharest. The manuscript and the diploma, in Romanian, are also kept in a big folder.*

We then came upon the piano piece that had aroused Honegger's wrath. I asked Xenakis to play it on the upright piano in his studio. The first few bars, which Honegger reluctantly accepted as music, added up to a solemn melody accompanied by consonant chords which all of a sudden, at a spot marked by an asterisk indicating the beginning of the section rejected by Honegger, seemed to lose direction, consonance giving way to dissonance. Xenakis had also written the first half of Honegger's remark over the first bars, omitting the second half (about how even the first few bars were not music) because he was ashamed of it. There was another quotation as well: 'He regarded this passage as atrocious because of the parallel octaves and the retard once heard before.' On reading this comment Xenakis played the passage over two or three times, to recapitulate what Honegger may have meant.

This piece is a much more consistent composition [*Xenakis pointed at a score dated 1952–3*]. *Procession aux eaux claires* is freely composed, for chorus and orchestra. In the north of Greece the peasants have kept the May holiday of Constantine the Great up

to the present day. It's a heathen and a Christian ritual at the same time, when peasants dance on glowing coals and also hold processions carrying icons. The holiday is called Anastenaria and they also walk to the holy springs and sacrifice bulls.

[*Xenakis had planned to compose a triptych on this subject. He didn't write the third piece* – Procession *would have been the first one, and* Sacrifice, *which he considers even more important, the second.*] But *Procession* is also significant: look at the divisi in the choral parts – each singing a different melodic pattern. It's very tonal music but the many different voices produce a mass phenomenon which was to play an important role in my music.

The next piece to come out of the folder was the score of Sacrifice *itself. This was much more abstract than* Procession, *which uses a medieval Greek melody once sung by frontier guards. It shows some of Messiaen's influence; glissandos also appear, and intervals smaller than semitones, which produce an effect Xenakis loves – the acoustic beat. I asked him to talk about it at greater length.*

If you tune two nearby strings on the piano a little bit off, you hear the pitch, but also a wu-wu-wu effect. The number of beats per second corresponds to the difference between the frequencies. For instance, if one string has a frequency of 440 and the other 442, we get two beats per second. I use a special sign in the score to indicate this.

Sacrifice was only performed once, never again. Unfortunately, the recording is lost. A friend suggested I should show it to Boulez, who was then in the process of preparing, together with Scherchen, the programmes of the Domaine musical. Boulez said my music was too simple (to others he said I didn't know enough about music) and that music had to be complex. I engaged in a debate with him, saying that if music reaches a point where it has become too complex, you need a new kind of simplicity. Complexity is not synonymous with aesthetic interest. We argued like that, and eventually it led to our first row, which lasted several years and deepened further after my article on the crisis of serial music.[7]

While talking, Xenakis went on leafing through the contents of the folder. He found a letter his father had written, addressed, as a precaution, not to him but to his wife. Xenakis' father and brother had been imprisoned by the Greek authorities in an attempt to find out where he was hiding. He was also on the files of the CIA, who asked his other brother who was in the USA but had not yet received American citizenship, whether he had anything to do with Xenakis the resistance fighter. 'Can you imagine that?' he asked me, incredulously. But he was already holding another piece of paper in his hands:

This is a rhythmic exercise based on the golden section.

I used to have a bad tape-recorder which left a little noise on the tape when you pressed the button. When I noticed that, I exploited it: I measured the length of the tape and marked it at certain points in pencil. I pressed the button of the machine at every mark, and when I played it the noises followed one another according to the golden section. In other words, I received an exact aural picture of that proportion.

I had taken the idea from architecture. Le Corbusier rediscovered the golden section for himself after reading Matila Ghyka's book about it.[8] In the 1920s Ghyka had published several books on the relationship between the arts and geometry, as well as mathematics. Le Corbusier read those books and then forgot about them – at least, he pretended to. Because when Scherchen asked me to write a study of the role of the golden section in Le Corbusier's art and I mentioned Ghyka's books to him, Le Corbusier asked: Who is this man? Towards the end of his life, he became more and more vain. Incidentally, he changed the name of the golden section and called it *'modulor'*. What was his method? Taking the height of an average man [6 foot – i.e. not an average Frenchman, but a Scandinavian, who is taller] as a basic unit, he then worked with the golden proportions of that unit. He made many measurements of Greek buildings, not only buildings like the Parthenon, but also folk architecture. He studied the traditional architecture of the islands, primarily the Cyclades, and used some of the motifs throughout his life – for instance, the wall niches and the benches, which are not made of wood but are built together with the wall.

During this time the folder had been removed from Xenakis' knees to the table and from there back to the bookshelf. Our conversation once again took on a systematic shape. Our next subject was Messiaen.

*

On the advice of Annette Dieudonné I went to see Messiaen, taking some of my smaller compositions with me. He said he didn't give private lessons any more but saw that I was talented. You are even very talented, he said, but you compose in a naive fashion. On seeing that I was a bit taken aback, he added: Please don't take it as an insult. I hope I am also naive and will remain so as long as I live. By naivety he meant lack of bias, openness.

He let me attend his lessons, but I couldn't go regularly because I had too much to do in Le Corbusier's studio. For one or two years I went along more frequently, then less and less. I showed him *Sacrifice* and he said I had developed a great deal. Then I took *Metastasis* along but he made no comment on that.

Messiaen taught you that it was enough for you to listen, to hear as much music as possible, and that you didn't need any academic training.

Yes, he said that the first time I saw him after class.

In one of your writings you say you profited a lot from his analyses of Debussy and Wagner.

Yes, but I enjoyed most of all his analyses of his own works. I studied with him in 1949–50, the time he was composing *Livre d'orgue*, the first and second *Ile de feux* and *Mode de valeurs et d'intensités*, which was to become of central significance for serialists.

What captivated me most of all was his pure combinatorial thought. He used a language that I could immediately understand. I drew the conclusion that his methods were actually very rudimentary and that it was possible to do much more complex things.

Messiaen obviously does not have the same mathematical training as you do. He approaches mathematics from the outside, as an amateur, while you are an expert in the field.

It's not true that he's just an amateur. He's a genius because, despite his traditional musical training, he's been able intuitively to create something completely new, with an intuitive insight into maths. He has thus arrived at an abstraction which differs from the Second Viennese School, first of all from Schoenberg.

In class he was always looking at the dry facts. The emotional charge of his scores is obvious, at least to him, but when analysing his music he left emotions out of the account. I was very interested in what he said about Indian rhythms – the way he combined and transformed them was new to me – and I also liked the way he used the piano as a percussion instrument, almost drumming in the bass register. Then there were the permutations. He didn't like this word, preferring '*interversion*'. But he didn't continue along this path, perhaps because he lacked the necessary mathematical means.

Messiaen's example has taught me that I can do whatever I like, without any restrictions, provided, of course, that what I want is interesting.

Do you think you've taken up where Messiaen left off?

Yes and no. Let us take, for instance, the question of scales. Messiaen appeared at a sensitive point in music history, after Debussy, who was the first to discover a scale different from traditional ones.

The whole-tone scale.

That was what Messiaen continued. I had also often wondered how the diatonic scale came about in the course of music history, how the chromatic scale developed, what lay behind all that. I began to study their origins. With the help of François-Bernard Mâche[9] I succeeded in finding the writings of Aristoxenos,[10] and suddenly understood where all we take for granted comes from: the white keys, the chromatic system, everything. Expressions

like 'enharmony' – which is nothing but a remnant of ancient theories that have since lost their meaning – suddenly began to make sense.

I also discovered that scale and mode are two different things. The scale relates the distance between pitches: it's a structure outside of time. Modes on the other hand include the outside-time structure of scales and also in-time structures such as percentages of notes or melodic pattern.

The question for me was how to produce scales on a more general level, not just in the field of pitches. I only realized it years later in the sieve theory, which applies not only to pitch scales but also to any other characteristic of the sound, provided that the values of that characteristic can be ordered. In other words, if we take any three values of a given sound characteristic, and if we can classify them in such a way that one falls in between the two others, then we have an 'ordering structure'. In addition to pitches, you can do that with intensity, time and so on. In other words, I have not only developed Messiaen's discoveries further but, developing out of its historical roots, have raised the scale itself on a more general level.

After Olivier Messiaen, you owe the most to Hermann Scherchen. You have always remembered him with great affection, calling him on one occasion your 'father-confessor'.

I met Scherchen in the following fashion. I was keen to work in the *musique concrète* studio of Pierre Schaeffer, who asked me to let him see the kind of music I wrote. I sent him the score of *Sacrifice* but he couldn't read it. He forwarded it to Pierre Henry who had a conservatoire education (he was a percussionist) and Henry took it to Hermann Scherchen.

He must have found it interesting because he sent a message saying I should go to his rehearsal, where he was working on Varèse's *Déserts* in the presence of the composer. That was when I first met them.

The rehearsal had just ended when I arrived. Scherchen, who was perspiring as he always did when he was conducting, was naked and being rubbed down with towels by his students. He

invited me to visit him in his hotel the next morning at seven o'clock. I was working late every night, until midnight or one o'clock, and found the appointment a bit early, but I turned up at seven, taking the score of *Metastasis* with me. He was lying in bed holding the manuscript of *Sacrifice*. Would you like to perform it? I asked. He said no. OK, never mind, goodbye, I replied and rose to leave. What have you got in your hand? Another piece of mine. I gave it to him.

The work was written on giant pieces of paper, and when he'd read the first page he threw it down on the floor, so as to get to the next one. I didn't know what to do but eventually I stood next to him and took each page as he finished it. When he'd finished he remarked: In both pieces I find it interesting that you don't approach music as a musician. You look at it from a different point of view, from the outside. I am going to conduct *Metastasis*, but you will have to rewrite it. I can't conduct from a score as big as this. And cut the number of instruments, because I haven't got twelve cellos. So I changed it a bit (I've still got the first version but that was never performed). Eventually, it was not Scherchen who gave the première of *Metastasis* . . .

. . . but Hans Rosbaud in Donaueschingen.

In the meantime I had shown the piece to Fred Goldbeck, who liked it so much that he immediately called Heinrich Strobel's attention to it. Strobel replied by return post that he had programmed the piece and that it would be conducted by Hans Rosbaud. Could I provide the orchestral material? I can't remember who eventually prepared it – but it was performed. I had sent Strobel the original, large-format score (I hadn't yet completed the new version) and he had the idea that during the performance a boy should stand by Rosbaud and turn the pages for him.

I had also written to Dimitri Mitropoulos in New York about *Metastasis*. He replied that he was too old to conduct new music and suggested that I send it to Donaueschingen, where music like that was supported . . .

During the course of our first conversation you told the story of the

première – how Metastasis *was liked by the young while older people demonstrated against it. But what was the performance itself like?*

It was perfect. During rehearsals Rosbaud had actually defended me against the orchestral musicians, and by the time I arrived in Donaueschingen they had learned the piece. Rosbaud asked for only one change: I used harmonics in some glissandos that began very high and he suggested I replace them with normal glissandos. Naturally I agreed. The first performance was the best *Metastasis* was ever to receive.

There was a conference at the festival on the future of music. Did you participate?

No, because nobody invited me. The chairman of the conference was the convinced serialist Antoine Goléa, who didn't like *Metastasis*. He wrote that, as was the case every year, there was a scandal at Donaueschingen. This year it was because of a young Greek who brought a piece crammed with glissandos. However, he wrote, that protoplasm-like material was devoid of any interest.

Let us return to Hermann Scherchen and the meetings he arranged at Gravesano for musicians and scientists.

Scherchen was the only conductor at that time to support my music. It was not played anywhere after Donaueschingen, except for *Pithoprakta* which was given in Munich in 1957 and in Darmstadt in 1958. That was the first and last time that a work of mine received its première at those festivals. New music was in the hands of the serialists, who prevented any other trend from making itself heard. The musical directors of German radio stations defended serial music to prove for themselves, too, that German music still had something to say. Then appeared composers like Boulez who believed they had found absolute music. Anything that was different didn't count. The French, the Germans and the Italians had formed an influential and exclusive club, that of serial music. Scherchen was then the only one who

liked and supported what I was doing and who invited me to Gravesano to attend the meetings and give lectures. And, what was most important, he asked me to write articles for his journal, the *Gravesaner Blätter*, this way forcing me, as it were, to formulate my ideas, also for myself. Otherwise I would probably never have done that.

The days I spent at Gravesano were interesting, for I met experts like Meyer-Eppler,[11] Friedrich Trautwein[12] (he was then very old) and Springer,[13] who invented the method of changing the speed of a tape without changing the pitch.

Scherchen, then, organized conferences to which he invited experts from all over the world. He even paid them out of his own pocket, although UNESCO may also have contributed. Scherchen wanted to set up an international musical centre and to build a studio out of the money he had saved from his fees. He asked me to design a concert hall and the studio. They were never realized, unfortunately: Scherchen ran out of money and died soon afterwards.

He never taught me – he wasn't my teacher in the traditional sense of the word. I was simply with him, watching him work, listening to his ideas. He interpreted music very critically, profoundly and in an original manner. He was one of the few musicians capable of seeing the large form of a composition and still having time and energy to work out the details. He was able to get the best out of an orchestra, also in sound quality. It was a genuine learning experience, to attend his rehearsals and watch him work with the orchestra. The result was not always perfect, of course, a great deal depended on the quality of the ensemble – but that's a different question.

What kind of experiments were conducted at Gravesano?

For instance, Scherchen made a studio recording of the orchestral music of *Erwartung*,[14] then performed the piece with Helga Pilarczyk accompanied by the tape. He was interested in how he was able to conduct the piece without the solo voice, and he was also thinking economically.

He also experimented with a sphere-like loudspeaker. This was

about sixty centimetres in diameter and its surface was comprised of many small loudspeakers. He thought it would produce an interesting sound, but he was wrong: the result was noise because of the rotation of the sound. Nevertheless, it was an interesting experiment – he was seeking something different.

At the request of Scherchen I designed a portable loudspeaker which turned on its own axis, the sound being directed with the help of movable panels. That was another interesting idea that didn't end up being put into practice.

In 1959 Scherchen conducted *Achorripsis* at a Lamoureux concert, along with Schoenberg's Five Orchestral Pieces and I forget what else. Naturally, it ended in a scandal. As in Germany, the critics in France attacked my music and only one or two found it interesting. That was my first clash with French audiences – four years after my German clash! The concerts of the Domaine musical continued without any scandal: they were only playing their own music, as well as that of Schoenberg and Webern.

Then, in 1960, I was informed that the Poles were writing music like mine. People came from Donaueschingen with the news that I had a Polish disciple, by the name of Penderecki, and that he was writing music with many glissandos like mine. And there were other composers on a musical path similar to mine.

How did they have a chance to hear your works? You can't have had records at that stage.

They must have heard it on the radio. *Metastasis* was also performed, incidentally, in Sweden in 1958 [conducted by Sixten Ehrling] and *Nutida musik* carried articles by me and on me. Friends of mine had returned from Warsaw before 1960 with the news that the Poles admired my compositions – so I had known earlier that they were interested in my ideas.

That must have been a comforting thought in your loneliness.

Yes . . . that there are people somewhere who follow my activities with interest. I was no longer on my own composing music like that.

It was a strange situation ... Because I felt that that was *my* music. How did others have the courage to imitate it? I had understood very early on that I was to imitate nobody. I could not do the same thing as Messiaen, Bartók, Schoenberg or Stravinsky. I was deeply convinced that I was either able to stand on my own feet or not at all. That's what I learned from Le Corbusier and Scherchen: both of them held radical views on this. As far as Varèse was concerned, I greatly appreciated his music and liked it but it didn't have any influence on me. I shall have more to say about this later on – anyway, I regarded him as one of the most original composers of the century.

But then I thought: if others were using my methods there must be an objective need for what I was doing. That's why I was being imitated, without those composers being aware of it. Just as I used to imitate Bartók at one time. They liked it, and it influenced them. Of course, it would have been another question if they should claim to have invented it all – even that might happen. But the fact that my ideas were spreading was itself a comfort to me.

Incidentally, I didn't tell you the truth when I said that Scherchen was the only one to take an interest in my music. Nicolas Nabokov was another. He had established a European cultural foundation, financed by the Americans. After all, in those years nobody but the Americans had money and many times they spent it with generosity. At the first competition run by the foundation *Metastasis* won first prize. The jury included Nabokov himself, as well as Boris Blacher and some others. I won 10,000 Swiss francs – that was the first time I had made money out of my music. Berio also received a prize which he shared with somebody else.

The publishers also approached me. I had a great deal to be annoyed about – for instance, because of such repulsive firms as Schott's. Because Scherchen suggested it, I signed a contract in which they didn't undertake to publish my scores within a certain period of time. After two or three years I wrote to them and asked how much longer I had to wait. They replied that my music was outside the mainstream of the avant-garde and couldn't receive the same treatment as Luigi Nono, who was the central figure of new music. Of course, he was also a serial composer, a member of

the Darmstadt group. You see how those people were thinking? I left them and went over to Boosey & Hawkes.

To get back to Nabokov: in 1961 he organized an East–West meeting in Tokyo and invited me to attend. It was an unforgettable experience, because I became acquainted with a different way of life. By now much of it has been Americanized but in those days the traditional way of life predominated and you could see men and women wearing traditional costumes in the streets. Tokyo hadn't been rebuilt either, there were many ruins around, but some old timber houses were left. Today they've been replaced by skyscrapers. I also visited Kyoto, which has survived the changes almost intact. In the early 1960s the whole atmosphere was different from today. We had a chance to hear Japanese music, we visited the Noh theatre and saw and heard Gagaku in the imperial theatre.

I couldn't understand why young Japanese composers were writing tonal or serial music. Perhaps Yoritsune Matsudaira was the only exception – he was also inspired by traditional Japanese music. I conducted conversations with Takemitsu and other gifted musicians and I realized that most Japanese composers didn't actually know the wonderful traditional Japanese music, they didn't understand it and were indifferent to it. All of them had been trained in Western-style conservatoires and despised their own traditions. Many years later they changed their minds and that change has to a certain extent made itself felt in the music written since.

In the course of that visit I made the acquaintance of Yuji Takahashi, the brilliant pianist, who must have been around twenty then. His recitals consisted mostly of the works of contemporary composers. A few months later I received a letter from him: he was very poor, he wrote, but he wanted to commission a piano piece from me. I was moved by that gesture.

And that's when you wrote Herma.

Yes. He only paid half what he had promised and he still owes me the rest. But he had no money and I liked him, his playing and his mind.

I remember showing *Herma* to some composers. Are you crazy? they asked. Why write such a difficult piano part? Nobody will be able to play it! Maybe after four or five years of hard work. Why didn't you write it as a piano duet or for two pianos?

I became worried and wrote to Yuji to ask his opinion. Is it really impossible to play? He replied that *Herma* was very difficult but not impossible. A few months later he could play it by heart.

In the meantime I had to live somehow. I went to see the leading architects in Paris and made them the following proposal: I am an engineer with such and such experience as an architect. I would like to work with you provided I am free to do my own designs. I didn't talk much about money. All of them turned me down. They were conservative, you see. So that attempt failed. Yet I had to live. Scherchen was also worried by the situation and reproached me for having left Le Corbusier. He tried to convince me that I had to continue architecture or engineering at any cost. I, however, stuck to music and told him I wanted to devote my life to it. You see, even Scherchen wasn't sure of me, although he liked and supported me!

Naturally, I didn't stop looking for a job, and eventually, through an engineer friend of mine, I found one I could do at home. I had to compute concrete elements – columns, slabs, things like that. I took on a great deal of work, just to make ends meet. My wife was also working. In my free time I composed.

Then, in 1963, Aaron Copland phoned unexpectedly from New York. Did I feel like teaching at Tanglewood, he asked. It didn't take me long to say yes. Putting it into practice was less easy, however. After all, I was a political refugee, and I didn't have the necessary papers, except the refugee certificate. Eventually I managed to get permission to leave for the United States. I met Lukas Foss, Gunther Schuller and of course Copland. Schuller was the first American to conduct my music, which he did without having met me. He had done *Achorripsis* in New York in 1961 or 1962. Some time later it was also performed by Lukas Foss and by Bernstein.

That's a surprise!

Yes. Bernstein devoted a series of concerts to avant-garde music, conducting works by Cage, Brown, Ligeti and myself. But he made a mistake: on entering the podium, he gave a little speech saying he thought it was his duty to present so-called avant-garde music to the public, even though he himself was not interested in it at all!

Walter Damrosch did something like that with Copland's Symphony for organ and orchestra. That was in January 1925, and the soloist was Nadia Boulanger. Damrosch turned to the audience and declared he didn't like that music at all.

I didn't know about that. Next day the critics had their say in the press. Bernstein eventually wrote to me explaining he hadn't meant it like that. Of course. I have a recording of that performance, by the way.

What's it like?

The sound quality is so poor it's impossible to judge.

The world, however, has slowly come to accept your music.

Yes, but always amid quarrels and scandals. In Paris, for instance, they played *Stratégie*[15] for two orchestras and two conductors. One was Bruno Maderna, who hated my music, and the other was Konstantin Simonovitch, who liked it. The concert was held in the Théâtre des Champs-Elysées. There was a huge scandal, with people climbing from one floor to another to attack those they disagreed with.

The irony is that it was Maderna who 'won' that night!

Yes, but victory or defeat is not a musical problem. In 1962 it was the first time I had done a computer program for instrumental compositions and the first concert financed by IBM.

That was the ST *series:* ST/4, ST/10, ST/48 *and* Morsima–Amorsima.

That's right. I think I succeeded in starting something quite new and basic with that: I was the first to compose absolute music with a computer, free of tradition and contemporary trends. The program is a very simple and at the same time very abstract structure based on probabilities. Its originality is proved among other things by the fact that it is still being studied and used at American universities.

The next important date is 1963, the year of Musiques formelles.[16]

Yes, it was published that year. Most of it is made up of articles I had written for Scherchen. I changed some of it for the book and also wrote some new chapters.

What happened then? My cooperation and break with Pierre Schaeffer. As you know, he invented *musique concrète.* He worked in one of the French Radio studios and also let other people use the equipment. He did receive financial support, but he might easily have kept everybody away from the studio, as Boulez is doing at IRCAM. He let people do what they wanted.

He did of course try to influence us with his strange, mystical ideas – his behaviour was often destructive. He regarded himself as a disciple of a self-styled Greek philosopher from Tashkent, Gurdjieff, like Katherine Mansfield, whose suicide may have been committed under his influence. I also met others who came under Gurdjieff's spell. It was a bizarre company, advocating introspection but in fact spreading self-destructive ideas. Schaeffer also had a damaging effect, on himself and others around, but there was a progressive aspect to his activities as well.

It was years before I was able to work in the studio, in 1957. That's when *Diamorphoses* was realized for Enrico Fulchignoni's film, *Orient-Occident,* followed by *Bohor,* which created a scandal in Paris. I had dedicated *Bohor* to Pierre Schaeffer although he hated that music.

In the meantime I had made the acquaintance at Scherchen's Gravesano of Max Matthews – he was producing sounds with

computers. The computers were, of course, just one aspect of my activities. Another was concentrated on instrumental music, where I was working on a general level with probabilities and other theoretical questions. But if one could produce sounds with a computer, the circle would become complete, not only in the field of macroform but also in the smallest domain, that of sound synthesis. I tried to convince Schaeffer and the other researchers working there to make room for music based on maths, something I was interested in. The young people, with the exception of Michel Philippot, were indifferent. Philippot later received an important position at the Radio and almost gave up composition. At that time, however, he was the only composer with whom I succeeded in establishing some kind of contact. Schaeffer, however, wasn't interested in my plan. Finally we quarrelled and I left.

Did it not occur to you that you might work in the electronic studio of the Westdeutscher Rundfunk? You did go there later on.

No, because electronic music left me completely cold – and besides, Stockhausen was the absolute master. He had never invited me there. Pretending to ignore someone's work is a way of fighting it. But recently Wolfgang Becker, the director of new music at the WDR, invited me to go and produce a work. That's how I realized the 46-minute music of the *Diatope* on a seven-track tape.

EPISODE NO. 5

I'm not quite sure about the difference between Schaeffer's studio and an electronic music studio.

The difference is not all that great. Electronic music stems from the Fourier-synthesis.[17] They work with sine waves; combine them and theoretically you can produce any sound. Of course, that's not quite true in practice, because sounds in reality are much more complex phenomena. The mathematical theory of the Fourier-synthesis is valid for many fields but it doesn't apply to

the sound at this level. Eimert,[18] Stockhausen and later perhaps Kagel, who were the first to go in for electronic music, were serialists and endeavoured to produce serial music with sine waves as well. Soon, however, they also used different kinds of sound because of the poverty of strict electronic sounds.

Schaeffer despised sine waves. We are here, he said, to work with concrete sounds because they are really alive. He was right, too.

In other words?

In other words we recorded actual sounds with microphones and transformed them in the studio. It also corresponded to Varèse's ideas and its roots go very deep, right down to the Italian Futurists, Russolo and others.

I also agreed that sine waves didn't produce satisfactory results. At the same time I wanted to take possession of the sound in a much more conscious and thorough manner – the material of the sound – and also wanted to be able to create it. That's why I was interested in computers. I wanted to produce sound with the help of theories which I had applied earlier in the field of instrumental music.

I left Pierre Schaeffer's studio in 1962, and it meant an end to tape music as far as I was concerned, for some time to come. Through a mathematician friend of mine, François Genuys, I succeeded in finding free computing time at IBM in Paris, where I could work with computers, at least in instrumental music.

In 1964 the Ford Foundation offered me a scholarship to spend a year in West Berlin. The sum in question was considered quite high for those years (it has since been cut, of course). That was the second time I made money with my music . . .

In Berlin I lived in complete isolation in a beautiful house. I remember Blacher asking me: What have you come to Berlin for? Would you not have preferred to stay in Paris with the same money? Of course I would – but that was the condition! The spiritual life of the city was arid and attempts were being made to liven it up with such scholarships.

Did you compose anything in Berlin?

Yes, I wrote *Eonta* there, and also a study about the 'cosmic cities'.[19]

In 1967 I left again on a lecture tour of the United States and Canada. It was then that I realized the *Polytope de Montréal.*

That was the first in the series of your audio-visual works, followed by Persepolis, Polytope de Cluny, *the* Diatope *and* Mycenae. *The 1970s then brought a fundamental change in your standing in the world of music, with one Xenakis festival after another, and at long last, after so many years, you were able to return to Greece in 1974.*

Yes, because I had been condemned and deprived of my citizenship until Karamanlis enacted a special law annulling the sentences and opening the way towards my return. I had been a French citizen since 1965.

In 1967 Indiana University offered me a post which I accepted on condition that I could establish a centre for mathematical and automated music.

According to György Sebők you found the environment at Bloomington too conservative, and didn't feel at home there.

I felt isolated because those in charge of the music department wished to have little to do with new music. Among the teaching staff there were only two people – Fiora Contino, a woman conductor, and Arthur Cora – who were interested in contemporary music. The students were also discouraged from playing an active part because they received no credit for the performance of new music. Wind teachers went so far as to persuade students that playing new music was bad for their lips, destroyed their sense of style and so on.

The financial contribution towards the Center for Musical Mathematics and Automation was also gradually cut. Eventually there was no money left at all, because of the crisis of the Vietnam war. My own work in the studio also got bogged down. Only teaching was left, which didn't by itself interest me. So I left.

I also know from Sebők that your state of mind was faithfully reflected by the state of your apartment. Apparently it consisted of three rooms. The first was empty, the second had a telephone and the third a bed – that was all.

That's right. I had difficulties with it anyway. I was at Bloomington twice a year, for three months and it would have been ridiculous to have rented a flat for the whole year. The only solution was to rent one temporarily – I even rented the bed! Later I moved to a hotel, which was more comfortable, with armchairs, a television set and so on. Nevertheless, those years were very interesting for me because I really lived in the heart of the USA, the Mid-West, and I was fascinated. Besides, the Indiana University Press published my *Musiques formelles*, as *Formalized Music*, thus bringing my theories to a broader English-speaking public. That was a real piece of luck about which I still feel delighted.

Well, we have arrived in the present. The past few years have seen many commissions and much success . . .

Yes. It seems as though my music is finding its way to people without any difficulty. When was the last scandal? I can't remember. Which must mean I've become conventional.

Conventional? I don't think so.

Or maybe people have changed. It's difficult to know which is true. The Bonn Xenakis Festival organized by Hans-Jürgen Nagel in 1974 ran without one negative reaction!

I think you're worried that there are no scandals, that you have become successful. Something must be wrong!?

Something must be wrong . . . I have grown so used to opposition that when there is none – well, it's a nice feeling, but perhaps it ought not to be like that.

2 Interludium (Confession)

I have to tell you something.

For years I was tormented by guilt at having left the country for which I'd fought. I left my friends – some were in prison, others were dead, some had managed to escape.

I felt I was in debt to them and that I had to repay that debt.

And I felt I had a mission. I had to do something important to regain the right to live. It wasn't just a question of music – it was something much more significant. So my thoughts were also moving around more general, universal problems.

I became convinced – and I remain so even today – that one can achieve universality, not through religion, not through emotions or tradition, but through the sciences. Through a scientific way of thinking. But even with that, one can get nowhere without general ideas, points of departure. Scientific thought is only a means with which to realize my ideas, which are not of scientific origin. These ideas are born of intuition, some kind of vision. None of this was clear for me then but I worked instinctively in this direction.

What period are you talking about?

1953–4. My compositions represented independent and yet interlinked steps in that direction. First the free compositions, then folk music, then again free works, the deeper and more complex *Procession aux eaux claires*, the more abstract *Sacrifice*, *Metastasis* and finally the even more abstract *Pithoprakta*.

These works go deeper and deeper towards the central idea: the world is extremely complex and we can find our bearings in it only if we rely on scientific means. At the time of writing *Metastasis* I didn't yet have such means at my disposal – all I had were guesses. I possessed some visual fantasy (straight lines, for instance, that is, glissandos, came naturally for me)

which I could transform into auditive fantasy, and vice versa.

There is something else I have to tell you.

I think I've become the way I am because of my wound.

First my hearing was damaged because the explosion occurred directly by me. The massive sound volume irreparably damaged my inner ear: I can't hear high pitches as well as I used to and there's a constant noise – even now. Three or four years ago I was in Montreal, at the performance of a piece of mine. I remember it was terribly cold. And suddenly I was deaf. All I could hear was a *shshshshsh* noise and I could hardly understand what was said to me. It was like that for the next three years. The doctor said it had to do with my deep-sea diving but I didn't believe him. Luckily, my hearing began gradually to clear up by itself and today I can hear as before – but there still remains that very high sound of 8000 Hz in my ear.

The big splinter destroyed my cheekbone. If it had hit me a little higher I would not have escaped. One eye was lost, however, with the consequence that even months later I was unable to stand up straight. I kept falling. The distance of objects was always changing and I felt I was falling and had to hold on to something if I wasn't to find myself on the ground. For years I was unable to gauge distances with the one eye I had left.

All that has led to the fact that I don't live in reality. It's as if I'm in a well. Because of my weakened senses I can't immediately grasp the surrounding world. I think that's why my brain has turned more and more towards abstract thinking. I've had to learn to assess the distance of things through inference. At every step. And then I became used to making generalizations about other things as well.

Your life has been accompanied by a sense of isolation. You felt lonely at school; your hankering after ancient Greece made the world of the present alien; then you were isolated in France as a refugee and as a musician – and you are isolated because of your injuries.

That's true. And also because of my bad character.

What do you mean?

Yes. As a result of all the things you have listed.

Quite frankly, I've found you surprisingly well-balanced, serene and open. There's no trace of a defensive or attacking attitude, even though you've had ample time to get used to a state of alert, as it were.

No, because . . . You see, one can defend oneself in two ways, or rather, there are two ways of suffering defeat. One: I convince myself that it wasn't my fault. The other one, the enemy, is the bad man, the wicked man, and so on, and so on. One makes oneself feel bigger – as in love. You love a woman but she deceives you. Then you immediately start finding fault with her and praise yourself.

The other way: trying to understand the reasons and to be much more careful. In my youth I suffered defeat and failure so often because of my behaviour and ideas.

My life has been guided by a hierarchy of thoughts. Since I'm not a believer I haven't been tied by moral considerations. I've been free, or at least I've tried to be. But I've had philosophical ideas. I've told you that I used to read Plato and Marx. Rather a strange mixture, but it worked. I've been interested in social questions, in the relationship between people and the aesthetic aspect of all that. That's why I've been able to control myself and to try to understand.

Also, I'm no longer aggressive. In the past when I was teased I would bear it for a long time, then suddenly explode. I remember that from school.

I've never suspected anyone of bad intentions. In the beginning I always gave and expected friendship. Even today I recognize enemies too late. But I feel no hatred, none at all. Which doesn't mean that I forget, although much goes out of my mind.

The main thing is that I got into a deep well, and I'm still there, so that I have to think harder than if I were able to grasp reality immediately. Musicians, of course, are never in direct contact with reality because some time passes before they can hear what they've composed. If they are wrong, if they've made a mistake, they're finished, at least for some time.

3 Roots

By way of introduction, I would like to quote Fernand Léger: 'Every artist holds a weapon in his hand and attacks tradition with it.' Do you agree with him?

No, I've never had a weapon, nor do I have one now. I'm not against tradition. I fight for different goals but that doesn't mean I want to destroy tradition, provided it doesn't destroy my objectives. But even then I wouldn't use arms against it. I would let it live!

As far as your musical thinking is concerned, however, you have gradually become convinced that a radical change is necessary.

Yes, I'm quite sure of that.

Composition, action are nothing but a struggle for existence. To be. If, however, I imitate the past, I do nothing, and consequently I am not. In other words, I am sure that I exist only if I do something different. The difference is the proof of existence, of knowledge, of participation in the affairs of the world. I'm convinced of that.

Let me give you an example from the field of physics – this is more tangible than music. If you read Einstein you will realize that his ideas are different from those of Planck,[20] Mach[21] and others. It was that difference which enabled him to embark on a completely new path.

Einstein, however, did not turn against Newtonian mechanics. The revolution in thinking that he brought about was on a much more general level. That is also my endeavour.

My music makes no revolution; it comprehends the forms of expression used in the past. My greatest achievement would be to compose something which could include any form of expression. It would be interesting to try. It has the precondition that I free

myself of any ties or conditioning that prevent me from being free. One has to shed the fetters of the past. Therefore one has to think, to feel, to work.

Tonal music is one such tie, serial music another, Indian music, Japanese music, and so on, another. They are all separate worlds, continents or islands, each with its own closed rules. One has to examine what these islands have in common, what mental structure is present deep down in all of them; whether there is a path leading to each and whether it's possible to create a higher order.

The aim of our conversation was to look for your roots. What you have said so far, however, makes it obvious that you reject the very idea of roots.

I don't want to have roots. Of course, I had some; I also had my influences, but luckily there were so many that none proved decisive. I've mentioned them before: Romanian and Greek folk music, Byzantine chant, Western music, non-European music. I've tried to understand them; I liked some and disliked others, but I have let each one come close to me, not remaining outside any of them or saying about any of them that it was not music. In this way I succeeded in becoming free, and that's why I have no roots.

As far as Western music is concerned, you have 'let it come close to you' in a very individual manner. For instance, you have drawn a Bach fugue on graph paper to understand its structure. And during the years of study you sought in Western music what it was that was in harmony with ancient Greece. That's why you rejected German music and turned towards Debussy and Ravel.

Yes, in those years I was looking for music that would correspond with my ideas about ancient civilization.

I went to the museum and tried to imagine how the statues would move if they suddenly came to life. With what gestures? How would they speak? What would the music of their language be like? I have mentioned my admiration for the poetry of Sappho and my attempts to find the music best suited to it. When I first

heard Debussy (very late on, at the time of the war against the British, in December 1944; that was also when I became acquainted with Bartók) I felt that his music was closest to what I was searching for. More than Bach, Mozart, Beethoven or Brahms, whose music I heard more often than Debussy's and Ravel's.

Later on, when I was trying to find my identity (I have also talked about that) and my Greek origins suddenly became important to me, the example of Musorgsky and Bartók warned me that I had to understand and love Greek folk music. Soon, however, I realized that that was a provincial way of thinking – if I continued like that I would fall into a trap. I needed something more general. That was when I returned to the basic experiences of my youth, the demonstrations, even though the memory was painful because I had lived through that period and tried to escape from it.

During our Warsaw conversation, in the course of an analysis of the origins of Metastasis, *Xenakis conjured up the demonstrations and their effect on him as follows:*

'*Metastasis*, that starting point of my life as a composer, was inspired not by music but rather by the impressions gained during the Nazi occupation of Greece. The Germans tried to take Greek workers to the Third Reich – and we staged huge demonstrations against this and managed to prevent it. I listened to the sound of the masses marching towards the centre of Athens, the shouting of slogans and then, when they came upon Nazi tanks, the intermittent shooting of the machine guns, the chaos. I shall never forget the transformation of the regular, rhythmic noise of a hundred thousand people into some fantastic disorder . . . I would never have thought that one day all that would surface again and become music: *Metastasis*. I composed it in 1953–4 and called it starting point because that was when I introduced into music the notion of mass . . . Almost everybody in the orchestra is a soloist, I used complete divisi in the strings which play large masses pizzicato and glissando.'

I want to tell you about Debussy, and Ravel also; they wrote their music in modes, or harmonies, that differ from the trad-

itional tonal harmonies of the German school. Ravel's piano suite, for instance, *Le tombeau de Couperin*, and also the orchestral version, is one of his best pieces, and several passages reminded me of ancient music. It's not dominated by tonic–dominant thinking, which is inseparably linked to German and Central European music in general. Bartók, as I said, is an exception. He also moved away from tradition – for instance in *Mikrokosmos*, in which he obviously wanted to do something different.

What considerations led to your writing the article which was to become famous later on, on Schoenberg and serial music in Gravesaner Blätter*?*

I suddenly realized what it was that Schoenberg wanted to achieve with the twelve notes. That was one of the starting points of my article. The other: that I didn't like his music, nor that of the serialists. I felt they were continuing the pathos of German music and had carried it to an extreme. It was only later that I learned to appreciate Schoenberg's compositions, especially his piano works. They are witness to an immense power of imagination. Imagination is, of course, something intuitive, but I could understand those pieces by separating them from the theory. As far as Webern's music is concerned, it reminds me of the film music of that time.

How is that?

Yes, it *is* like film music. Especially the early little pieces – perhaps because they are realistic. The later ones are much more dull. But the early music is colourful.

Berg?

A romantic old chap. I like his Violin Concerto.

In your article you point out that serial music became so complex that it was impossible to keep track of the compositional thought, the line.

Serial music is based on the row. You can't do much with twelve notes, they have to be repeated, and meanwhile the tempo, the distances between the notes, change. There are two methods: they transpose the row, that is, play it higher or lower, and also use the inversion of the row, its retrograde and retrograde inversion. (Years later I identified all that as the 'four group' structure, or the 'Klein group', called after the German mathematician Felix Klein.)

Schoenberg's invention was of extraordinary significance at the time. He conceived of melodic patterns in a geometrical manner. If you think of the row as a jagged line and look at it in two mirrors, one horizontal and one vertical, you get the four basic versions which I mentioned just now. Schoenberg turned to this solution because the tonal wealth had been exhausted, there was no other way, he had to find something new. One feature of his method was the negation of the octave as a self-standing interval. In this way, however, the continuity of the row was weakened. In the case of several rows (polyphony) it's difficult to identify each one. Another characteristic feature was that each note was played by a different instrument (*Klangfarbenmelodie*) so that the timbre was also changing continuously. In the case of many rows (in the music of the Darmstadt epigons – Stockhausen, Boulez and others) it was obvious that the rules of serialism couldn't be fully observed. The composers thought they were orthodox serialists but that was only true on paper. In reality they had mass events which they should have listened to in an unbiased manner. On the level of conscious thinking they should have introduced such notions as average density, average duration, colours and so on. I tried to point that out in my article. All that, however, would have led to a radical way of thinking which could result in only one thing: instead of serial music, stochastic music,[22] probabilities.

How was your article received? Did they try to refute it or did they ignore your conclusions?

On the surface they pretended not to notice it but in fact they were furious. A few months later they suddenly did something similar but on a poor scientific basis: that was aleatoric music.[23]

In other words, the appearance of aleatoric music was a kind of reply to your article?

It was a consequence of the fact that they had reached an impasse. My article, and primarily my music, may well have evoked some reaction, but instead of thinking about it and considering the possibility that I might be right they started something which they thought was new and found a name for it. I had not yet employed the term 'stochastic music'. They hit upon the expression '*alea*', 'aleatoric', the meaning of which was close to their aims – but the definition was nevertheless false. In science, aleatoric is used to mean 'probable'. In mathematics, an aleatoric variable is an exactly circumscribed notion. The serialists, however, loosened up its meaning and identified it with improvisation. They continued to write rows, because that was what they were used to, but gave the interpreter the choice of playing this or that, here or there. The interpreter could choose according to instinct. However, that is not aleatorism but improvisation on a given material computed according to the serial system. Stockhausen did that, then Boulez in his piano sonatas and finally it became improvisation. It has failed to produce any enduring theory in musical composition, although the written parts – not the improvised ones – are often quite interesting. It was a fashion, like jazz. Like fashion, that music didn't last.

You were one of the few people to support the music of John Cage right from the start.

Yes, I liked his thinking, which is of course a characteristic product of American society. I was attracted by the freedom and lack of bias with which he approached music. He also uses improvisation – not in a vulgar way but with the help of *i ching*.

Like many Americans, Cage believes that something stemming from a non-American culture, preferably from Asia, must necessarily be deep. The United States became a world power in a relatively short time. It came into contact with different cultures of which they remained ignorant or to which they were indifferent. Now, suddenly, they react to them sensitively. This is what

happened with Cage, and it lends a mystical colour to what he's doing. But at least he tried to do something different and in opposition to the absolutist trend of the serialists.

Cage's music can be interesting, until he relies too heavily on the interpreters, on improvisation. That's why I've kept aloof from this trend. In my opinion it is the composer's privilege to determine his works, down to the minutest detail. Otherwise he ought to share the copyright with his performers.

Varèse must have been closer to your way of thinking – for one thing, he had a scientific education too.

What exactly that scientific education consisted in I never discovered. We never talked about it.

Every musician tries something new. Schoenberg's system also set itself the aim of making music freer. He wanted to shake off the fetters of tonality, so what he did was revolutionary. And while he did manage to leave the realm of tonality, I would say that dodecaphony led to a kind of axiomatization of music.

He put music in another kind of prison.

That's right. Cage was looking for maximum freedom – not the freedom of thinking but that of intuition. That was again a mistake, or rather it was too partial.

Varèse was a man who felt the sound in an extraordinary way. He also tried to get rid of tonality, of melodic patterns. His method was the crashing of sounds and a kind of immobility, of continuity [connected notes]. For some reason he didn't apply discontinuity [jumps of notes]. I don't know why not – perhaps he simply didn't think of it. Continuity would have entailed the danger of reviving melodic patterns, which would have been tonal in the way Stravinsky was tonal. It is in any case possible to find traces of Stravinsky in Varèse: tiny melodic patterns in *Amériques* and *Octandre*. That's probably why he decided on the immobility of pitch. What does change with him is rhythm, timbre, intensity and a specific mixture of these.

My attention was drawn to Varèse in the early 1950s, when he

was almost unknown. One person to do this was Messiaen who, when leaving the Conservatoire after a class, mentioned that there was a French composer living in the United States who was one of the most interesting of the century. Another was Le Corbusier, who said roughly the same thing about him. When I mentioned Schoenberg, Bartók and Stravinsky to him, he said, simply, '*pompiers*', which in this case means something like 'conventional'. Only one musician counted for him, and that was Varèse.

Le Corbusier had his reasons for this opinion. He came from a musical family. His mother played the piano quite well, mainly Bach, and his brother was a composer who wrote in a more or less conventional style. They regarded Le Corbusier as lacking in talent and sent him to be an apprentice. That's why he grew to hate traditional music, including the kind his brother composed. There was, however, another reason for his admiration for Varèse. In the 1920s several painters, sculptors and architects discovered the beauty of raw material: stones, timber etc. Varèse belonged to the same trend in music: he discovered for himself sound as such. That's why Le Corbusier regarded him as his spiritual kinsman.

Did Varèse know your music?

I showed him *Metastasis* but he only made a brief comment: 'That is the music of our age.' On another occasion, however, not in connection with the piece, he admitted that he hated string instruments . . . I think he must have liked *Metastasis* nevertheless because he tried several times to get it performed in New York. He didn't succeed.

The difficulties around the music he composed for the Philips pavilion occasioned Varèse much bitterness. The technicians had no idea who he really was and didn't understand his intentions; they weren't on the same wavelength. Varèse, who was then living in a small Dutch town, didn't speak the language and missed human contact – it was a hard time for him. What made matters worse was that Philips began to be worried that work was proceeding too slowly and asked Varèse to show them what he had composed. They disliked what they heard, so much so that

the directors decided to find another composer. They wrote to me, as Le Corbusier was then in India, and Le Corbusier replied that if Varèse went, he would go as well. So Varèse stayed.

Philips, however, asked a mediocre, conventional French composer, Tommasi, who had written several *son et lumière* pieces, to design a visual play which would be presented simultaneously with the music. Later they thought they would separate the two, alternating music and the spectacle daily. Eventually they gave up the idea of the latter altogether (I saw it, incidentally, it was horrible). Soon afterwards Varèse returned home.

He did come to Paris once more, when Scherchen gave the premiere of *Déserts* in the Théâtre des Champs-Elysées. It created a big scandal. I had stayed in my hotel to record the performance but later was sorry not to have attended the concert. After a while the audience began to shout. I found the mixture of music and noise quite beautiful, but Varèse, when I played him the tape the next day, became very sad, he almost cried. He was an old man, nearly eighty, and was distraught because after so many years his music was still not understood in France. I tried to comfort him and told him that *Déserts* was an excellent piece.

How did it come about that you wrote Concret PH *as a kind of introduction to Varèse's* Poème électronique*?*

I composed it at the request of Le Corbusier.

It lasts only a few minutes.

Yes, it has a duration of two and a half minutes. It was an introduction to the spectacle designed by Le Corbusier, which lasted six minutes. Or, more precisely, it played the role of prelude or interlude between spectacles.

The question of whether you like listening to old music also belongs to our subject: roots. Do you enjoy the music of Bach, Mozart, Beethoven?

Before replying I want to tell you something else.

I heard a three-member brass ensemble at the Shiraz Festival in Iran. I was told their music originated from the period before Islam. It was the music of the Sun. I found it enormously interesting because it was the same kind of polyphonic music that I had heard sung by peasants in the north of Greece. What could be the reason for this similarity? The Greeks did get as far as Persia under Alexander the Great, but I don't think they acquired local habits of music-making or that they transplanted their music. As far as the Persians were concerned they did not come into contact with Greece after the defeat at Marathon and Salamina until the war with Byzantium, and when the Turks conquered us they didn't bring any music prior to Islam; on the contrary – Turkish music assimilated much belonging to Greek music, as well as Arab and other music of course. For me the only explanation is that both are 'islands' which preserve extremely ancient traditions.

To get back to your question: I do enjoy listening to classical music. Not so long ago I discovered the Schubert sonatas, which used not to interest me, although I did like his other chamber works such as the Trout Quintet, the Death and the Maiden Quartet and the B flat Trio. And, I've always felt close to the music of Brahms, closer than to any other composer of the nineteenth century.

Can you say why?

I'm attracted both by the complex form and by the melodic and rhythmic patterns of his compositions. The First and Fourth Symphony, the Piano Quintet, the sonatas for cello and piano and the last short piano pieces, which exerted such a strong influence on Schoenberg and others – they're my favourites.

Your views on Mozart are notoriously unorthodox.

Yes, I think he's trivial. There are, of course, exceptions: the piano concertos are beautiful and so is *Don Giovanni*. But he wrote too much. I think Haydn is purer and more abstract.

Bach?

I like him very much. Every work of his is stamped by his extraordinary personality and characterized by a unique intelligence, power and richness. I'm also attracted to the music of Machaut and Dufay.

And, as you mentioned before, Palestrina, whose choruses you sang on Spetse.

Yes. As far as opera is concerned I like Wagner and I find the nineteenth-century Italian operas dull, uninteresting, too naturalistic. Among Stravinsky's works I consider *Sacre du printemps* to be especially important; *Les noces* is nothing but a reformulation of that. I don't like his neoclassical period at all, although I admit those pieces are clever and resourceful.

Obviously you don't like his dodecaphonic compositions either.

No, no.

4 The Compositions – a Preliminary

Do you start composing with some kind of basic material, and if so, what do you do with it?

I have no basic material. In every case I start out of nothing. I consider this to be right because I try to break away from the past. Sometimes there's some theoretical starting point. I'm not thinking of mathematics or physics; I'm always interested in the form, in the organization of sounds. Sometimes a slow, lengthy process brings results (group structures are a good example), sometimes I follow an impression.

What do you mean by impression?

I mean that I simply set out to do something, like now, when I'm working on a very long piece. I don't force myself into a predetermined structure, I want to navigate freely. This, of course, occurs rarely in my life. Now and again I use some old material but basically I decide day by day where I'm heading.

Do you sometimes come upon a solution unexpectedly, in an instant? One could call it inspiration, of course.

The idea of arborescences (clonings, I prefer to call them) cropped up in an instant, I don't know how. I just caught myself doing it. In the field of sound synthesis, too, I unexpectedly hit upon a combination of the parameters which led to an interesting result. I often have experiences like that. What's really difficult is to recognize the possibilities they offer, to realize that we have discovered the germ of something new. Revelation can come at any time.

Do you have an overview of the work to be written, so that you only have to work out the details?

Sometimes, yes. In the case of *N'shima*, for instance, I knew that I wanted to write a piece that was horizontally compact. I had no idea of the details at that stage. There again the idea came without any warning.

I made notes while listening to your works. The adjectives 'savage' and 'aggressive' come up rather frequently. Your music sometimes inspires anxiety – it sounds like an irresistibly approaching doom. Where does that savageness come from?

It's part of our everyday life. Too much music is nice. By savage you mean brutal, painful, don't you?

Roughly, yes.

The universe is like that too. I don't think music ought to be pleasant all the time. Profound music is never like that. Sometimes, perhaps, but most of the time it is fearsome. No really great music is tender. Give me an example!

Do you not think that a Schubert Lied, *which is so perfect and so tender, is great music?*

Yes, but there is violence in the tension of the melody . . .

[Humming] *'Röslein, Röslein, Röslein rot . . .'*

[*Laughing*] Well – OK. But listen to his sonatas! They are terrible! Or the B flat Trio! It's full of violence and charm at the same time. The two can't be separated. Some short pieces are soft and quiet – perhaps some longer ones too – but in general really great music combines peace and struggle, serenity and pain.

I've heard quite a few of your compositions and it seems to me they lack lyricism. Their quiet is always charged with tension.

Perhaps that's so, I don't know. I do lack lyricism. Maybe life killed it in me – but it's also possible that I was born without it. I don't know.

In one of your writings you describe silence as silly. It seems to me, however, that silence nevertheless plays an important role in several of your works: for example, in Achorripsis, Aroura, Anaktoria, ST/4 *and* ST/10. *Even if it lasts only a few seconds, it seems to influence the music to come, and also, retroactively, the music one has just heard.*

Silence is always a surprise. Music suddenly stops and we don't know when it will return. It's also interesting psychologically: our brain thinks backwards and forwards. During silence we can think over what we have heard and understand it better. In *Duel* silence is part of the strategy of the game.[24] Later I gave it less of a role to play.

Silence is difficult. We can regard it as the suspension of action, but also as a state before explosion. Its timing is therefore not simple. And another thing: music is sound, that is, action. If there's no music, there is silence. In other words, silence is the negation of music. With all that, I want only to say that one must not abuse silence.

While listening to Synaphaï *I noticed something very interesting (I found similar things also in* Cendrées, Nomos alpha, Antikhthon *and* Anaktoria *as well): suddenly there appears a melody. It disappears just as quickly, but because it's so different from the context in which it's heard it attracts attention immediately. Do these melodic patterns have a special significance or do they occur 'accidentally'?*

In the cases you have listed, accidentally. In following a train of thought the corresponding music might produce something which is reminiscent of a melody. Am I to break the continuity of thought only to avoid that? Sometimes I do change it but at other times I don't care.

The melody, then, logically follows from what came before: it doesn't appear because you wanted to write a melody.

That's right. Sometimes, of course, I compose a melody. It depends.

In your works the dynamics are continually changing, with shorter or longer crescendos and decrescendos following one another. Crescendos often culminate in a sforzato, or sfff. *If it occurs after a very short crescendo the effect closely resembles the wu-wu-wu acoustical beat you mentioned earlier. What's the reason for the constant change of dynamics?*

The aim is to make the sound itself live. There are different ways of doing that: we change the timbre, employ tremolos and accents, repeat the sound and change dynamics. (I am only talking here of instrumental music, of course.) In this way the inner life of the sound is not only in the general line of the composition, of the thought, but is also within the tiniest details.

That accounts for the almost perpetual pulsation of your music. Incidentally, Messiaen thinks highly of Debussy partly because the specific rhythmic world of his music lends it a constant pulsation. In your case it is the result of the continual change of the dynamic level.

That's right. At the same time, with the dynamics and the accents, there come about different multiple rhythms as well.

You partly replied to my next question when you said that the composer is responsible even for the minutest details of his music. However, you confront your performers with such extraordinary technical difficulties that some people think you cannot expect them to reproduce your scores perfectly. They say you allow for those difficulties and the resultant approximation of reproduction.

My works are to be performed according to the score, in the required tempo, in an accurate manner. That is how they are played by Takahashi and now by others like Claude Helffer, Marie-Françoise Bucquet, Georges Plundermacher, Geoffrey Madge, Roger Woodward, Peter Hill and others. It *is* very difficult, but sometimes they succeed.

Do you take into account the physical limitations of the performers? I'm thinking not only of Herma, *but also of the incredibly difficult piano part of* Synaphaï *or* Eonta, *and of* Theraps *for double bass, of which Barry Guy has said that to perform it as it's written in the score almost transports him into a hypnotic state.*

I do take into account the physical limitations of the performers, otherwise I would have written symphonic compositions for a single interpreter, for one piano. But I also take into account the fact that what is limitation today may not be so tomorrow.

Gmeeoorh, for organ, which I wrote for Clyde Holloway, is also very difficult but not impossible. *Khoaï*, for harpsichord, dedicated to Elisabeth Chojnacka, is not easy either. Here is my harpsichord.

Xenakis got up and produced from a shelf a piece of cardboard, rectangular in shape, folded in a 'terraced' manner, on the horizontal surfaces of which were painted the keyboards of the harpsichord.

I wanted to see how one could play on both keyboards at the same time.

[*He placed the fingers of one hand on the two manuals.*]

The same solution occurs in *Gmeeoorh*.

Here is a string orchestra.

[*Now he fetched a stick looking like a metre-rod but longer and thicker than that. On three sides of the rod were drawn the fingerboards of three string instruments.*]

This is the viola, this is the cello and this is the violin. It's all a question of fingers – where we place them, how to produce a special effect.

Then there are works, such as *Synaphaï*, where it's up to the soloist whether he plays all the notes or leaves some out. Of course, I prefer it if he plays them all. So if I think it's necessary I do give this possibility of an easier solution.

But as I've said before, for all their difficulty, the pieces can be performed. In order for the artist to master the technical requirements he has to master himself. Technique is not only a question of muscles, but also of nerves.

It's a kind of yoga, then.

You can call it that if you wish. In music the human body and the human brain can unite in a fantastic, immense harmony. No other art demands or makes possible that totality. The artist can live during performance in an absolute way. He can be forceful and subtle, very complex or very simple, he can use his brain to translate an instant into sound but he can encompass the whole thing with it also. Why shouldn't I give him the joy of triumph – triumph that he can surpass his own capabilities?

Do you have a preference for any particular instrument?

I like the organ but I have a particular flair for string instruments. The only instrument I don't like is the flute – it has a silly sound.

György Sebők told me about an interesting debate you conducted with János Starker. Eventually it was Sebők, a pianist, who was able to produce the kind of sound you imagined on the cello.

It did sound beautiful! I invented that sound – it didn't exist before. I explained to Sebők how it could be produced and he borrowed the cello from Starker. That's it! Beautiful! I said. Starker grew very angry and shouted: That's no music!

There is the difference in a nutshell between you and traditional musicians.

From the point of view of sonorities, yes. When I was working on *Anaktoria* I consulted the best French clarinet player, Guy Deplus. He came here, to my studio, and we experimented together to discover how he could make the sound more interesting, less pure. After a time he was able to produce what I had imagined.

A rougher sound is richer. Is that why you like it?

Yes. That kind of sound is free of the traditional pitch versus time relationship and the musical ideal that is linked to it. Suddenly the material and timbre of the sound become important.

What do you mean by pitch versus time relationship?

Music used to be based on melody – in other words, on pitches in time. However, it's possible to do something interesting with the sound itself – and sound is much more general than pitch. Sound can include pitch, but it doesn't have to. It's important, therefore, to go beyond the limits of the pitch versus time domain because that relationship only takes into account the melody and the rhythm. The material itself may become an exclusive factor. One of the basic questions of composition for me is how to produce interesting sounds and what I can do with them.

As far as your instrumentation is concerned, I have the impression that you don't strive for anything new there. You use the traditional symphony orchestra which is the same all over the world.

That's true. Once I write for the orchestra I have to use it! It's a machine, widespread in the world, which makes sounds. I don't understand what you mean.

I only remarked that it's interesting that there's an aspect of music you don't wish to change.

Is there an alternative?

You might use unusual instruments. Hungarian composers, for instance, write more and more for the cimbalom, the zither and the recorder.

I don't think that fundamentally influences music.

It adds new colour.

That's true. One could also revive old instruments, such as the viola da gamba which has an interesting timbre.

Then there's the Ondes Martenot and other new instruments.

I don't like them. Nor do I like the synthesizer. Either I produce interesting sounds from the orchestra or I make electroacoustic music myself.

Many of your compositions have been written on commission. Does the wish of the commissioner decide the apparatus you use or do you compose what you feel like writing anyway?

Some commissions are for a specific ensemble such as the orchestra. Whatever the set-up of the ensemble may be, the quality of the piece will be determined by my musical ideas – not the other way round, for example with the instruments influencing my ideas.

For instance, when Boulez asked me to write a piece for the Domaine musical (it took him ten years to make up his mind) my attention was taken up completely with the problem of the group theory. I knew that this was a phenomenon deeply rooted in music but I didn't yet know how to put it into practice. The commission then made me think about a piece and suddenly I conceived of the idea of combining a piano with brass. I remember how it happened, at Tanglewood. I was sitting in a boat in the company of a pretty girl. We were surrounded by a forest and I stroked the water with my hand. It was then that I first thought of the instruments to be used in *Eonta*. The actual composition occurred later, in Berlin.

You are a prolific composer and one naturally has the impression that you compose easily.

It's not easy at all! On the contrary! I work hard, I do nothing else. I'm leaning over the desk all the time.

Your oeuvre is already quite bulky. It's also true, of course, that you've been working for nearly thirty years.

The question is whether 'bulky' means 'important'? It's not a matter of quantity – and in any case I haven't written a hundred symphonies or anything like that.

Are you emotionally attached to your works? I mean, do you like some and are you dissatisfied with others, do you change them at all?

I never rewrite anything. Once I've finished something it's done, once and for all.

Sometimes I forget a piece completely, then rediscover it many years later. That can be a pleasant surprise but the music can also leave me indifferent. It depends on my mood and other circumstances.

I try to avoid any strong emotional ties with older works because I need to concentrate all my energies on the one being written. Otherwise I'd be imitating myself without being aware of it. I play a hard game all the time.

So far as imitating yourself is concerned, it's been impossible for me, listening to your works, not to notice that certain means of expression occur almost everywhere. There is hardly a Xenakis composition that doesn't employ glissando, repetition and tremolo.

These aren't a means of expression but raw materials. When writing for the orchestra I have to use orchestral instruments. The sounds aren't new, only their combinations. The same applies to the possibilities of playing the instruments: they are limited, just as the sounds themselves are.

With regard to glissando, that's one of the basic ways of playing – you notice it because it has a special effect. For me it represents the most usual behaviour of a sound, while a sustained note is something special because the slope of the pitch versus time change is nil. Traditional Asian music, for example, has no constant pitch and the sound is always moving around it.

But it was you who made me aware of the beauty inherent in a single sustained note. The long crescendo in the opening note of Linaia-Agon *was something of a revelation. In other works of yours, too, there are occasions when the sound first grows in intensity, then weakens, then goes from instrument to instrument, each of which plays it in a different way. It's incredible how much possibility there is in a single sound!*

It also helps us to ascertain whether we are dealing with a genuine artist. Most instrumentalists – mainly string-players – use a lot of vibrato and change the timbre all the time. They are unaware that they have to control intensity and timbre absolutely, at every instant. The great virtuosos, of course, exercise that control to a maximum degree.

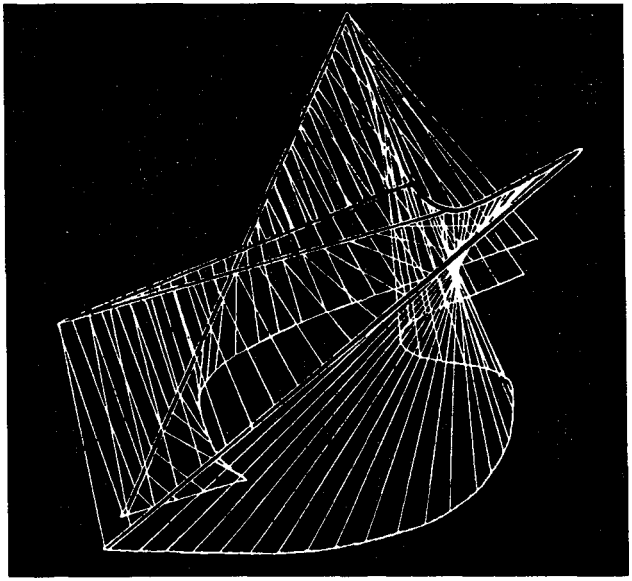
One can also exploit the possibilities of changing timbre. With it we inject life into the sound, and that change can become music.

I would like to ask, in parenthesis, can one think of crescendo–decrescendo in terms of a glissando in intensity?

Yes, because intensity changes versus time, like the glissando, in a continuous manner.

And is the line of the Philips pavilion not a glissando in space?

Of course it is. What is a straight line in two-dimensional space? The continuous change of one dimension compared to the other. The same happens in the pitch versus time domain: the straight line is the continuous change of pitch versus time. The difference between physical and musical space is that the former is homogeneous: both dimensions are lengths and distances. In music, however, the two dimensions, pitch and time, are alien in nature from one another and are connected only by their ordering structure. The musicians of ancient times, Guido d'Arezzo and others, weren't conscious of that, and neither are those living today. I've thought a lot about it and can see this question clearly.



The first model of the Philips pavilion

Before getting on to your compositions I'd like to ask one last question. I visited the Louvre this morning and the works of two painters made such a deep impression on me as to erase any other: I can conjure up in my mind's eye the pictures of Fra Angelico and Uccello any time, perhaps because their personalities are condensed into a few characteristic features which radiate with incredible intensity. They had a vision, not just talent. It seems to me that your music also has some fundamental, salient features which make it immediately recognizable – unmistakably yours.

If the artist works hard there crystallize as a result a few, maybe more, features which really belong to him alone. He ought not to stay with that stage; he ought to change as far as possible.

However, the artist can't change – he can only remain himself. He can't escape from himself. He may try to in his youth but then he realizes that he can't. In my experience this is true of all the arts, and even of the sciences. What people call the consistency of art is not the merit of the artist but a law. No one can create a new world. It's impossible to create something really different – no example of that exists in the history of art. It's sad: we are prisoners of ourselves.

5 Theories – Compositions

Your early morning visit to Hermann Scherchen's hotel provides a vignette that illustrates the fundamental change that took place in your development as a composer around 1954–5. You left behind Sacrifice, *which represents the end of your studies, and arrived at* Metastasis, *the first of your compositions to become known in the world.*

I was interested in two things in those years. One: I wanted to write a kind of dodecaphonic music with the help of computations – a music whose macroform emerges from a few basic principles. In *Metastasis* I made computations based on the permutations of intervals, with the help of the axiomatic approach known in mathematics.

Two: I was interested in the continuous change of chords. Let us take, for example, six of the twelve notes – we get one harmonic colour. Let us then take the complementary pairs of those six notes – once again we get a particular harmonic colour. The change between the two occurs without any transition, abruptly.

The question then came to me: how can one make that change a continuous one? So long as one remains in the same scale, the only solution is a glissando. From the first six-note group to the second we can start in the direction of any note and in each case we get a different result in sound. That was the basic idea.

That's why I called the piece *Metastasis*: there's a dialectical contrast in it between '*meta*' [beyond, after] and '*stasis*' [immobility]. The problem exercised the minds of ancient philosophers, beginning with Parmenides[25] and his disciple Zeno. I'm sure you've heard the example about Achilles and the tortoise, which illustrates this very problem: the contrast between movement and immobility.[26]

I became more and more interested in the idea of continuous and discontinuous change. In *Metastasis* the former is represented by glissandos, the latter by the permutation of intervals and

also the organization of time based on the golden section.

As far as I know I was the first to employ complete divisi in the strings: the forty-odd voices, each independent of the other, open out like a fan, or a painter's brush, and when they reach the extreme point they stop and stay there for a while.

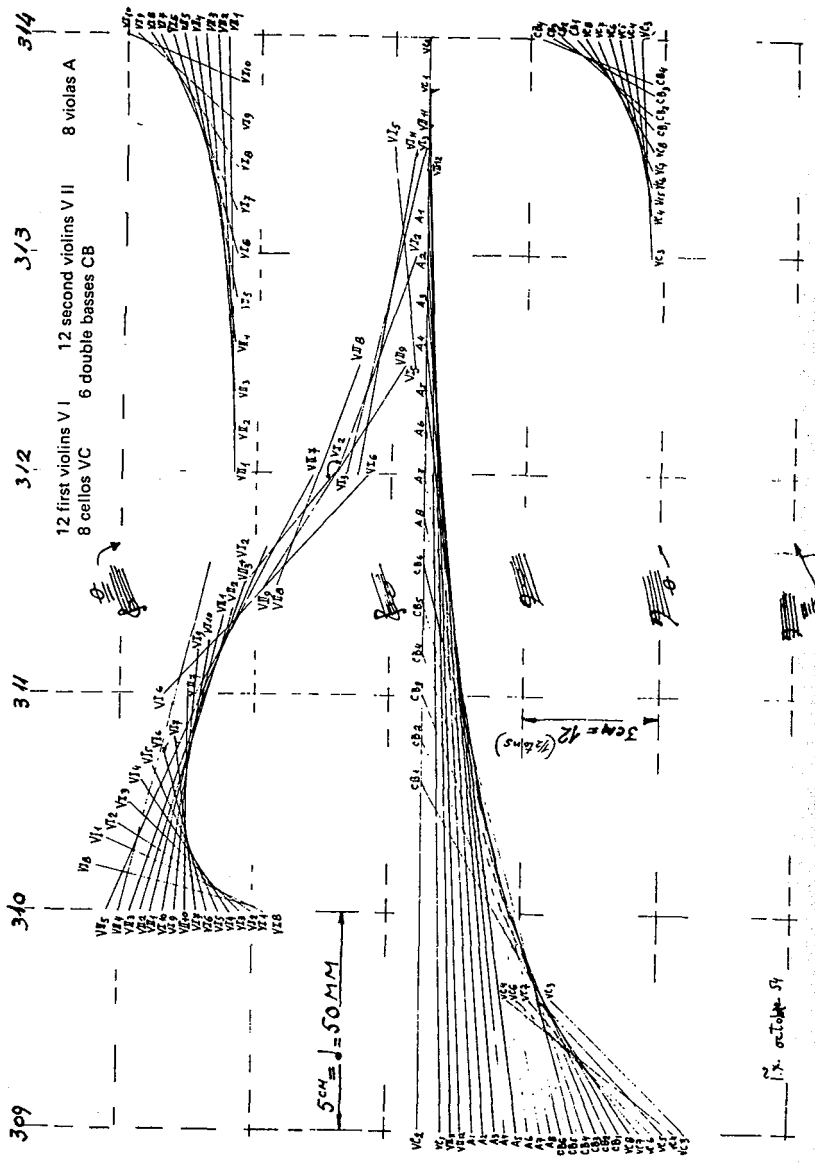
In the middle section of the composition I used little 'brushes' where a central kernel is surrounded only by twelve notes. If, say, the C is such a centre of gravity, then six notes go upwards towards the F sharp, and six go downwards also to the F sharp but an octave lower. In other words we get a little brush which opens up. We can then transpose it, lengthen and contract it in time. Here, then, the two basic ideas of *Metastasis* (continuous and discontinuous change) are mixed.

I had to control so many events at the same time that I realized only probabilities could help. In those years I was as yet unacquainted with the probability theory – at the Polytechnic School only the basics were taught to us and we could not complete the course because of the war. Even in France it was regarded then as something remote and mysterious – even for the engineers, let alone musicians! I, however, felt that I could solve the slow change in the large masses of sound events only with the help of probability. In *Metastasis,* I relied on my intuition. Then I wrote *Pithoprakta* and *Achorripsis* in which, employing the same stochastic method, I used a very small number of events.

In other words, Metastasis *is the cradle of glissando and the stochastic approach.*

Yes. *Metastasis* was the third piece of the triptych after *Procession aux eaux claires* and *Sacrifice,* but I separated it from them because it is so different, because I progressed so far with it.

I finished *Metastasis* but ideas connected with it continued to preoccupy me. Nevertheless, I put a stop to it, because it was tiring to grapple with the same piece for so long. That's why it ends the way it does: it's the opposite of the introduction – not an exact inversion but the basic idea is the same. Some silly composers immediately started talking about an ABA form. So what?



Sketch of *Metastasis*.

In the next step – that was *Pithoprakta* – I wanted to process the problem of mass more thoroughly.

In what respect is Pithoprakta *more abstract than* Metastasis*?*

It has no musical basis of any kind. In *Metastasis* the permutations of intervals played a part but in *Pithoprakta* there's nothing of the kind. And another thing: *Metastasis* was still close to the serial way of thinking; *Pithoprakta* is devoid of that, too.

Pithoprakta is a jump into the unknown. I was guided only by my ideas about its macroform. And by the time I had written it I became conscious of the musical aspects of my experiences with nature and mass demonstrations which appeared rather unconsciously in *Metastasis*.

For the listener the most immediate impression given by Pithoprakta *is the presence of sound effects: the special ways of playing on the bodies of string instruments.*

Yes. And it's not difficult to explain why I used them.

I wrote *Pithoprakta* primarily for strings because it's easier to produce mass events and various timbres with them than with any other instrument. I also needed percussion effects. Instead of calling for a great many percussion players, which would have entailed organizational and other difficulties, I used the body of the instruments. It was that noise – the cloud of percussive sounds – that I transformed gradually, using statistical methods, into musical sounds. It's like dissolving one picture into another in film technique.

The question then was how to dissolve from noise into another kind of sonority.

Once again I was facing the problem of continuity, but from a statistical point of view. Instead of glissando I was working here with point sounds – pizzicato. That, then, is the beginning of *Pithoprakta*.

As far as rhythms are concerned, there's no trace of the golden section; I applied probability theory almost exclusively.

I spent many months studying and experimenting in order to

be able to keep all that in hand and head. I wrote down parts separately, made diagrams to find the suitable parameters of the formulas. That is, first to understand the formulas, then to find the parameters which correspond to the output: music. The fact that we know a formula doesn't on its own ensure that it will achieve our aim. We have to work keeping an eye on the end result. In other words: I had to imagine how all that would sound. And that took a long time.

I don't know whether any composer has ever worked with probabilities as much as I have. That's strange. The reason composers don't use them, even if they're interested in them, is because they didn't receive the necessary education. But scientists who also work with music don't use them either, even though they do possess the theoretical background. It's too far from what they mean by acoustics. That's one of the reasons why research in sound synthesis has come to an impasse, even in the United States, with all its technological advantages. Scientists simply lack imagination in a field which lies outside mathematics or physics. And I, in trying to control mass events, naturally reached determinism and indeterminism.

Would you explain?

In determinism the same cause always has the same effect. There's no deviation, no exception. The opposite of this is that the effect is always different, the chain never repeats itself. In this way we reach absolute chance – that is, indeterminism.

The ancient philosophers – the Stoics and Epicureans – devoted much of their attention to this. I never learned about these things and it was only through my own efforts that I realized the way the problem appears today in quantum physics and Heisenberg's indetermination–uncertainty theory.[27] In my work as a composer that whole complex plays a very important role. After all, the first thing a composer comes up against is the rule. What is the rule? I knew it had to do with determinism/indeterminism, and as I was trying to find the musical equivalent of these notions the riddle was suddenly solved and everything fell into place.

Serial music left out of account the problem of continuity–

discontinuity, even though its roots are there in both tonal music and new music. It occurred, for instance, that through instrumentation they gradually changed the timbre, yet they didn't accept continuous change itself as something of fundamental significance.

Continuous and discontinuous change can be found in other areas as well. When Beethoven transposed from C to G the jump appeared to be large but in reality it was very small. Remember that in C major there are only white keys and in G major there are also, except for the F sharp. We have two sets of sounds which are almost identical: the distance between the two is the smallest possible. Here again we are dealing with the question of continuity, if we look a bit below the surface. That again was an aspect of composition that I had to concern myself with.

If we link continuity with causality we again get at a basic problem of probability. In the case of chance phenomena we can't foresee what's going to happen; only with the help of the probability theory can one foretell things. It's there that we can find the roots also of causality and determinism.

Then there is repetition, which plays such an important part in music. For instance, the variation of the theme is a kind of repetition: the not quite faithful reproduction of a unit (the theme). Between the two there's a small change. If the first variation is followed by others we eventually get so far from the theme as to make the link between the last variation and the starting point unrecognizable. If at the end we disperse the elements that make up the theme and terminate the relationships that originally characterized them we shall have the impression that they occupied their places by chance. The distance produced by more or less faithful repetition is once again an aspect of the question of continuity and discontinuity.

All this used not to be clear to me at all. Only gradually did I realize the connections. The first step was the control of mass events and the recognition of laws which govern nature. Then I looked for the analogy of these natural phenomena in music.

The kinetic gas theory offered a handy parallel. Formerly the molecular theory of gases conceptualized the particles as billiard balls that hit each other according to the Newtonian laws of

mechanics. With the help of these laws it was possible, if they knew the position of the molecules, the quantity, direction and energy of their movement at a given moment, to foresee the state of gas in a future instant. If you possessed all that information, and excluded the possibility of outside influence, you could foretell the state of, say, a cubic centimetre of gas.

However, even within such a small volume there are billions of molecules. How could one make all the necessary computations? It was impossible. So Boltzmann[28] and Maxwell[29] had the marvellous idea of resorting to the probability theory. They pointed out that, in a given quantity of gas, it was the average density of movement that counted: the average energy of the particles was in connection with the temperature of the gas. If, therefore, the gas had a greater energy – that is, if the particles hit each other faster than before – then the temperature would also be higher and the pressure on the wall of the tank would increase. Through a very simple inference they came to the conclusion that that energy was determined by the Laplace-Gauss probability distribution law, which was discovered nearly a century earlier.[30]

When I applied criticism to serial music, I wasn't working with computations – that would have been too complicated, and in any case I wasn't then quite clear about probabilities. I relied on my intuition. Our attention is unable to follow all the various events, so instead we form a general impression. That's simply how our brain reacts to mass phenomena – there's no question of scientific computations. Our brain does a kind of statistical analysis! Again, the solution is probability theory. Thus we have to reckon with the same thing as in the kinetic gas theory.

I followed Maxwell's approach step by step: what he did with the molecules I did with the sounds. Why not? I made the same simple initial hypotheses with intervals, durations and intensity; I found the formulas that determine them.

Then two questions arose: is it possible to make music with fewer elements (i.e. fewer than a 'mass') and yet with the same method, that is, stochastically? And: do I have the right to make computations with elements which are not physical by nature but are linked to our senses? I was seeking to justify what I was doing – after all, I was the first to embark on this path.

These first questions led to another: is it possible to construct something using a minimum of rules? I was interested in that from an aesthetic point of view. Was there any sense in composing such music, and how might it be done?

That was Achorripsis.

That's right. Then came the *ST* computer program. In contrast to *Pithoprakta, Achorripsis* is a closed entity, which I created with interlinked stochastic rules. In *Pithoprakta,* tiny glissando clouds, pizzicato and col legno powder constitute the macroscopic events. In *Achorripsis* I applied the macroscopic approach, from the viewpoint not of the senses but of the internal structure. It was my aim to create a homogeneous construction based on probabilities which would be interesting for the listener. I realized that probabilities used wrongly could be boring, but if applied properly they could be interesting.

So the answer to the first question was given by *Achorripsis.*

The second one set in train a whole chain of thought. What was my role? That's what I tried to find out. After all, I was working with problems such as continuity, causality, mass and not-mass – but I also had to decide what I was to do with them. In the course of making the decision I chose for myself elements which correspond to my ideas.

That's my contribution to the development of music: I use ideas in composing that are completely alien to music.

There was a German general at the beginning of the century called Bortkewitch who had the idea of examining whether Poisson's law[31] was true of a phenomenon independent of mathematics. He examined how many soldiers in peace-time were dying of a kick from a horse. Horses are nice animals, as you know, and soldiers are nice too, in peace, but horses kick from time to time. And people die of it. Things like that occur rarely, of course, which corresponds to the conditions of Poisson's law of probabilities, which applies to 'rare events' without causality. The law is true of music as well: that recognition was my contribution.

That, then, was the second step: to understand why I was doing what I was doing, whether I had the right to do it and whether

there were any precedents. All those questions became more important for me than the stochastic method, which I stopped using for a time, returning to it ten years later.

In which piece?

In sound synthesis with computer, where I used probabilities again. I think I came up against the limitations of the method. I could have gone beyond these but more important problems came up which I had to solve, in *Cendrées*, *Mikka*, *Mikka S*, in the music of the *Diatope*, and in *N'shima* but in a completely different manner.

Chronologically, the next pieces were the ST *works.*

They originated from *Achorripsis*, from the problem of the minimum of rules, and are also linked to the structure of the automaton. We have a structure, a 'black box', in which we put the data, introduce energy into it and what comes out is music. At the time of composing *Achorripsis* I didn't yet have a computer at my disposal and so I couldn't create the continuity of the changes. The structure of the *ST* program is the same as that of *Achorripsis* but here I was already working with computer and used the corresponding approach.[32]

So the question was as follows: how to create, figuratively speaking, a 'black box' which has music at the other end, and not just music, but interesting music?

This idea also has interested mankind ever since ancient times. In the beginning there was the prolongation of the human hand – the tool. On a higher level the tool was replaced by the automaton.

The first automaton was probably the steam engine of Heron of Alexandria. In the Byzantian court automatic lions roared and automatic birds sang to impress the envoys of the barbarian countries. Descartes also discussed automata and the difference between a machine and a human being doing the jobs of man – where is the soul? The culmination was reached in Mephistopheles' homunculus in Goethe's *Faust*.

All that reflects man's desire to possess divine qualities. Man first invented God to symbolize the power of Nature, of Destiny

over man – then changed it inside out (unconsciously at first) and tried to be God in order to change the world around him.

The first abstract automaton had the structure of the fugue – not a strict one, but loosely speaking that is the model of an automaton. The minuet is similar too. As soon as we have a structure it is also, however tiny, an automaton at the same time.

What did you actually put in your 'black box' to produce the ST *pieces?*

Probability formulas that are interlinked, and functions which make it possible to produce their combinations. As a result a decision is made at every moment, not only on which note will sound but also on the overall form. In other words I determine the piece simultaneously on a 'mini'-level (I reserve the word 'microscopic' for sound synthesis) say by the second, and on a macro-level, that is, by the minute, even ten minutes or longer periods.

That, then, is the task of the program: we put in some data and receive music at the other end.

In the five pieces – ST/4, ST/10, ST/48, Atrées *and* Morsima–Amorsima – *you realized the same program and yet each is different. How is that?*

Because if the data input is different, the result will be different. Some of my pupils also worked with the program and the results they got were different again.

In other words the structure of the program enables it to be valid up to the present and is general enough to produce different results all the time. That's very important.

The program is nothing but a very simple and generally valid form which can be used by other composers as well. The fugue and similar structures are also 'programs' which were employed by many composers.

Suddenly I realized that a composer could, with the help of the stochastic method, create not only new works but also new forms and thereby new 'work-families'. This is the zero-level of causality, of determinism.

However, we can inject memory into the stochastic method as well – and here we have arrived at the Markov chain.[33]

Markov was a Russian mathematician; the chain named after him was something of a curiosity in probability theory before the Second World War; since then, however, it has assumed great significance. It has also influenced linguistics, one school of thought claiming that the Markov chain was valid to linguistics before the opposite was proved by Noam Chomsky.[34]

However, what is impossible in the case of language can be realized in music. After all, music is not a language: it doesn't have the task of expressing something through sounds and symbols. Music stands by itself, there's nothing beyond it. We can therefore use the Markov chain, provided the result is interesting.

I have composed three pieces in this way: *Syrmos*, and *Analogique A* and *B*.

Then came the phase when 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, called my attention to the experiments of Jean Piaget:[35] 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 stopped 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 that time intervals can be added and permutated, and consequently that they have 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. (There is an axiom which says that real numbers can be shown as points on a straight line.)

Then I said that, if all this was 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, the judgment 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. We can, for example, characterize a timbre by saying that it has a more flute-like sonority than another and between the two there can be different nuances. However, to arrive from this timbre at noise, we can choose several paths, while in the case of time, pitch, intervals etc. which have a total ordering structure there is only one solution, one path.

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 one of his books (Messiaen is also of a similar opinion: music is nothing without time). In fact music is basically outside time and time serves only 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 the elements of the sound and play with them. That's the minimum level, as in mathematics.

The sets are based on the characteristics of sound: one set consists of pitches, another of timbres, a third of intensities – other sets could be more complex, or even simpler, like the samples in sound synthesis by computers.[36] After the definition of the sets comes their combination. That's how I composed *Herma*. All these ideas were in my head when Takahashi asked me to write a piano piece, so I seized the opportunity to try them out in practice.

Why do you call Herma *symbolic music?*

Because the sounds are symbols, they have no other meaning. The word symbol, as you know, is used in two ways: sign, and the symbol *of* something. I am using it in its former meaning, of a sign: the idea came from symbolic logic and symbolic mathematics. Symbolic logic tried, in the mid-nineteenth century, to replace words by symbols, because words are often ambiguous, not quite clear, when used for describing an operation or a relationship. Boole[37] was the first to discuss these things; symbolic logic then spread widely and some of the symbols applied by Boole are now employed everywhere.

In order for me to write *Herma* I had to do logical operations with the sets. The basic operations are intersection, union and negation. In *Herma* I selected three sets and combined them into logical functions with the help of these logical operations. Naturally I had to place it all into time because so far I was only working theoretically, with an outside-time structure (the logical functions). I used the time as a blackboard: On it I 'wrote', one by one, in a more or less perceptible manner, the operations I had carried out. Time, then, is a means for us to unfold the outside-time structure of the piece.

How can we demonstrate the sounds of a set on the piano? By playing them one after the other. In what order? If we played them chromatically, upwards or downwards, we would be observing too strict a rule. If we want to be free the sounds should follow without any melodic law, independently of one another. So we have to play them at random. In other words, to demonstrate the elements of a set we have to use the stochastic method. The basic idea of *Herma* has nothing to do with the stochastic

approach – stochastics is needed here only to demonstrate the elements of the sets.

Let us say, as an example, that I have an A set and a B set. What can I do with them? I can combine them in a logical way. One such way, as I said, is their union – in other words I take all the notes of the two sets. Then I can take the sounds the two sets have in common. And finally I can take the sounds that the two sets don't have in common. There are, of course, other, more complex logical functions. In each case I get a new set.

How can I demonstrate the elements of the sets? By playing them. But in order to remain neutral I have to play them at random. I emphasize: only the sounds that I play at random demonstrate the logical functions of the sets, nothing else.

The set can be amorphous as in *Herma* or it may occur that its elements are connected in some way. In other words the sets may have an internal structure. That's what led me to group structures. They characterize human thinking since time immemorial.

If there is a connection between the elements of a set one can produce combinations by pairs of the elements, thus performing a binary operation. Let us take, for instance, the pitch intervals. If we 'add' one interval to another we get a third. If we combine three intervals we get a fourth. Either we start by adding the second to the first and the result to the third and so get a fourth interval, or we start by combining the second and the third and then add to them the first. That is called the associative property.

If we have an ascending interval and then take the same interval but descending and add the two, we have returned to the starting point, to the zero interval. The zero interval is such that we may add it to any interval but it doesn't change it. It's a kind of neutral element. Every interval, then, has an inverse: every ascending interval, has a descending one and the other way round. The neutral element that doesn't change the one to which it is added is the unison.

These four properties make up a group.[38] Like pitch intervals, duration and intensity intervals also have a group structure.

In what works have you used the group structure?

In *Akrata, Nomos alpha* and *Nomos gamma.*

In Nomos gamma *the public is intermingled with the orchestral musicians. Has that also to do with the group structure?*

Yes.

In that case Terretektorh *may also belong there.*

No, it's much freer. It would be too complicated to analyse the role of space here, but I can tell you that with the groups we can measure the symmetry of a given structure. Let's take an example from geometry.

We can state of two triangles that they are equal if we place one on top of the other and their sides and angles overlap. But what are we to do with a polyhedron, let us say, a diamond, if we want to see whether it's symmetrical? We can't cut it in half – it's solid, and can't be put one half on top of the other. Another solution is to rotate it and, without destroying it, examine by which rotations parts of it replace other parts.[39] The rotation is the transformation of the polyhedron, the diamond or the cube, into itself. If it returns into itself it's symmetrical.

If we now take a rectangle – let us say a piece of paper – the axes of symmetry are parallel with the sides. If we rotate the rectangle along one, we shall see that it's symmetrical along that axis. That's one transformation. We can make a similar transformation along the other axis. The two can be combined and we get a third. In the case of symmetrical objects such transformations also form a group. The rectangle has four transformations; the square, which is more symmetrical, has eight. So the number of transformations belonging to a group corresponds to the amount of symmetry characterizing the object. The richer the group, the more transformations it has, the greater the symmetry.

The question can be asked: is there any sense talking about symmetry in music? The answer is yes.

The ABA form, for example, is symmetrical.

Yes, it's symmetrical in time. But don't forget that music has outside-time aspects as well.

Let us say that we have a cube. If we rotate it we shall see that it has twenty-four transformations. They also form a group.

What is a cube? It is an object which has eight vertices. If we rotate it we move these vertices out of their positions and they take up new positions compared to the original ones. It's as if we had another one, a ghost-cube made up only of these positions. This ghost-cube doesn't move, but every time we rotate the actual cube we relate its vertices to this ghost cube. This means that we need two sets, each consisting of eight elements. One consists of the vertices of the real cube, the other of the ghost positions. If we rotate the cube we place the eight vertices into the eight positions. It is as if we had eight cells and placed eight coloured balls into these numbered cells. How many ways are there of doing that? More than 40,000! [$8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 40{,}320$.] We can put eight objects in so many ways into the eight positions.

However, there are not 40,000 ways of putting the eight vertices of the cube into the eight ghost positions, only 24. Which means that of the 40,000 only 24 create the symmetries which form the cube. To put it another way: we have to find the 24 ways of putting the eight balls into the eight cells so that they correspond to the group of the cube transformations.

Now let us imagine an abstract musical 'cube' and examine the equivalent in music of the eight balls and the eight ghost positions. We need two sets, each consisting of eight elements. The ghost positions can be, for instance, clouds of events. One can consist of point sounds (e.g. pizzicatos), say, in the pitch versus time domain. Let its structure be ataxic, lacking rhythm, and the selection of pitches be based on a particular point of view, but the density can be in the domain of the low notes, or the high, or in the middle. In addition it has an average duration and average intensity. These, then, are the characteristics of this cloud.

We need eight clouds. One is ataxic, that is, amorphous. Another can move statistically towards the higher notes, a third towards the lower notes. A fourth cloud is neutral – it doesn't go upwards or downwards but stays unchanged without being ataxic.

We can take four further elements (clouds) which consist not of point sounds but of small glissandos. One can be, again, ataxic, one rises, one descends, one stays in its place but is not ataxic. Now we have a set consisting of eight ghost positions.

We need another set for the 'balls'. We can think of them as points in a three-dimensional space. Talking of music, one dimension can be intensity, another density, and the third duration.

Just as in the case of the cube we could put the vertices in the positions of the ghost-cube, so here it is a precondition that we are able to put the points in the three-dimensional space (treating them as the 'balls' of the real cube) into the 'cells' of the ghost-positions, that is, the clouds. In other words density, intensity and duration can find their equivalent in any of the eight elements.

We have eight clouds, each possessing density, intensity and duration – but as yet we have no music. We need – talking of instrumental music – the timbres of instruments, we need pitch; with the timbres we can connect ways of playing (arco, ponticello, harmonics, tremolo).

That's how *Nomos alpha* was composed. In *Akrata* we find the symmetry not of the cube but of the tetrahedron, which has only twelve elements. *Nomos gamma* is again more complicated and is based on group structures.[40]

After that, in sound synthesis, I returned to probabilities, but some instrumental pieces were also composed using this method.

At the same time I also set out in a direction that has nothing specifically to do with probabilities yet is distantly related: the idea of arborescences is closely linked to causality, repetition and consequently variation.

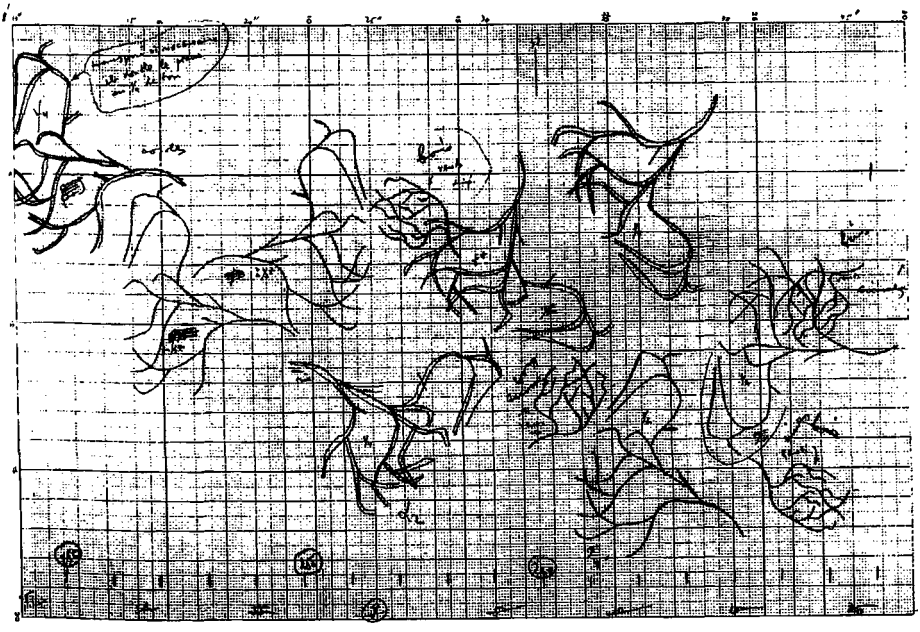
We start out of a point in space. This can be pitch versus time space or any other. In order for it to exist the point has continually to repeat itself. In this way a line is formed which can have any shape. Any point on the line can also reproduce itself and bring about an arborescence. In this way, eventually, a bush comes about. Starting out of a point we have reached 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 [transform] it; the rotations can be treated

as groups. But even if we leave groups out of account we have an object that we can transform. We can use the traditional transformations of the melodic pattern: we can take the inverse of the basic melody, its retrograde and its retrograde inverse. There are of course many more possible transformations because we can rotate the object at any angle.

Let us say that we have a ⌒ shaped melody. [*He hums it.*] If we rotate it a little it sounds like this. [*He hums the new melody.*] If we rotate it further we find several melodies simultaneously – three branches, no more. We have transformed a single melodic pattern into a sequence of three superposed melodies. That's how we can create something and then deviate from it (variation). 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.

I think Evryali *was the first piece in which you employed the method of arborescences.*



Sketch of *Evryali.*

The basic question of *Evryali* was how to achieve continuity on an instrument which has an opposite nature. I designed models – trees – which at that time I didn't rotate; that is, I didn't transform them but got from one shape to the next, thereby creating new ones. I used the method of transformations later.

What I don't understand is how you developed the shapes themselves. When you wrote Evryali, *for instance, did you draw the shape that corresponded to the melodic pattern that you imagined or the other way round?*

The drawing and thinking of the sound-image go hand in hand, the two can't be separated. It would be silly to leave out of account, when drawing, what will sound in reality. We have also to be able to find on paper the visual equivalent of the musical idea. Any changes and modifications can then be carried out on the drawing itself. This feedback has to operate all the time.

What advantage do arborescences have over traditional notation?

If I use traditional notation I lose the continuity.

Let us say that I have a bush of three lines that stem from the same root. If I map it in the Cartesian system of coordinates I have before my eyes the picture of what it sounds like. If I were to write the same on staves I would have to break it down into many staves and continuity would be lost. The whole thing would be much more complicated.

When I transcribed the organ piece into traditional notation I had to use so many staves that the organists were unable to play it. (The situation was similar, though to a lesser extent, with the harpsichord piece.) Eventually I had to prepare a different score and cut down the number of staves.

While I am composing the rotation has to be quick and easy. After that we can decide on the most practical solution using traditional notation. To help planning I developed with my friends a graphic electromagnetic system at CEMAMu[41] with which we can draw any shape and obtain the corresponding music with the help of a computer.

We can employ the method of arborescences also in sound synthesis from the computer. While instruments were manufactured in order for one to play melodies on them – in other words, the models are in the pitch versus time domain – in sound synthesis we are moving in the pressure versus time domain. This is also a two-dimensional space where the sound can be mapped as a single line. Although the quality and the essence are very different, the method and the result are the same: we obtain lines. One line is the melodic pattern, the other the sound pressure, that is, the sound itself – in other words, the music.

How can we construct a line? Once again, with the help of a rule such as a sine wave or a descending straight line or a complex line. The freest line corresponds to noise in the pressure versus time domain. In the pitch versus time domain the noise is translated by a melodic pattern which moves up and down all the time but without symmetries. This is the richest melody. How can we produce it? With probabilities and functions – in other words with the help of an abstract 'machine' which operates with probability functions. Through this 'keyhole' we have returned to probabilities.

[*The walls of Xenakis' study are decorated with computer oscillograms of sounds and noises. He pointed at them and commented:*] I made those graphs with the help of probabilities, at Indiana University. They were designed by computers based on the program prepared by myself. That, for instance, is a noise. It's too rich for the ear, we can't perceive it as repetition, so, because our ear is nothing but a periodicity-counter, we put it in the noise domain. In the pressure versus time domain we can transform that design into sound, while in the pitch versus time domain we get a more or less strange melody, continuous or discontinuous. It was with the help of such graphs that I made *Mikka* and *Mikka S. Cendrées, N'shima* and *Phlegra* are much more complicated: here, as well as arborescences, I used curves which I call random walk or Brownian movement curves.[42]

Mention has also to be made of the problem of pattern recognition, which is an important question not only in music and the other arts but also in sciences. When astrophysicists receive signals from space with radio telescopes it's important that they

should recognize the quality and quantity of periodicity so that they can draw conclusions with regard to the phenomena that occur in space. For messages to be transmitted by intelligent beings they have to be differentiated from natural signals. The latter are more or less periodical. Do the messages sent by intelligent beings also arrive in the form of periodic signals? To a certain extent yes, otherwise the result would be just noise, without any meaning. How can one differentiate between this periodicity and the natural one? That's a very profound problem in the pattern recognition of signals. So far as music is concerned it corresponds exactly to the question of pattern recognition in the field of sound synthesis and melodic patterns. As you can see, one can find fantastic links between music and other fields of human thinking.

Before going on I'd like to clarify one or two things. You have several times made a distinction between pitch versus time and pressure versus time. What exactly do you mean by pressure?

What is perceived by the human ear is the result of changes in atmospheric pressure. Those changes occur in time. Any sound (or music) can be mapped as a line showing the changing pressure. Every pressure is a value in time which, while changing, draws a curve. In the case of pure sound the image of pressure is given by the sine wave. Noise, on the other hand, is not periodical, and its image is also irregular. In order for us to perceive pitch we need a regular and periodic pattern. I have also mentioned that pressure exists in two-dimensional space: one is time, the other is atmospheric pressure. When this curve is transposed to instrumental music, instead of pressure we have pitch. The melodic line, however, can be drawn in both cases according to identical rules.

There is another question I would like to clarify: in talking of sound synthesis, do you mean electronic music?

No. Sound synthesis is a general term referring to the production of artificial sound by some means. Electronic studios use frequency generators that produce single sine waves and a single

kind of noise, whereas any curve can be designed with computers, through programming. In the latter case we have to compute every instant. If we then feed the figures corresponding to the curve into a device it will transform them into electric tension changes, and with the help of a loudspeaker we get the sound. Any curve can produce a sound. The method using computers is the most general and the most radical in sound synthesis.

Which of your compositions have been written using this method?

The most important is *La légende d'Eer*, the music of the *Diatope*. Some of it was made at CEMAMu, some in Cologne, and I put together the whole on a seven-track tape. The computer research was carried out at CEMAMu because there are no computers at the electronic studio of Westdeutscher Rundfunk.

Before going on to a more detailed account of tape music, perhaps you might sum up the sieve theory.

The sieve theory helps in the selection and organization of points of a line. The line represents any characteristic of sound which has an ordering structure (time, pitch, intensity and/or density, and degree of disorder if we work with clouds of events; also, the smoothness of sound. Tremolo and flutter-tongue, for instance, are smoother than staccato but less smooth than sustained sound without flutter-tongue etc . . .).

The question, then, is how to organize sets of the characteristics of sound. Let us take pitch, for example, which is outside time and a well-known characteristic. How to select certain values – in other words, how to produce a scale? After the disintegration of tonality Western music used the totality of the chromatic scale without making any difference between the individual notes. It led to a deterioration in the quality of music because the chromatic scale is neutral. In order to get a more interesting, more complex scale, we have to choose between the notes.

I took the first step in that direction in *Herma*. I have told you

that I chose three sets of the notes of the piano and introduced them by playing each note, stochastically, that is, without establishing any link between the notes. That is also the first stage in the relationship between the elements of a set.

The next stage is to create links between the notes, that is, intervals. In other words we look for a law to determine the points on the line. The line is actually the continuum of pitches.

From the values of the line we allow only some to manifest themselves. That is why I call this method a 'sieve'.

How can we establish a firm link between the points? I started at the beginning, in other words with an axiomatic method, defined some fundamental propositions accepted by everyone, then, with the help of logic, I continued to build up from there. That's what the sieves were for.

I started out of perception. Everybody hears the intensity, density (the number of events by seconds), pitch, the degree of order and duration of sound. We then determine the values of a given area of perception, for instance the perception of pitch. These form sets.

When we perceive two pitches we not only hear them but, on a more abstract level, we assess by comparison the distance between them. That is our second proposition.

The third: we are capable of repeating that distance and thereby receive new values of pitches.

In possession of these three very basic conditions, with the help of general logical operations, we can choose between the points on the line – that is, we get a scale. How?

Once again: we perceive the different characteristics of the sound. We choose one, such as pitch, take two values of the set, perceive their distance and repeat it. What do we obtain? A kind of chromatic scale.[43] That's the first object we have gained using these basic conditions. Aristoxenos was the first to suggest the setting up of the chromatic scale. He started out somewhere else but was interested in the same problem. However, he divided the scale into twelve equal parts. The chromatic scale became a focus of attention again in the seventeenth century, then, with Schoenberg, it reached an impasse, from which no way forward could be found.

In the pitch domain, then, the chromatic scale is the first object that we have gained. In the time domain, too, we get a chromatic scale. [*He knocks evenly on the table.*] This is the chromatic scale in time. We take two instants and repeat the interval between them. In intensity, we get the decibel scale, and so on.

Let us assume that we build the chromatic scale out of semitones. Let us call it 1. Now let us make a scale out of whole-tones. Based on the step compared to the first one, let us call it 2. This contains only half the notes of the chromatic scale. In order to get the other half as well we have to shift it a step. If the former is written 2_0, this will be written 2_1. If we do the same with a three-semitone step we get another scale (e.g. C–E flat–F sharp etc.). This is written 3_0, which contains a third of the possible notes. If we shift it once by a semitone step we get two-thirds – 3_1. With two shifts we get 3_2 which is the remaining third. Yet another shift takes us back to the starting point. If we work with a step of five semitones we get five different sub-sets of the chromatic scale with no intersection.

Since we have sets, their elements can be combined logically. If, for instance, we combine 2_0 and 3_1 we get an irregular scale with unequal spacing between the notes. If we pick the common notes of 2_0 and 3_1 the number of notes will diminish; if we do the same with 2_0 and 2_1 there are no common notes. If we combine the two with the operation of disjunction (union) the result will be the chromatic scale.

The main thing is that any scale – even the major scale – can be shown employing such a logical formula. Twelve is the modulus, after that the whole thing will be repeated. Well then: $c = 12_0$, $d = 12_2$, $e = 12_4$, $f = 12_5$ and so on, until 12_{11}; $12_{12} = 12_0$. If we combine by disjunction (represented by v) all of 12_0 (in other words every *c*) with all of 12_2 (that is, every *d*) and so on we get the complete major scale. We can reduce it to a logical expression made out of the modulus 3 and 4 because 12 is the product of 3 by 4. In this way, by reducing them to their simpler elements, we can compare scales with large modulus with other scales as well. In my books I logically analyse the major scale reduced to the 3 and 4 modulus.

Let's suppose we're looking for a completely different logical

expression among the sets of these simple sieves. We choose a very general logical formula and, based on it, we can do operations with the sets (intersection, union, negation etc.). In this way we get a scale which may completely lack repetition (periodicity), or at least it can't be perceived aurally.

What, then, does transposition mean – let's say that from C major to G major? Using the signs outlined before ($12_0 \vee 12_2$ v etc.), we now have to shift by seven semitones – in other words we add seven to the indices of 12: $12_7 \vee 12_9 \vee 12_{11} \vee 12_{12}$ and so on. This is how one can show transpositions algebraically. If we change the indices irregularly we get a completely different scale which in fact is the same but rotated.

In *Herma* I chose sub-sets from the chromatic scale – that is, I chose some of the points on the straight line. After that I put to myself the following question: How can one carry out this process on a more general level which would comprehend all the scales used in the past and all those that may come into use in the future? The sieve theory gives the answer. This answer may not be complete, but it's certainly effective and many-sided. The development of music arrived at the neutral (chromatic) scale, and now there's a possibility, instead of turning back to the past, to change that scale by transforming its structure. We have thereby opened up the impasse and can reverse the deterioration in the quality of music which I discussed earlier. It is also interesting to note that, with the help of the three basic conditions mentioned above (and I don't believe one can find simpler ones than those), we arrive at the chromatic scale – that is, at the final point of the long development which came about through different scales in the course of history. With the help of axiomatic thinking, bypassing all these scales – that is, bypassing evolution – we have arrived directly at the chromatic scale. It now encompasses all the scales used, both in the past and in other cultures, as well as the ordered sets of the future.

6 On Space, Ballets, Incidental Music, Vocal Works and Games

ON SPACE

There are three works in particular in which you allot an important role to space: Terretektorh, Eonta *and* Persephassa. *What is the relationship between space and music?*

Space first and foremost has the task of allowing sound to be heard properly. If, for instance, we seat four, five, six musicians performing a chamber piece close to one another the sound coming from one point is too thick, the instruments can't be differentiated from one another. We have to do with a phenomenon well known in acoustics: if they belong to roughly the same pitch zone the stronger sound neutralizes the weaker. The sound will be much purer if we seat the musicians well apart – that is, if we insert space in between.

There's no argument in any case for music to be played at one end of a hall only, rather than at several points. Music can surround us in the same way as the sounds of nature surround us in the forest or at sea. The practice generally observed at concerts, of music coming from one source, is merely one possibility of many.

The most important thing is: if the musicians fill the space at their disposal we can exploit its kinetic properties. Instead of static music we can produce something mobile. Movement is an interesting means of expression, which can hardly be employed with traditional orchestras. Sometimes I have also used that limited possibility in an orchestra seated traditionally on the podium, making sound wander from right to left or from left to right. There's no depth, however, because the perspective of sound is insufficient. Genuine movement can come about only if the musicians surround the listener. We can therefore 'tame' space.

If, however, orchestral musicians mingle with the public practically every listener hears a different kind of music because obviously the instruments in their vicinity drown out the sound of those playing at the other end of the hall.

The individual listeners don't hear a completely different kind of music, but they certainly do hear the same music from a different perspective. If the piece is good it will be performed more than once, and it will thus be possible for everyone to hear it from different angles.

This solution has another advantage as well: the physical proximity of the instruments makes their sonority much more alive than when you hear them at a distance, in which case the energy they radiate dwindles and components of the matter of sound are lost. If we are as near to the instruments as the conductor and the musicians then we find ourselves in the very middle of the sound.

The situation is the same with a Beethoven symphony. It is worth getting to know the components of Beethoven's music, also, and if during rehearsal we walk closer to the strings we can hear many things that are otherwise lost. We can listen to the individual parts separately and then reconstruct the entirety of the composition in our head. We can also walk round a building, look at all its details and then build up its image in our mind without needing to be there, in every nook and cranny, at the same time. To get back to music: we can compose in such a way that the musician close to the listener does not play all the time, and so those in the distance can also be heard.

Beethoven, of course, wrote his symphonies in the knowledge that they would be heard at a distance.

I'm not so sure of that. I don't think Beethoven put himself in the position of the listener sitting in the hall; rather, he imagined himself in the middle of the orchestra, or at any rate in the conductor's place. I'm convinced of that. There the sound image is global and particular at the same time, and, in addition, the energy of the instruments is intact. He can hear pianissimo and fortissimo and all the timbres. I don't believe Mozart or anyone

else composed for the listener sitting fifty or even twenty metres from the orchestra. I do admit, however, that organ works were composed for listeners far from the instrument, because the acoustic near the organ is very poor.

One conductor has actually declared that his is the worst of all positions, and that if the sound is satisfactory to him then it will certainly be satisfactory to those in the hall.

He's right in the sense that sounds amalgamate at a distance from the orchestra and that unevennesses are therefore less noticeable.

Yes, that's the point I wanted to make. And also that in my view composers write with that phenomenon in mind, that that's how they choose balances and so on.

Things like that are greatly dependent on the acoustics of the hall. Sometimes one can't hear a thing near the podium while at a distance the music can sound quite loud. I don't think, therefore, that we can consider distance as a yardstick, nor can we assume that the composer was thinking in terms of distances. It's much more likely that they consider music objectively in terms of real sounds, rather than from any particular distance, which would be silly ... unless they were thinking of some ideal hall which doesn't exist.

Is there an ideal hall for Terretektorh*?*

No. It may happen, by chance, that the acoustic isn't too bad. There's no hall, however, which suits it perfectly.

If I remember correctly, you imagined a large, ball-shaped hall for Terretektorh.

Yes, where the listener, wherever he may be sitting, can hear properly what is being played both in front of and around him.

I read in an issue of Tempo *about a performance of* Terretektorh *at one of the English Bach festivals. A compromise solution was reached: the*

members of the orchestra were seated so that the public could be placed in aisles between the 'beams' of the players.

That was on the recommendations of the fire service! In France and elsewhere the performance proceeded according to the original plan.

Your wishes can be more easily met in the case of Persephassa. *I heard it in London's Round House and it made a very good impression there.*

The Round House isn't bad, but it's not really suitable. The hall is too high and much of the energy of the sound is lost.

The music, however, did surround us.

That's true. The acoustic problem is simpler. But I emphasize once again: the closer we are to the instruments, the less we lose of their energy.

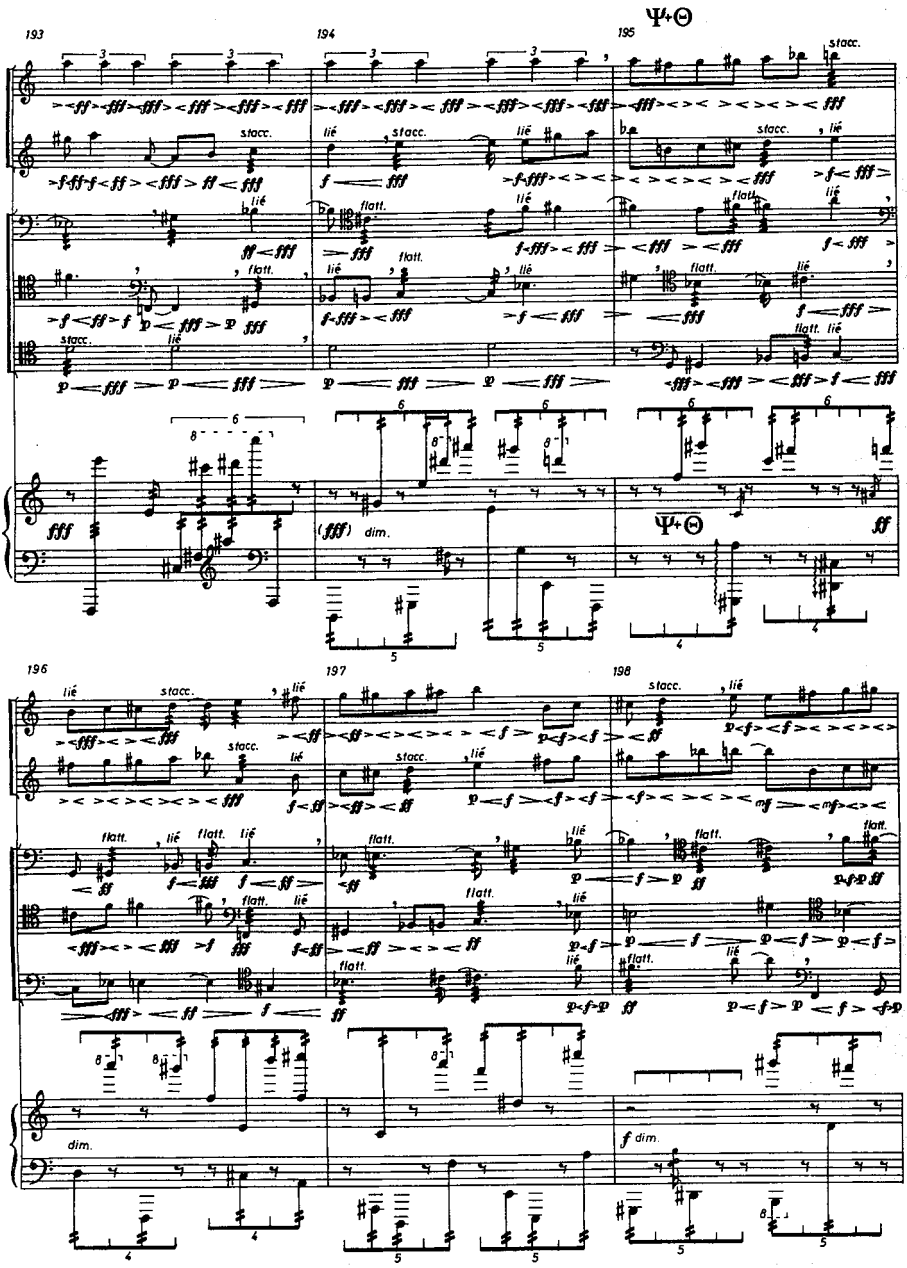
Of the three compositions, Eonta *is the least complex, so far as the use of space is concerned. You wrote it earlier than* Persephassa *and* Terretektorh *– can we therefore regard it as a first step, an experiment?*

Perhaps, yes. Here too the basic idea was to ensure the sound was not coming from just one source. Of course that's only possible with the wind-players, because we can't move the piano.

That's true, but if there were several pianos on the podium the soloist might move from instrument to instrument.

That's right. I didn't use that solution, however. Instead I chose to make the sound more dense by getting the wind-players to perform bending over the open piano. With the help of the piano's resonance, the quantity of the sound will also increase.

We are digressing, but I would like to take this opportunity of asking you to elaborate on Eonta. *The piece starts with a highly complex piano solo. You composed that introduction with a computer, didn't you?*



Score from *Eonta*.

Yes. There are other passages as well, if I remember correctly, at the end, where I used the computer. I also employed the stochastic method when I needed clouds consisting of sounds selected at random. I calculated the changes in density and intensity with the *ST* program.

What is the reason for the frequent change in dynamics?

I determined dynamics statistically, with *fff* and *ppp* as extreme values. There are passages where only one or the other occurs and also where every note has a different intensity. If the two are mixed it's natural that the nuances should also be mixed.

In the score you explain that the title is the plural present participle of the verb 'to be' in the Ionian dialect. But why did you dedicate the piece to the memory of Parmenides? Was it simply because of your admiration for him, which you have so often stressed?

Parmenides was one of the first philosophers to bring in inference as an approach to truth, to existence. When he set up the theory of existence he reasoned that, if something exists, it's not possible that it didn't exist before or that it should cease to exist. In his opinion it's equally nonsensical to say that something doesn't exist now but that it will. Whatever exists now has always been, in exactly the same way as it is now and everywhere, in the whole universe. Consequently there's no change.

Aristotle said Parmenides was crazy to say things like that because everyone knows that things change. However, Parmenides thought like that because he realized the ontological essence of existence, of 'to be', and felt that existence couldn't consist of one instance only. If it exists only for an instant and then disappears it doesn't exist in eternity. The two together are inconceivable. Existence can only be total.

As far as *Eonta* is concerned, the piece changes, of course, but is based on something constant. As with *Herma*, I used sets of sounds. That's how I approached indirectly the questions of existence in time and space.

Parmenides' opposite was Heraclitus,[44] who thought everything changes, nothing is constant.

The struggle between constant and change can be found in music and in every other phenomenon. For instance man dies but, in order to exist, first creates his own 'copy'. So he remains, as Parmenides said, but also dies, as Heraclitus claimed.

In any case, you haven't dedicated a piece to Heraclitus.

No, no.

In your notes on Eonta *you say that it's based on 'logistics'. What is that?*

'Logistics' is simply the name used in the nineteenth century for symbolic logic. Today everybody talks of logic or mathematical logic, that's all.

BALLETS AND INCIDENTAL MUSIC

I would be interested to know what you mean by abstract ballet. You use this expression in connection with Antikhthon. *You feel that abstract ballet would be the ideal choreography for your music, but you have yet to see it done.*[45]

Ballet is based on the human body, which has limited formal possibilities, in that it's confined to the movements we can make with our limbs, our trunk and our head, and that's all, although the distance from the earth can also play a role. The vocabulary of ballet, then, is not rich. Until Merce Cunningham appeared on the scene it always expressed emotions and relationships. The question is, how to substitute abstract events for these? How to design a choreography which expresses only shapes and the relationship between them in space and time? That's what I mean by abstract ballet.

So Merce Cunningham comes close to that ideal?

Up to a point, yes, but he has kept some vestiges of realism. I know this is not an easy road to follow, but I believe in the possibility of realizing abstract ballet.

And you think Antikhthon *would serve as a suitable background to such ballet.*

Yes. I composed *Antikhthon* at the request of Balanchine, some ten years ago. I liked the way he had choreographed *Metastasis* and *Pithoprakta*. Those ballets were in many respects different from his earlier works – they were much more abstract. But the choreography of *Antikhthon* was never realized. There were personal reasons for this: Balanchine fell in love with the ballet dancer Suzanne Farrel but she loved someone else and wanted to get Balanchine to employ her lover. Balanchine naturally refused, Farrel left the company and the plan of the choreography was dropped.

While composing, are you influenced by the knowledge that your music will be danced to?

No, it doesn't interest me. The only subjects that inspired me were ancient tragedies, because they reminded me of my youth and of my attempt to conjure up the music of that period. That's how I wrote the music of Aeschylus' *Hiketides* and *Oresteia*, Sophocles' *Oedipus*, Euripides' *Hélène* and Seneca's *Medea*.

Does that mean you wrote stylized music?

Not always. In *Hélène*, composed for female chorus, and *Oedipus*, the answer is yes. *Oresteia* and *Medea* are freer, while in *Hiketides* the link between subject and music is loose. I invented something new in the staging as well but unfortunately I missed seeing how it was done because at that time I was still unable to go to Greece. It was my idea (and this has since been imitated by others) to fix instruments to the costumes and feet of the chorus and to give them instruments to hold in their hands as well. Thus they could produce sounds by their movements alone and the instruments

on the stage could also be sounded when touched or hit while dancing.[46]

VOCAL WORKS

I've heard four of your compositions in which you use the human voice: Polla ta dhina, Akanthos, Nuits *and* Cendrées. *In the latter two I was particularly struck by the way you treat the voice as an instrument: you employ glissandos and pizzicato-like sound clouds.*

Yes. I can't see why the human voice should have to be treated in any special way. In *Nuits*, incidentally, I experimented with different phonetics, which is why I used Sumerian and old Persian phonemes.

If you were looking for new kinds of sound you might just as well have invented them yourself, without their having to carry any meaning.

I did that later. In *Anemoessa*, written for the Holland Festival, the chorus sings only vowels. In my experience the Germans are the only people who pronounce consonants properly. That's why it's nonsensical to set any meaningful text to music, because one can't make out what's being sung. The same is true, of course, of operas – unless one knows the libretto one has no idea what it's all about. That's why I like televised operas, where the text can be read on the screen. In *N'shima* I want guttural sounds which don't occur in any language. I wrote the piece for the Testimonium Festival of Jerusalem, and I use some Hebrew words as well, on and off, but mostly phonemes and special guttural sounds.

For me, Cendrées *is one of your most beautiful compositions. In it I came across a special effect which I don't think occurs anywhere else: the chorus sometimes sings very short glissandos.*

That solution appeared in *Mikka* for the first time, I think, and is applied to vocal music in *Cendrées*.

There was something in the realization which disturbed me. I don't know whether that was your intention – the soloists sometimes made those glissandos sound comical – rather like barking.

I think a perfect performance of *Cendrées* has yet to come.

So it hasn't yet been performed the way you would like?

It's never performed the way I want. Singers have a great deal to learn. They can't control their voices, especially those I haven't worked with. It takes much effort for them to get rid of their conditioning and this process requires intelligence as well. However, even if I manage to get them to achieve what I want, by the next performance they will have forgotten and I have to start again from scratch. Instrumentalists are much the same, though perhaps to a lesser extent. The most difficult thing is to induce string-players to make a real difference between ponticello and arco: the former should be rich in high harmonics. They do it as I want when it's explained to them, but soon return to their customary way of playing.

Unfortunately, you can't attend every performance.

No, and I wouldn't want to. Or, rather, I would want to but I haven't the time to go everywhere. Nor am I invited. They are afraid.

Composers are at the mercy of performers. And even if a composer happens to be present at a concert which caused him more bitterness than joy, he has to appear on the podium and congratulate the artists. I've never heard of any composer on such an occasion turning to the audience and saying: You have received a false picture of my piece, I imagined it otherwise.

That's true. Many performances are needed in order to develop an interpretative tradition of a composition. I remember an exclusive film projection showing Zubin Mehta conducting *Sacre du printemps*. After it was over Stravinsky turned around and

declared he was dissatisfied with the conductor. He added that he couldn't understand how Mehta could have misinterpreted the piece to such an extent – after all, *Sacre* already had a tradition. By that time it had been played for some half a century, all over the world. If even then some performances left the composer dissatisfied, what can one expect of a more recent composition which has only been played a dozen times, mostly by different musicians?

But even when one has the same performer it's been the case with a piece of mine that the more often it was played, by the same orchestra, the less it had to do with my instructions. It was an instance of entropy.[47] In such a case the only solution is for the composer to rehearse once again with the performer. I don't forget what I said, but I may add new things later on.

Wouldn't the easiest solution be for you to conduct your works yourself?

I don't think so. It's important that the performer should be able to maintain a certain distance from his repertoire. This detachment would be impossible with the composer; he couldn't be objective. Stravinsky was a very bad conductor. Also, preparations for a performance take a long time, and conducting requires constant practice.

GAMES

A Dutch ensemble performed Linaia-Agon *in Budapest, but because there were no programme notes we didn't understand why and who won scores – on what basis one won and others lost. We enjoyed the music, of course, notwithstanding the lack of information.*

In what respect do you call Stratégie, Duel *and* Linaia-Agon *games?*

The game is based on musical events, the tactics, which occur simultaneously. The participants employ a strategy determined by me which leads to the simultaneity of two particular musical

sections out of a number of possibilities. The winner is the one who is more adroit in employing a series of tactics designed to achieve higher final results in accordance with the 'Matrix of the Game'.

How can the conductor communicate with the musicians during performance? How can he tell them which strategy to play?

He could give signals with his hands, but that's too complicated. It's simpler if he uses light signals.

How would he do that?

A box with buttons on it is placed on the conductor's platform. One signal which lights up among the players tells them which strategy to choose, and another marks the beginning of playing.

Who wins?

The one who has accumulated the greater number of scores according to the matrix.[48] I am the judge – the one who determines which solution is more interesting. The game has nothing to do with the quality of the music corresponding to the various strategies.

This is a kind of aleatoric music.

No, because the choice is based on the matrix, provided they want to win.

Who doesn't?

That's true. In this case they follow the rules – in other words the values determined in the matrix. I decide what the values are, that is, what is advantageous for them to choose.

If both conductors select strategies based on the matrix they stand an equal chance of winning.

Yes, but they can make mistakes – for instance they might not foresee certain choices.

Obviously there must be a referee at each performance.

Yes, he counts the scores.

These pieces have a component to them which I have only partially succeeded in solving, and that is that each strategy should be genuinely interesting. Each strategy has to be different but it can't differ basically from the others because I have to retain the continuity of the music.

7 Tape Music. *Polytope–Diatope*

You have composed concrete music alongside instrumental compositions, but in strikingly smaller quantities.

First of all, I prefer to use the term 'electroacoustic' or 'tape' music.

There are fewer of these works than there are instrumental works because after my row with Pierre Schaeffer I simply couldn't find a studio where I could continue my research. Pierre Henry's studio was too small, and it didn't have the equipment to interest me, while Stockhausen didn't let anybody use the Westdeutscher Rundfunk studio – and it was in any case outdated, nothing had changed for twenty years. Nor was Scherchen's studio suitable for the kind of experiments I wanted to do. In Bloomington the situation was obviously too precarious, and anyway I didn't have time to set up a studio. Finally CEMAMu provided the necessary framework for my research – that's where I designed the music of *Mycène*. There were also private studios, but they were very expensive – although it's true, of course, that others paid for them, not me. For instance, the expenses of *Persepholis* were covered by the Shiraz Festival.

Where did you prepare the tape of Kraanerg*?*

In a private studio, under very difficult circumstances. I should do another.

Is that the only piece where you employ tape music and live performance within a single composition?

No, the same happens in *Analogique A* and *B*. It's a kind of electronic music because I needed pitches, so I used sine-wave generators.

Diamorphoses *was the first among your electroacoustic compositions. What did you learn in the course of its realization?*

I drew several conclusions. For instance, that by dense mixing one can obtain continuous sounds out of discontinuous ones. It also became clear that there is a logarithmic relationship between the increase in density and its perception. I made the following experiment: I recorded sounds on tape without regular rhythm, of irregular density. Then I copied the recording and mixed it with itself. However, I edited the second tape in such a way that I avoided any repetition and echo: the sequence of sounds didn't correspond to that on the first tape. When I listened to the new recording I asked myself: Can I hear the difference? And I found that I had arrived at the border of change. I then carried out these operations with three tapes. The result was that the density undoubtedly increased by one step. In order to perceive an increase of the same magnitude I had to mix the three tapes once again, with the help of three tape-recorders. The density was now nine times greater but, as I said, my senses perceived it as an increase of only one step. Here is the proof of the logarithmic connection.[49]

As far as Bohor *is concerned one feature of the piece struck me, though I don't know how essential it is to the work: the presence almost throughout of a drone which changes in intensity and in proportion to the 'busy' sounds that surround it.*

Yes, that's a very important feature of *Bohor*. Incidentally, Alfred Frankenstein, who is an influential music critic in the United States, compared *Bohor* to *Sacre* in its significance and described it as a fundamental composition of the twentieth century. It doesn't make a proper impression, of course, if listened to in a small studio. It needs space.

You say somewhere that if you can imagine something for yourself it exists or might exist. I think that conviction accounts for your daring, sometimes even utopian, projects. For instance, the one which would cover the globe with a cobweb-like veil of light, or the one which would use the clouds and the satellites as mirroring surfaces, and so on.[50] *Do*

the Polytopes[51] *and the* Diatope *represent a first step in the direction of such grandiose projects?*

Of course! They are only the beginning. As the means develop further it will be possible to realize even more daring ideas, as man reaches further out into space and extends deeper in his thinking.

Unfortunately, I haven't seen/heard any of the Polytopes *and can only form a vague picture of them based on the descriptions. Nor is their aim quite clear in my mind, apart from their being some kind of wonderful toy.*

The problem is the same in music as in other forms of artistic expression. It also occurs in other areas of life. To land on the moon, to go out into space – that's also a game isn't it?

The primary object is scientific research.

But it remains a game nevertheless.

Perhaps in the sense that the scaling of a mountaintop incurs the risk of loss of life. But what other objective does your Polytope *have?*

It experiments with novel ways of using sound and light. It's an attempt to develop a new form of art with light and sound.

It occurred to me that you might be endeavouring to create a new kind of Gesamtkunstwerk, *something more comprehensive than anything attempted before.*

That's the result of the experiments. The starting point is my desire to live – that is to do, to create something, with my hands and with my head. In the case of the *Polytopes* I was attracted by the idea of repeating on a lower level what Nature carries out on a grand scale. The notion of Nature covers not only the earth but also the universe. When we look from space at the earth at night we see that the globe is lit by artificial light, which didn't exist a

century ago. You see what I mean? And this is only the beginning. If the kind of development we have seen recently continues the possibilities of mankind will multiply and all that novelty will also enrich art. One can realize more and more interesting and complex things – artists will possess immense power.

Yes, in the writing I quoted earlier you pointed out that the artist would play a pioneering role because he is the freest of all.[52]

For me, that seems quite natural. After all, in science it is necessary to prove statements. There is room for experimentation as well – mathematics is less concrete than physics and takes longer. In science theory and experiment exist side by side and complement each other.

In art there is no truth but there is inference. If, for instance, the rhythm remains unchanged for a long time, we can assume that it will stay that way. The chain of inferences adds up to a kind of demonstration or proof. In music, listening to a piece – the performance – is nothing but experiment. That's how we can check the truth value of the work in a social and statistical sense.

Inference and experiment, therefore, also exist in art, even if not in the same strict sense as in science. Art, however, has an aspect which needs no proof. Suddenly we understand something: that is revelation, intuition. That's what renders art more free than the natural sciences. More free and more powerful, because art conquers domains that lie outside science at the same time as claiming fields that they do cover.

I should add that there is a branch of science which is based not on experiment but on observation – and that's astrophysics. Here, observation is a kind of bet: we bet that, with the help of our interpretation of certain phenomena, new observations will become possible. It's not in our power, however, to repeat the observations themselves. The development of social structure belongs to the same category. There is no possibility for experiment. So one sets up a theory – as in astrophysics: one checks its truth through observation.

To get back to the Polytopes*: is there any link between the music and the spectacle?*

The link is not between them but beyond or behind them. Because beyond there is nothing but the human brain – my brain.

We are capable of speaking two languages at the same time. One is addressed to the eyes, the other to the ears. The content of the communication is different but sometimes there's a link between the two. This is necessary because we're used to the fact that there's a connection between what we see and what we hear.

I have realized that several musical theoretical solutions can be applied in the visual field as well. The *Polytope de Montréal*, for example, in 1967, used 1,200 sources of light in the French pavilion of the World Exhibition. These lights, fixed to steel cables, formed a kind of transparent sculpture. Each light could be operated separately. In other words: I had a cloud of lights in space with which I could carry out the same operations as with clouds of sound. Something similar could easily be realized on the grand scale, in space – within a few generations. I have also thought of bringing about Northern Lights artificially, at any altitude. Northern Lights are produced by electrons coming from the sun, by exciting the atoms of the stratospheric gases. If we can direct from the earth a radiation into the high atmosphere, probably Northern Lights will result. I have discussed this with scientists. In their view it would damage the ozone layer and therefore such experiments shouldn't be carried out. I doubt the truth of that argument. Surely one can find a solution which would spare the ozone layer – and in any case we don't know whether the ozone layer reproduces itself, or if once destroyed it will never reappear.

That's another question. The main thing is that the technical conditions are there and it all hinges on whether or not the money can be found to translate it into practice.

It also occurred to me that, with beams of light concentrated like a laser, one could illuminate the dark side of the new moon or the old moon – after sunset or before sunrise. Through mirroring surfaces placed on the moon one could establish visual contact between the two stars: the earth and the moon.

One can also do new things horizontally. When I was asked to

think of something for the inauguration of the Centre Pompidou I suggested that the highest points of Paris be connected by light – for example by mobile laser beams – and to use the anti-aircraft loudspeakers which are checked anyway every first Thursday of the month – otherwise they are there, useless. The music that would have been broadcast through them could have been linked with the light effects. The idea was rejected on the pretext that it would have cost too much. Technically it's feasible – only it does cost a lot of money.

In the Polytopes *and the* Diatope *you have been able to put some of your ideas into practice, even though on a smaller scale – nevertheless you have been able to produce a fantastic audiovisual game, a marvellous show. What in fact is the difference between the* Polytopes *and the* Diatope*?*

There is none. Robert Bordaz, who initiated the *Polytope de Montréal,* approached me with the idea that I should design a similar project for the inauguration of the Centre Pompidou. Since I had called the show I made for the Cluny museum a *Polytope* (that, incidentally, was commissioned by Michel Guy, the then director of the Paris Festival d'Automne) Robert Bordaz asked me to find another name. I was looking for one that sounded like the *Polytope* but made sense. That's how I eventually devised *Diatope.*

What's the difference between the Polytopes*? How did you develop the first one further?*

The one in Montreal was determined by the environment provided by the interior of the French pavilion. The next one was arranged in special premises: the Roman bath of the Cluny museum in Paris. As far as the *Diatope* was concerned I was the one who designed its shape and used more varied means than in the earlier ones. For instance, the *Diatope* had four laser beams instead of the three used in Cluny – there were none in Montreal.

In Montreal I used 600 floodlights, in Cluny as many flashlights, and in the *Diatope* as many as 1,600. The most important

difference is that in Montreal I achieved the visual effect through film, while in Cluny I used digital magnetic tape.

In Montreal the frames of the film followed one another in the 25th of a second. Each black frame had a white spot on it and the light passing through it activated a special photoelectric cell. Altogether I had 1,200 of them. I had to prepare the score and the set-up of the lights. The *Polytope* lasted about six minutes; the lights flashed 25 times per second, that is, 1,500 times per minute, 9,000 times during the six minutes of the show. I needed that many frames. The man the organizers commissioned to prepare them nearly went crazy completing the job. When we met he said: I give up! I'm on the verge of a nervous breakdown! The frames, however, were more or less faultless. In Cluny, as I said, the human contribution was no longer necessary: it was possible to program a magnetic tape. The show was longer, lasting 22 minutes: I had transformed concrete sounds into a kind of electro-acoustic music. Much of the music of the *Diatope* was also prepared that way, but there I also used a computer, with a much more complex program. The *Polytope* I am working on now (I have been commissioned by the Mexican government to do it for performance in the pre-Columbian ruins) requires less technical detail than the *Diatope*. Thousands of Mexican children will participate: they are already being trained to do various formations in the stadiums. I have to finish it by the end of 1980 or early in 1981.

In Terretektorh *the sound waves hitting each other play an important role. Don't you have something similar in the* Polytopes *– where the sound masses coming from the loudspeakers crash against one another?*

These are two different things. In the case of the orchestral piece, where the public is standing or walking among the musicians, the audience is surrounded by sound. In order to obtain interesting sonorities with loudspeakers, on the other hand, one needs huge equipment and space to be able to place the speakers properly. In the *Polytopes*, however, the space had to be left free for the laser beams.

In the 1950s I proposed a space 'paved' with loudspeakers. I

imagined cubes with speakers in their vertices. The sound would have come from everywhere: the floor, the ceiling, from the front and from the back – everywhere. In other words, I imagined a three-dimensional net and the loudspeakers would have been in the 'knots'. In this way the impression of movement and space is much more easily created than in the concert hall. That idea was a bit closer to the basic principle of *Terretektorh* than of the *Polytopes*.

8 EMAMu/CEMAMu

You founded EMAMu [Equipe de Mathématique et Automatique Musicales] in 1966. Obviously you lost patience after a while: you were fed up with having to do research at the mercy of others, with no hope of uninterrupted work. You wanted to have an institution of your own. Was EMAMu what you wanted?

The idea itself had occurred to me earlier. Yes, I wanted to set up an institute with equipment and computers of its own. I needed other people to do that and I needed money. I did find companions, but for ten years I couldn't get any money. The mathematics professors François Genuys, and Marc Barbut and Georges Guilbaud of the Ecoles des Hautes Etudes were interested in my plans: I wanted to design equipment which was suitable for sound synthesis and was also capable of producing music with the help of a computer, based on mathematics.

In 1972 EMAMu became CEMAMu [Centre d'Etudes de Mathématique et Automatique Musicales], a non-profit-making organization, thanks in particular to the physicist Leprince Ringuet and computer science expert Alain Profit.

Like its predecessor EMAMu, CEMAMu had the aim of making it possible for composers directly to transplant scientific thought and mathematics into music. Directly, that is, without any sound generator or musical instruments.

As an example: some of the theories I developed can also be used in computer music, because they're based on mathematics. They were born out of compositional necessity, that is, for reasons outside mathematics, but they need mathematical means for their realization. We can then work with the computer on a more general level, because we can put into practice a program generating an entire family of compositions. At the end of the chain, on the lowest level, there is the sound which can be produced by one or another theoretical means.

Will you please explain in detail what you mean by producing sound by theoretical means?

We can make a pressure versus time curve and transform it using a special device, the digital analogue converter, directly into music. It is, of course, not easy to find interesting curves – ones that yield sounds which are interesting to our ears. It depends on the underlying theories.

The basic difference between CEMAMu and other studios is that we take the pressure versus time curve as a starting point – that is, what we hear. Others, by contrast, operate with sine waves to obtain sounds and timbres: they hope that by combining simple sine waves they will succeed in obtaining a pressure versus time curve which can produce an interesting sound. The curve, then, is the final result. We start from the other end: instead of going backwards we start with the curve.

One tool for that is the electromagnetic table, on which we can draw with an electromagnetic pencil which looks like a ballpoint pen. This makes it possible to establish direct contact with music, without any programming and notation. The shape drawn on the table is calculated immediately[53] by a computer and the result can be heard within a few minutes.[54]

The computer interprets the lines: the vertical one shows pitch, the horizontal one shows time. Any polyphonic music can be composed in this way. What is missing is timbre and dynamics. But the computer is also directed to interpret lines as timbres. If we draw, say, a sine wave on the table, the machine will interpret it as a unit. It returns to the projected score and 'says': That line is in such and such pitch and repeats the sine wave, which is a period, so many times per second corresponding to the frequency of that pitch. We can, of course, draw any picture on the table and any line which the computer will treat as a period and repeat as often as is required by the pitch in the score. We can design different shapes and they will be stored in the 'timbre bank' of the computer.

What is still missing is the intensity. Again we design any linear shape on the table – it can be simple or varied. This time the line will be interpreted by the computer as a dynamic shape and

we can form a bank of that, too, from many shapes. Now we have two banks and the two together, assigned to the previously designed score, sometimes produce fantastic timbres.

Do you mean that the two interact and produce timbres that cannot be foreseen?

Yes. That's very important: it's not only the shape of the wave that influences the timbre, but also the dynamic shape and the interaction of the two.

After that we have to determine the intensity – that is, the average volume of the line in the score – for every sound or glissando.

What is the difference between dynamic form and average intensity?

We can start, for example, with a forceful attack which gradually grows softer – but all that can happen piano, pianissimo or fortissimo.

After having determined all the characteristics of every line in the score we can compute that page of our score. If it's not too complicated we shall get the result in a few minutes. If it's complex we have to wait a little longer. The time also depends, of course, on the power of the computer. If we work with minicomputers it's interesting to use several at the same time: we can thus get the result almost immediately. We can therefore make any changes or modifications necessary, with the help of the electromagnetic pencil. We can solve the problems of the composition directly, with our hands. I think the equipment of CEMAMu is the most versatile in the world.

Who designed the table? You?

No, it existed before but was used for different purposes – for designing cars and buildings. The use I make of it is new and original.

That table is a clever game at the same time: we can have the aural equivalent of any drawing, whether by Leonardo or Dürer.

Yes. You don't need any musical knowledge to use the table, and in fact it also serves as a pedagogical tool. We're visited regularly by schoolchildren of seven or eight years of age, accompanied by their teachers. They draw fish, houses, trees – and can hear the result. Of course, the aesthetic quality of the drawing is no guarantee that the aural picture will also be interesting or attractive.

What other composers are active at CEMAMu?

François-Bernard Mâche, Jean-Claude Eloy, Wilfried Jentzsch, Candido Lima, Frédéric Nyst. Others are also invited – the door's open. That's the decision I reached with my direct collaborators, who include, in addition to Alain Profit, Guy Médique and Cornelia Colyer, specialists in software.

CEMAMu is also at the disposal of researchers. This aspect of its activities is, however, not yet well founded, especially as few researchers are interested. From time to time, however, we are in touch.

What is UPIC?

It stands for Unité Polyagogique Informatique du CEMAMu. *'Polyagogique'* is my coinage – *'agogie'* means training or introduction into a field; *'poly'* means many. When designing we are working in space with our hands (geometry); in constructing rhythmic models we have to compute distances (geometry and arithmetics); also general forms. And finally there's the sound. All those together, in adjectival form, make *'polyagogique'*.

Thanks to the kindness of Alain Profit, the treasurer and secretary of our organization and one of the directors of CNET [Centre National d'Etudes des Télécommunications] CEMAMu has been given three rooms in the CNET headquarters. We're rather cramped, but even so we have to be grateful because CNET itself hasn't much room either. They have also placed their equipment at our disposal.

What's the relationship between CEMAMu and IRCAM,[55] which was set up much later?

Originally Pompidou's wish was for IRCAM to be led jointly by Boulez and myself. He said so in a public speech. The money, however, was in Boulez's hands and the people around him were against the objectives of CEMAMu. Boulez, I think, was glad of that opposition and the initial cooperation soon petered out. That was in 1974. Last year he approached me again and suggested we renew our contact. It won't be easy: there's a precondition that CEMAMu should also have a share in the immense financial resources of IRCAM. Boulez's institution receives 15 million francs a year, as well as another 6–7 million francs to subsidize the concerts of the Ensemble InterContemporain. We on the other hand get a subsidy of 350,000 francs from the Ministry of Culture. If IRCAM meets our conditions it will be possible to exchange experience, then, later, to work together and exchange co-workers as well.

9 On Teaching

When you arrived in Paris in 1947 you were full of the desire to study and believed that you could make up for whatever omission there had been in your training from an experienced master. Later you realized that you were wrong. You wrote: 'Les choses s'inventent.' You relied on your instincts. How is it possible, then, that you should be teaching?

I don't consider what I'm doing to be teaching: my pupils show me what they have composed and I tell them my opinion. When I'm lecturing I talk not about my music but about the ideas lying behind it. Music history is mentioned only when it is pertinent to the subject, from some particular point of view. I try to get my pupils to think about certain fundamentals which can then lead to important conclusions and results. The sieve theory, for instance, is very important for musicians. Even if they don't agree with me they should at least think about it.

Do you find your pupils possess the necessary knowledge to understand your ideas?

Generally, no, because they received a musical, not a scientific training. Some, of course, are interested in sciences as well. But I hardly ever talk about mathematics – it wouldn't make much sense. I try instead to call their attention to the core of the phenomena.

Where do you teach?

I'm an associate professor at the Université de Paris I, in the faculty of Arts plastique et science de l'art.

Your view that it's unnecessary to teach traditional music, because the

world of new music is so rich, is in opposition to the opinion held by most composers.

I know. We've always represented opposite points of view. In my view it makes no sense to teach harmony and counterpoint unless the aim is to imitate old music. Many people are, of course, doing just that these days. In serial music, perhaps, some elements of counterpoint can be useful, but the rules of tonal counterpoint don't apply. As far as harmony is concerned, nobody composes triads today, nor do they use tonal functions unless they write tonal music.

In other words, you think one should start from scratch.

Yes, that's the best way. Naturally we can go back to the past and study traditional music, but with new eyes and new ears, certainly not with the methods used by the conservatoires. The conservatoires bind, rather than free, pupils' thinking. They don't explain, for instance, the reason behind the inversion and retrograde inversion of a melody. They don't tell pupils how to go beyond that or to use just part of it, they don't explain to them that all that comes from the theory of geometrical transformations and not from music. If they taught like that the whole subject would become much more interesting. The frames of the traditional musical idiom have become too narrow, they hinder development.

I think you can convince the musical world of the truth of your ideas, once genuine talents are found among your pupils.

It's too early to think of that – only time will tell whether any of them will make a genuine composer. I'm doing something completely new and my pupils, who received traditional training, sometimes follow me with difficulty. We have, of course, talked about that already. Slowly, however, they grasp the essence of my ideas and are more and more interested in them. It goes without

saying that the results of that process will show only in many years' time.

How long have you been teaching in Paris?

Since 1973 or 1974; I started immediately after giving up my post at Bloomington.

I understand you lectured at Darmstadt as well, in 1972. So far as I know, your listeners were hard put to make sense of what you were saying.

Of course! However, some of them listened with genuine interest. In 1979 I ran a one-week seminar in Siena. Between twenty-five and thirty people always came, although it wasn't compulsory.

Let me tell you an anecdote about this. It's about Plato as an old man. He can hardly see. On one occasion he had been lecturing for a long time and his servant warned him that all but one of his pupils had gone home. They were tired and they didn't understand him, so they left. Plato asked: Who is the one who has stayed on? The servant replied: The one who always comes. His name is Aristotle. Oh, said Plato, he is the one? In that case I will continue.

10 On the Role of Art

You once said that the music of tomorrow might become a tool to change man, by influencing the structure of his thinking. Would you elaborate?

Art might set that change in train – by itself it's insufficient.

The structure of human thinking (its 'categories') is more or less universal. The question is whether its origins are genetic or whether it has come about as a result of civilization. Thinking might also have a structure which is basically different from what we know. In order to think differently, perhaps we would have to change the construction of our brain. Perhaps we're deaf and blind, because we see and hear only one way. How could the structure of the human brain be changed? Who knows, perhaps by art or through basic research.

Perhaps that's why you expect so much from the artist and want him to possess extraordinarily extensive knowledge in the field of sciences as well – in archaeology, palaeontology, logic and many other disciplines.

Yes, that's one of the reasons, but not the only one. The artist works with forms. Forms are present everywhere: in space, on the earth, in fauna, in society. They're close to musical form, so we have to be able to 'read' them, to understand them – only thus can we work consciously and create something really new. For that we have to know not only the forms of the present but also those that existed in the past. That's why we have to study palaeontology, palaeo-anything.

In Metastasis *and the Philips pavilion you proved that the forms used in music and in architecture are closely linked and can be substituted for one another. Are there any other examples for the relationship of the two?*

When I designed the undulating glass panes of the Couvent de la Tourette I was making use of the results of my research into rhythmic patterns. I've also mentioned the experiments I made with my old tape-recorder. I based my designs also on those experiments.

In designing a building we have to take into account factors such as soil conditions, the immediate environment and the landscape in which we place the building. At the same time we have also to think about the tiniest details, the material to be used as well as the form of the building.

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 in 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 form. We work with such synthetic methods in architecture and the same approach ought also to be used in music.

11 On Immortality, Intelligence, Concentration and Other Subjects

In his conversations with Claude Samuel, Messiaen explains the notion of 'non-retrogradable rhythm' with an example – among many others – that made a deep impression on me. He says: 'This moment which I live, this thought which crosses my mind, this movement which I accomplish, this time which I beat: before it and after it lies eternity; it's a non-retrogradable rhythm.'

Before it and after it lies eternity . . . It's a frightening abyss, when you think of it. Our conversation, our lives are also such non-retrogradable rhythms – but music is not necessarily. It's here to stay, regardless of the abyss – who knows, it may even be eternal.

Have you ever thought of the possibility that your compositions will survive and your name may become immortal?

I don't think about it – after all, whatever happens after my death does not concern me.

People are said to procreate children so that their lives continue in them and in their children. You have spiritual children (as well as a real one, Mâkhi) who will also survive you. That can't be a matter of indifference to you!

It's a Platonic thought: he talks about it in the *Republic*. There is an ironic French expression: 'Ça me fait une belle jambe', which means, 'It's not much use to me'. In other words, it would be nonsensical to aim for immortality. The individual dies.

All right, let's forget about immortality. But the fact that your spiritual children interest other people, evoke emotions in them and influence their thinking must concern you! That you have worked not only for yourself but also for thousands of people.

Yes, without that I wouldn't know that I exist. Communication with the outside world is of basic importance. If, for instance, one is locked in a cell, all by oneself, one will know for a short time that one exists but eventually go crazy in that solitude. Suddenly one is nowhere, everything becomes doubtful. On being freed, the first proof of existence is that one does something. It's easier if one's action meets with approval, support.

Why we exist is another question. Perhaps we've grown too accustomed to the idea that it's necessary to exist. I think there's another way but I can't see it clearly: I can't yet say what it is. There may be another reason for our life, our actions, than to strive for immortality, power or a justification for existence, which is the weakest – or perhaps the wisest – aspect of that kind of thinking. There must be other reasons. In my experience, when we fight, and win or are defeated, it's more than a game. The loser thinks he's weak, good for nothing. But that's not true! It was only an episode. He may die and disappear but that applies only to the individual. But not . . . Never mind, let's leave it.

Why won't you continue?

Because it's too complicated. Another time. Later.

You have written a good deal about the significance of intelligence. In your opinion, music is simply the expression of intelligence through sounds. You also said once, in an interview, that for you intelligence is everywhere. Have you consciously studied your own?

No, no – I have no intelligence, that's why I'm looking for it. At any rate, I don't have as much of it as I would like.

Perhaps it's that dissatisfaction that urges you on.

Perhaps. It's something organic, something you can't decide – it comes from you.

Do you think anybody can help what becomes of him?

I don't think so.

When you were really alone in the world, before you met Scherchen, what induced you to persevere? The conviction that what you were doing was important?

Not at all! That's why I was doubtful about what you said about immortality. I persevered because I was very unhappy and music was the only thing that calmed me.

Did you escape into music?

It wasn't an escape, I wouldn't say that. Perhaps a drug?

I'm never sure of what I'm doing. What I've written belongs to the past. It's finished. Whether it has any value I don't know. The struggle goes on today, nothing has changed. In this respect I'm the same today as I was when I was young.

Have you any vanity?

What do you mean by vanity?

Are you happy about your success?

For some time I was, yes, but then I begin to doubt the genuineness of success. I don't know what success means. What failure is – I know that, sometimes. Success, of course, is nicer than failure. But so often I have witnessed success which in my eyes was completely worthless. One mustn't rely on success – it's always relative.

Does your scientific way of thinking affect your daily life? Do you look for logic in all that surrounds you?

No! Not at all! I'm so illogical that it takes a conscious effort logically to understand what I'm doing and what other people are doing. The situation is the opposite of what you think.

Is the faculty of concentration something you were born with or is it the result of self-education?

The latter. In my youth, when I was preparing for examinations at the Polytechnic School and had to study mathematics and physics for hours, in addition to my musical studies and my reading, I had, figuratively speaking, to tie myself to my chair, but my mind was still elsewhere. Now I have acquired so much self-discipline that I can concentrate my attention on my work. If the telephone rings I concentrate on what I'm saying for the duration of the conversation and then continue composing where I left off.

Do you think you would have made a good mathematician if you'd made up your mind to concentrate on that?

It wasn't so much a question of making up my mind as of opportunity. I'd like to have devoted more of my time to mathematics but in the beginning I simply couldn't understand many things in the absence of a suitable library and teacher. But it did interest me very, very much. Then came the Resistance and I had to stop my studies.

So, when you are in Paris you come to this studio to work. How many hours do you compose?

It depends. Five, six, seven hours. I work here if I'm writing instrumental music – otherwise mostly in the afternoon, at CEMAMu.

A giant ladder stands next to us. What is it for? And then this rope hanging from the ceiling with knots on it. And that stand, over there. Obviously you compose standing up.

Yes, I compose standing up. Originally I would sit at my desk, bending forward, not moving at all, and after a while my back would start to ache. I think it's healthier to do it standing up.

Like a scribe in the Middle Ages.

Pasteur and many others also worked like that. I've felt better since. The ladder is for cleaning: that's the only way we can reach the curtains if we want to remove them or put them back. With regard to the rope – I thought I could climb up at least once a year, after vacation, right up to the ceiling. But then I realized my palms are too soft, they ache. But I've left it there as an eternal challenge.

You like to spend your holidays on islands. No luxury, close to nature. You swim, fish and row.

That's the only time I feel normal. By the sea. But not just anywhere – only the Mediterranean, especially Greece where there are many islands. When I couldn't go there I spent my holidays on Corsica – in those years it was less crowded than it is today. I went with my wife, my daughter, my dog and a kayak – now only my wife comes along. It's wonderful: we visit islands where we meet nobody, just fishermen.

Nowadays we undertake more difficult things: we row from one island to another. Sometimes we even risk our lives, as we did last year when we nearly drowned. We didn't notice how the wind had got up, and left the beautiful little island where we'd camped (only wild onions grew on it, and seagulls flew above our heads), starting out towards another one just seven kilometres away. It must have been four in the afternoon when we set out and we didn't land until eleven that evening. The boat had started to leak by then. After that my wife, who had shown great courage in the midst of the turbulent waves, wrote a book which she called *Moi, j'aime pas la mer.*[56] It's a funny book but her main literary production consists of more abstract novels, of very fine poetic character and very personal.

It occurred to me this morning, preparing for our last conversation, that you are a kind of latterday Leonardo da Vinci. A twentieth-century polyhistor.

It was still possible in Leonardo's time to be well versed in many fields of human knowledge, because the aggregate knowledge of man was not as immense as it is today. In our time it's difficult to get to know even a single field. One might find something interesting in one's own speciality, but otherwise . . . It's sad that the manysidedness of knowledge, of life, that was possible when Leonardo lived is unattainable today.

The situation can only grow worse. Communication is likely to become difficult in the near future; more and more one will have to turn to specialists for help, even if their field happens to be close to our own.

It's also possible that man will discover new forms of communication which will facilitate the exchange of information. The system of education will also have to change.

However, in my opinion, the human brain is fundamentally unreliable. We only believe that we know something. Many things escape our mind; we may change our views according to our environment or for another reason. Therefore we have to check our work all the time, we must spare no effort, but think it over again. At the end we might feel it's OK, it was worth our while. But even then we have to check, with experiments or the cooperation of others. If we can't do that we shall only approximate things, we shan't reach the final phase.

The other day I read something about new discoveries in genetic research. They realized that the reproduction of DNA molecules entails a loss of information. It's like that in Nature – we have to do with biological simplification.

You see? Everything changes. How, then, can we know something about anything?

Conversations: 1989

Preface

The full stop marking the end of the interview with Xenakis in 1980 was changed into a semi-colon in May 1989 when a sequel was recorded to cover the compositions written over the past near-decade. The idea that the book should be brought up to date and published in a more accessible language than Hungarian came from the two people running the Konzertreihe mit Computer Musik in Zurich: Péter Révai and Vera Troester. The project has been made possible by the cooperation of the composer and of Dr Daniel Bodmer of Atlantis Verlag.

Our first interview was intended by Editio Musica Budapest to serve as a kind of programme for the Xenakis concert given by the Hungarian State Orchestra, conducted by Michel Tabachnik, in Budapest in October 1980 (consisting of *Metastasis*, *Pithoprakta*, *Synaphaï*, with Geoffrey Douglas-Madge as soloist, and *Jonchaies*).

My contact with the composer has since been rather sporadic, while my acquaintance with his recent music has been confined to *Nekuia*, which we heard in his studio in 1983, and also *Thalleïn* and *Waarg*, which received its world première at a concert of the London Sinfonietta conducted by Elgar Howarth in London, in May 1988.

It was therefore with considerable interest and curiosity that I addressed myself to perusing the numerous scores and listening to the cassettes generously placed at my disposal by Radu Stan of Salabert.

A large part of our first session was devoted to collating, as it were, my own impressions with Xenakis' comments – a fascinating exercise made all the more enjoyable by the composer's genuine interest in the conclusions I had drawn from his scores.

We were on shakier ground when my observations turned from the technique of composition to reflections, admittedly subjective, on the emotional impact his music had on me. This was something I couldn't possibly ignore, given the powerful effect his

compositions have on the listener, but it was perhaps unfair or naive of me to expect anything but vague or evasive replies.

I was nevertheless determined to fight this battle, to lay siege to the fortress of Xenakis' native reserve.

On the few occasions that his shyness gave way (as in the case of *Aïs*, for example), the insights into his personal history and psychology proved extremely revealing.

In most cases, however, I had to admit defeat. A rather amusing episode may throw light on our friendly duel. I ventured a comment on the bird-song that makes a refreshing, but for Xenakis rather surprising, appearance in the music of one section in *Thalleïn*. The composer seemed nonplussed by the idea and admitted no knowledge, and certainly no intention, of this. To prove my point I produced the score but was unable to find the spot I meant – and for quite some time the two of us searched for the purported bird-song. Xenakis surmised that I was referring to a violin part which could have been influenced by gypsy players he had heard as a child in Romania – when in fact, as I ascertained on my return home to Budapest, the 'bird-song' begins at the end of bar 155 in the piccolo, joined later on by the oboe and the clarinet, and ending roughly in bar 167.

We were really crossing swords over the age-old question whether or not music means anything beyond the actual notes. I remain convinced that very often it does, but I nonetheless respect the composer's position, based on a combination of aesthetic, psychological and temperamental reasons, that it does not.

The five hours I spent with Iannis Xenakis in Paris on 24–5 May reinforced the admiration I had conceived for him nine years before. Quite apart from the music, its roots lie in a deeply instinctive response to the genuineness of his character. Although I can't claim to have been accepted by him as a friend, his apparent trust, his treatment of me as, for want of a better word, an ally, and also his defencelessness and melancholy, his complete absence of conceit, the question-marks he still places over whatever he is writing, the little, short laughs that now, as in 1980, try to alleviate the bitterness of what he has to say – all that and much else have disarmed me and rendered me an avowed admirer.

The reader who cares to glance over the introduction to the

1980 interview will recall the description of Xenakis' studio. Nine years on a number of changes are apparent. The photograph of Scherchen with outstretched arms has disappeared. The low table surrounded by chairs has been moved closer to the far end of the room. If you walk over there, turn round and look up in search of the rope hanging from the ceiling 'as an eternal challenge', as Xenakis put it in 1980, you discover the most important single transformation that has taken place: a gallery has been built so that the composer can reach the uppermost shelves of the library. The rope is still there but dreadfully humiliated, its bold and daunting length curtailed, its straight line broken, forced to coil on the gallery's floor as a mere lazy snake.

The challenge is no longer sought, and the daring boat-trips in the Greek archipelago are over as well. Françoise, the composer's wife, has had to forgo them for health reasons and the couple now spend their holidays on Corsica. The composer himself had recently recovered from a longish illness which had forced him to give up certain projects. By the time we met, however, he looked fit again, considerably younger than his age and busy working on a new percussion piece.

For all the self-doubt that dogs his creative work, Xenakis continues to be a remarkably fertile composer. He views his own productivity with a great deal of suspicion, however, for his chief concern continues to be whether he can produce something interesting, something different. Imitating others or himself conjures the danger of ceasing to exist. It was with this idea that our conversation began.

1 Impressions and Comments

In our first interview, nine years ago, you admitted that, however much one might like always to do something different, one is a prisoner of oneself and one's efforts are ultimately doomed to failure. What I think you left out of account is that you yourself change, and this leaves its imprint on the music. My overall impression of the compositions you have written over the past nine years is that they are all unmistakably yours but in many respects they differ from pre-1980 pieces.

Before elaborating on the changes I wonder if you are in any way aware of them – or indeed whether they have been so gradual as to have remained imperceptible.

The latter is probably the case. I know that the music has changed but I don't know in what respect. I would have to be able to look at myself from the outside and that, of course, is a very difficult thing to do.

I'd like to begin with something that hasn't changed. On the evidence of pieces like Lichens I, Ata *or* Pour la paix, *you've been sitting in this studio like a latterday St Anthony the Great, still battling with the monsters of war, the monsters of your own past, and with the fundamental question of life and death. I hesitate to say this, but I've been almost sorry for you: it seems you can't break out of your own past.*

Perhaps you're right. On the other hand, the world is still full of monsters. Wars, terrorism, gigantic adjustments to the different ideologies that are having to be made everywhere on the planet. Wherever you look – in Asia, Africa, even in South America – people are in distress. The situation may not be as acute as in the Second World War, but the changes that are taking place in a quieter way are on a scale previously unknown to mankind. Just think of the crisis and collapse of ideologies and systems in Eastern Europe. It's not merely the past that affects me.

Besides, it may also be a matter of temperament, which I can't help. Do you find my music upsetting?

Some of it has the same atmosphere of doom, of a fate you can't escape. The same hallucinations of war – very concrete effects like the sounds of shooting and explosions. Also, of huge cataclysms of Nature. It's all there. But I should also say that your music now has moments of great beauty, moments of peace. And lovely melodies appear, such as the one in Alax *played by three harps. These are undoubtedly new features. Perhaps you have mellowed . . .*

There are islands. What's difficult for me to grasp is the style of the music – to know in what respect it's changed. Maybe you can help me find out.

To my mind the most obvious change is the predominance of vertical over horizontal thinking. In other words, the appearance of chords and clusters. Are there any underlying theoretical considerations?

The object is to obtain new sounds from the traditional instruments of the orchestra. Clusters based on specific scales offer one solution. You'll remember that I've been preoccupied with the problem of scales for something like twenty years. I've devised an axiomatic approach to their construction, not just of pitches but also of time – indeed of any set that's well ordered. I've discovered that it's through non-octaviating scales of the whole spectrum that different orchestral timbres can be gained. 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 colours move in masses.

Obviously you want the orchestra to produce a richer sound – something you expect from the individual instruments as well.

Yes. You see, in sound synthesis, thanks to the piling up of sine waves of various intensities (Fourier analysis), theoretically any timbre can be produced. Instruments, however, have a built-in harmonic pattern based on their construction. Of course, the

question of how to lead from one timbre to another in the orchestra was already being posed in the nineteenth century; the subject is treated in text-books of the period. Brahms came up with some very good solutions. Today, however, this has been submerged by the polyphonic approach of serial music, even by me, in my stochastic music, where clouds of sounds replace the polyphonic patterns. I think this has been my main contribution to contemporary music: masses of sounds controlled like clouds by means of probabilities that shape the clouds statistically. That was, let us say, another direction. But as early as *Metastasis* with its mass glissandos I set out to create a timbre evolving in space, not through the addition of other instruments but keeping to the strings. I think this is one underlying problem of music: the shapes of the aural aspect. Not so much the pitch or even the rhythm, but essentially the colour in abrupt or gentle change.

You treat the orchestra as a single instrument, with huge blocks of sound moving in one direction.

That's right – in many cases that's true. Now, as I said earlier on, there are three main actors in the orchestra: the woodwinds with their homogeneous sound (sometimes I include the horn in that group), the brass (sometimes including the bassoon, especially in contrast to or complementing the horn) and the strings. Each group has different dynamic properties; they also differ according to the smoothness or aggressiveness of the timbre. You can make them move like – well, yes, like beasts!

Sometimes you use just the flutes, oboes and clarinets together – the timbre is of great beauty.

Yes. And even when the writing is polyphonic in character it is actually like a cluster that doesn't sound in synchrony. The individual parts rub against one another in a given melodic pattern which is based on the scale. In any segment of the music the pitch scale should be different. The structures used in the high, middle

and low range mustn't be identical. Their conflict produces the richness of sound I want. This is something I have discovered slowly, over a long period of time.

As far as the form is concerned, you work in blocks. Activity within a block remains the same but differs fundamentally from what happens in the next one.

Yes. It's like sentences. In philosophical statements made by ancient Ionian philosophers – but you find the same thing in Buddhism and Hinduism – you have adjoining sentences that differ sharply in content. There's no need to provide connecting lines.

This is a matter of style of thinking, perhaps. You make an important statement that has an immediacy about it, and then you go on to the next one. Of course there's a link between them, a relationship – otherwise the structure would collapse – but it's not directly obvious. It's like the abstract painting of Kandinsky, Malewitch or Mondrian where the simple patterns owe their effect to the way they are set off against one another – there's no smooth transition.

Some people say I make romantic gestures.

That's very interesting: I have described Ata *as the romantic music of our time.*

It depends on what you mean. I hope you don't think I've returned in any way to the nineteenth century!

Not at all!

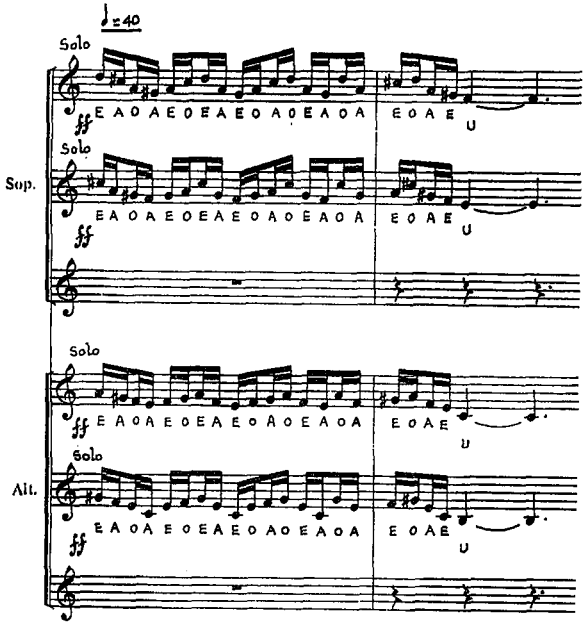
Perhaps you mean the dynamics, or something like that?

I was thinking of the fireworks of the brass instruments, the almost Wagnerian gestures of the winds.

But not in the sense of Wagnerian writing.

Of course not. But curiously enough Ata *is the only piece of yours to evoke romantic associations from me.*

Now on to a different question – one that came up again and again whenever I was confronted with a melodic line which I could best describe as neutral. It occurs, for instance, at the very beginning of Serment *(Example 1):*



1 *Serment*, bars 1–2.

The notes move up and down but they don't seem to convey anything, beyond the fact that they move up and down.

Yes, they have a static effect. The power of the scale itself should suffice to make the music interesting. If it isn't, I've failed.

I want to tell you about something which has been very important for my evolution: my study of Javanese music, and of the scale called the *pelog* in particular, which is based on a very powerful interlocking of two fourths.

The perfect fourth has universal currency – in India, Africa,

Europe, China, Japan. Nobody knows why. I give no credence to the explanation based on an arithmetic approach, the harmonic analysis which links the interval to the very simple frequency ratio. After all, the octave is even simpler, and ought to be even more universal, which it is not. It was to emerge much later.

In the *pelog* the two fourths are interlocked in such a way as to produce leading notes. For instance, you have G and C going up, and F sharp and B going up. The B is a leading note to C and the F sharp is a kind of leading note to G. At the same time the C and F sharp also make a tritone. This powerful melodic structure is the core of Javanese music, and also in a way of Balinese music.

I have linked the *pelog* to the ancient European tradition of the tetrachord – and indeed to Aristoxenos and Euclid[57] who both regarded the fourth as the most important constituent of the scale.

The white-key scale on the piano is based on two fourths divided by one tone: C to F, then you jump a tone and go from G to C. These two fourths are exactly identical in structure. The structure of the melodic scale is very important, not only in melodic patterns – melodies – but also in producing chords of a different timbre. If you take a given range, and if the structure of the scale is rich enough, you can stay there without having to resort to melodic patterns – the interchange of the sounds themselves in a rather free rhythmic movement produces a melodic flow which is neither chords nor melodic patterns. That, perhaps, is what you mean. They give a kind of overall timbre in a particular domain.

If I understand the sieve theory correctly, any scale can be created because any sound can be made to drop through the sieve at will. I can't quite see why you need to fall back upon ready-made scales like the pelog *when in fact you can create any scale you like.*

I gave the example of the *pelog* to show how the issue of tension needs to be kept in mind in constructing a scale. I didn't intend to say one should imitate any particular one. Tension is important for the melodic patterns, the chords, and for the flow of the music itself. In chromatic and well-tempered scales you can generate tension only through jumps, as in serial music. When the notes are closer to each other, as in the chromatic scale, you lose tension,

unless you apply a kind of sieve locally – that is, you choose intervals that produce some tension.

Isn't tension a rather subjective notion? After all it's possible to play C and C sharp on the piano in such a way that the sound is charged with tremendous tension – by the way they are played and felt by the player.

That's a matter of style.

Do you think of tension as an objective category?

Yes. Kind of.

What is it that creates tension, then?

The opposition of large and small intervals – that is, the contrast between something very narrow and something much larger. To maintain this tension all along the sieve – in other words in the scale you have chosen – is a tall order. It is also an intriguing problem: none of the parts is to be symmetric – that is, periodic; nor are the ranges to be periodic as compared to the higher or lower ranges, maintaining tension all the while in a different way.

Of course subjectivity comes in here, but the objective statement is made in the contrast between large and small intervals. Tension diminishes if there are too many of one or the other, as in the major scale which is very regular.

Rhythm in your recent music has become conspicuously simple and metrical. A particular rhythmic pattern may expand over a long stretch of the score and the effect is not unlike minimal music.

The reasons are threefold. First of all I come from a place where these rhythms – and I'm happy to call them Bartókian rhythms – are indigenous. They are traditional in Greece, not so much in Romania, and also in Bulgaria. I was brought up on them.

I have studied and been attracted by Indian rhythms: based on very simple elements, they are highly complex. You take one

pattern – say: 2–3–3; then you expand it by moving the beat (the down-beat, for instance) just one unit, and then go back to the original pattern. This creates a discrepancy in your mind. We're very sensitive to equal rhythm: it's like the movement of a train. If you shift it by just one unit you're shaken out of it. This is very important from both an aesthetic and a psychological point of view. I studied Indian percussion music a long time ago – not to imitate it but to understand the underlying principle, these shifts of rhythm which produce a multi-layered system even on a single instrument. In *Psappha*, for instance, the accents produce several layers of rhythmic patterns, superimposed one on another, all with just one performer. Of course, it's quite a challenge for the percussionist.

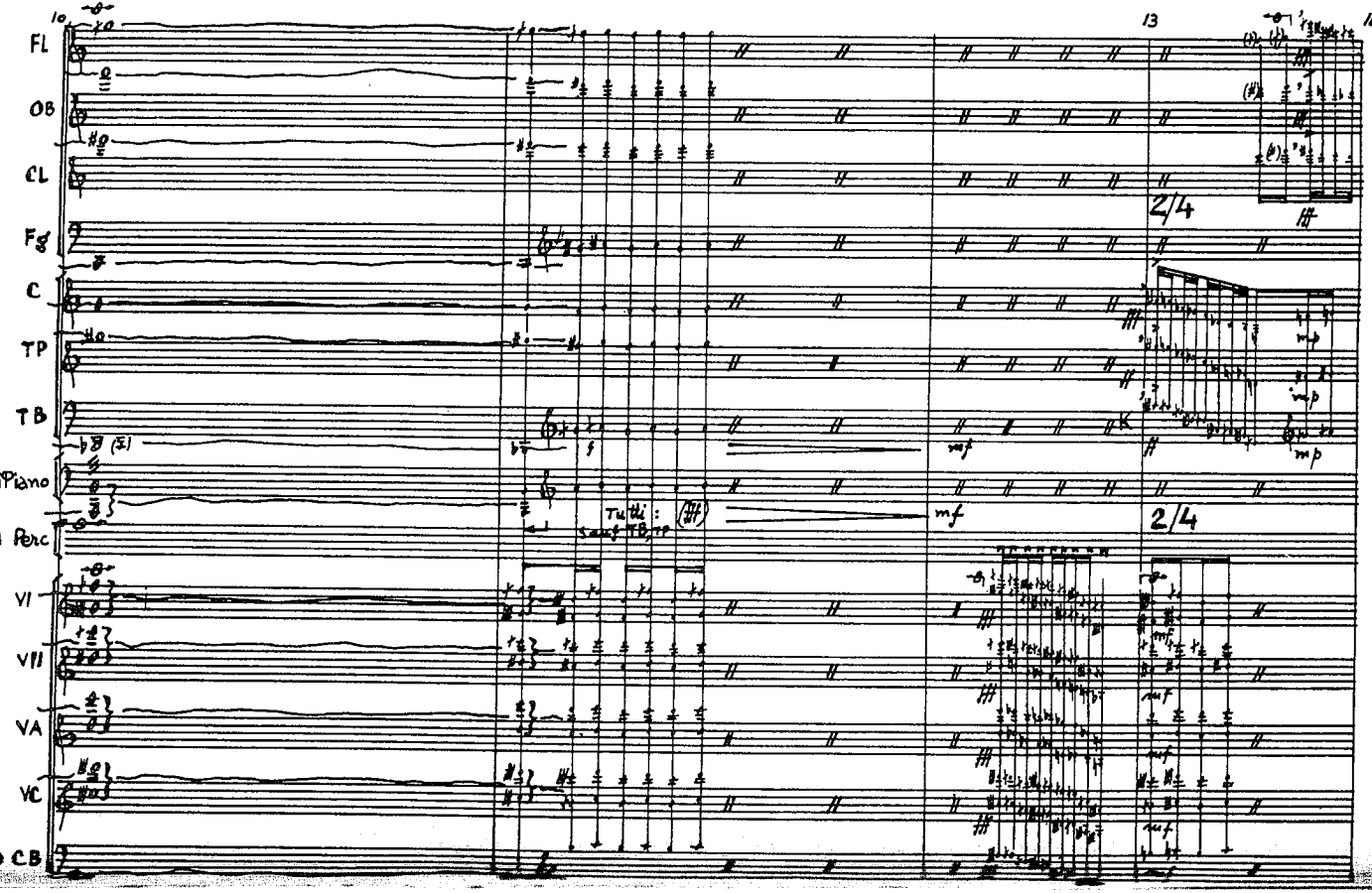
Thirdly, I've also studied African rhythms, which also appear to be complex but in fact are based on isochronic rhythmic patterns.[58] Again, they're very close to my axiomatics of complex pitch or rhythm structure, based on a pattern which repeats several moduli simultaneously. It's this structure that serves as a tool to produce polyrhythms.

You mentioned minimal music. That's simply a by-product of Indian or African music. In fact, however, it has always existed. Bach is repetitive – like a motor.

In the past I experimented with music without a rhythmic pulse, that is, having no precise rhythmic sense. In my latest pieces I seem to have come back to very sharp and simple structures that are immediately perceptible.

They become even more conspicuous if you link them to second or third steps, as in Thalleïn *(Example 2) or in the CB section of* Idmen A *(Example 3).*

Yes, that's because in order to understand a rhythm, to grasp its complexity, you need a kind of metronomic beat. For instance, if you have a sequence of four units and five units, the difference between the two is not immediately perceptible. You have to repeat them many times, as in traditional music, to make sure the listener takes it in. The underbeat must be regular so as to spotlight the difference, the shake.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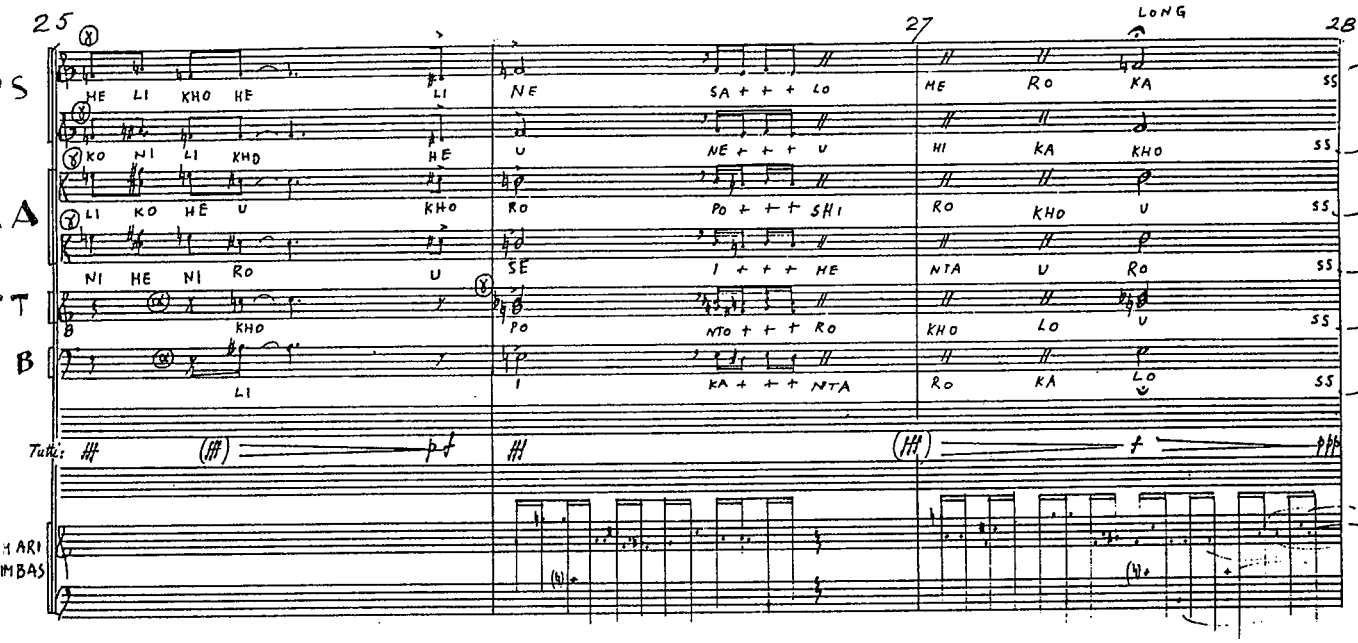
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NTA U RO SS
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Dotted rhythms and triplets are also a recurring feature.

Triplets combined with other rhythmic values make for a richer sound, based on very simple relationships – three to two, for instance. [*Sitting in the Paris métro later that day I presented Xenakis with a miniature score of some Bach organ works. He put on his folding spectacles, studied the score briefly and presently pointed to a few bars, saying : 'You see, here, too, it has three to two.*] As I said a moment ago, in the rhythmical discourse, you need something to hold you on a given pattern so that you notice when it's 'spoilt' by another pattern. It's like walking and suddenly tripping over something, so that you have to regain your equilibrium.

The simplicity of these sections contrasts sharply with passages of extreme complexity, where each of the superimposed parts has irrational values written above them.

You move from something which is very ordered to a section which is much less so. You can produce the latter, either with the help of probabilities, as I've done in the past, or by means of this kind of superimposition, where the musicians play the same rhythmic patterns. Because they are superimposed your attention travels from one line to another and is lost – the listener has the impression of complete irregularity. This is related to the universal evolution from minimum entropy to higher entropy and, indeed, to the aesthetic aspect of controlling the formation of clouds, or of crowds of people in a demonstration. They can be very regular or very irregular – the smoothness or abruptness with which one goes from one to the other is a very powerful aesthetic tool. The numbers you refer to aren't irrational – in fact they're very rational.

How do these ratios come about? How do you compute them?

In order to create huge disorder each line must have a different metric pattern. One line may have five 16th-notes to three, another five to four; then you have a change in the same line: from six to four, to three to two, then seven to five, while the other lines

have different patterns again. Complexity is brought about by regular patterns that intermingle until you can't follow them. You have a cloud of events which have nevertheless kept a degree of rhythmic consequence. If I were to use probabilities, all rhythmic coherence would be lost.

Another aspect I have discovered is the very effective use of rallentando. It may occur at the very end of a piece, and if it follows a rather regular rhythmic pattern the effect is of a machine winding down. Or you may write decreasing metronomic values above each bar, gradually slowing the pace. I have noted with interest that you never resort to accelerandos . . .

Why have rallentando? Usually it occurs at the end of a composition, especially where the rhythm is very complex. As the music slows down the rhythms become more and more perceptible. That's one reason. The other one is, as you said, to alert the public to the fact that the piece is coming to a close – you can forget it [*laughs*].

Rallentandos slow down the tempo, which in most of your recent works tends to be on the slow side anyway. Individual features such as tremolos may be fast but the overriding impression is one of slowness. Why?

Perhaps because I'm getting old. There may also be an aesthetic reason – to try something else.

It's certainly true that a succession of very powerful chords descending slowly has quite a special impact, precisely because of the pace at which it takes place. The slow procession in Horos *also owes much of its effect to the tempo.*

I think you use the contrast between a solo instrument or voice and a large ensemble more often than in the past. Usually the solo instrument would be a violin, or indeed a trumpet, and sometimes it's entrusted with a genuine melody.

This is perhaps to give players a chance to emerge from the orchestra as individuals, having been units in a vast ensemble. Also,

to provide aesthetic contrast, to have a single line of sound instead of a mass of sounds, as well as to offset timbral contrasts. There are many reasons, many layers. You may not be aware of them all analytically but you feel the difference globally, so to speak.

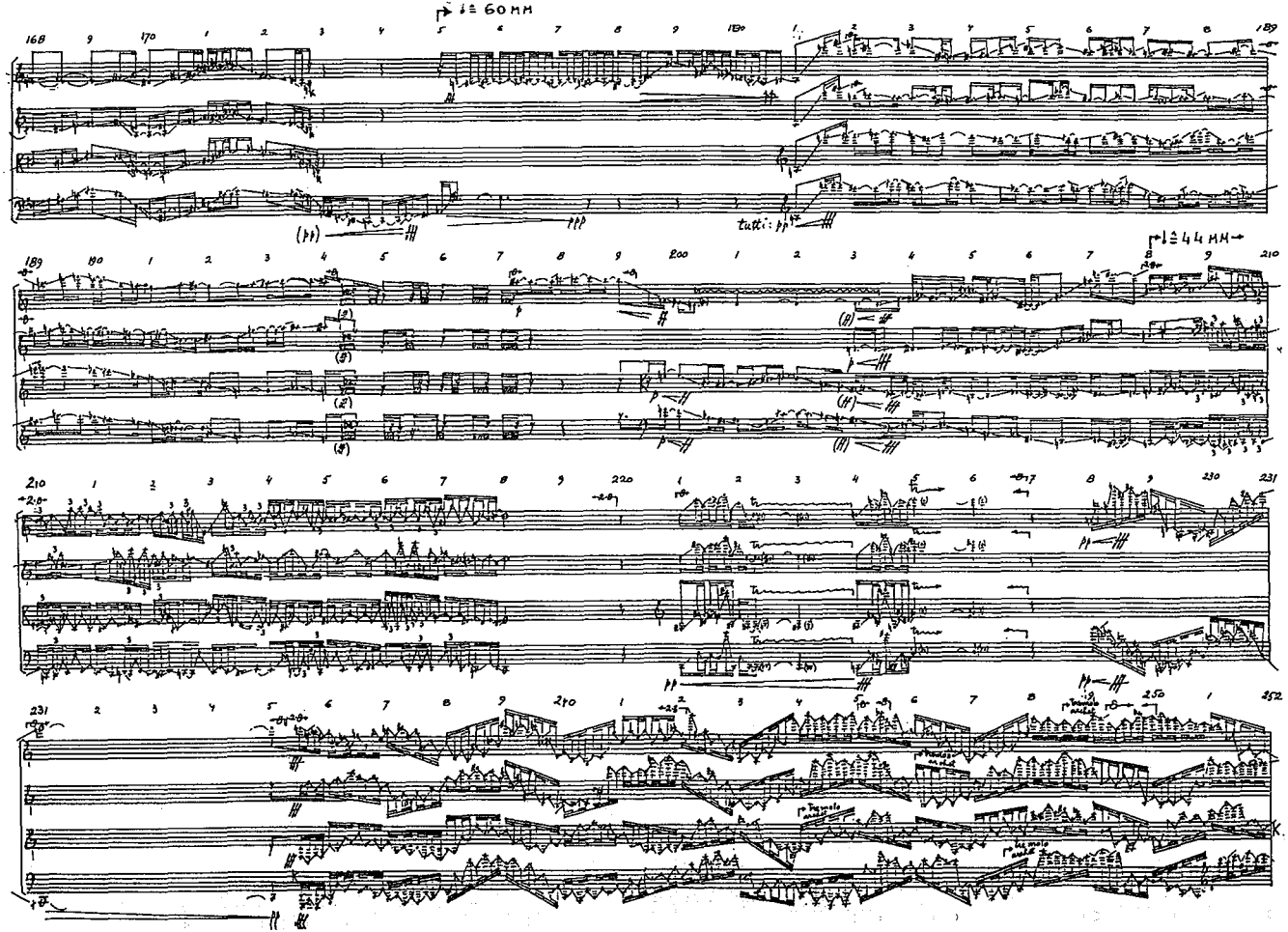
A very interesting effect is achieved by making instruments play notes alternately, each being played by a different instrument. The result is sometimes a kind of 'limping'. In some cases the instruments play the notes of an ascending chromatic scale.

That may occur in some pieces but lately I haven't used the chromatic scale in any systematic fashion but as just one of the many possible scales. It can, however, provide a contrast to some other scale structures.

You've described a feature I've borrowed from other approaches to music – that is, from sound synthesis, where such patterns arise if you use some stochastic distribution.

You know, when you have a probability function you may successively accumulate the outputs of that function and thereby tremendously increase its expansion. In that case you exceed the limits of the range of your instrument. In order to avoid this you enclose your cumulated result in two parallel barriers, or mirrors, which reflect inside them the amount of the excess jump. This is what happens with a bullet in a gun, for instance. The bullet hits against the inner limits of the gun and it goes out one way. These inner limits are the bullet's 'mirrors'; in probabilities you need such 'elastic' mirrors when their outputs are cumulative. Especially in the case of 'logistic' probability there is a very interesting relationship between the distance of the two parallel mirrors and its parameters which produce nearly symmetrical overall smooth shapes, although these are made out of fierce jumps. Of course, this phenomenon is more interesting in sound synthesis where you have 50,000 or so samples per second, and normally you hear it like a noise.

You don't seem to use glissando as much as you did in the past. In your recent music the apotheosis of the glissando is in Tetras *(Example 4)*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where the effect is sometimes that of a single instrument playing at incredible speed.

Otherwise the glissando now seems to play a minor role and, where it does occur, is often employed in a novel manner: it is brief and zig-zags in a jagged line.

Yes, especially in *Tetras*. It's more than a vibrato because the steps are larger. Jagged glissandos are intended to affect the dynamics and, if played by several instruments, they also provide an interesting aural effect.

Oscillating lines, covering sometimes as many as four notes, stretch over long passages in your scores.

They're like irregular tremolos and, again, are used to enrich the aural aspect of the chords, to avoid having sustained chords which, however interesting these may be, are static. Oscillation brings them to life, grabbing your attention and keeping it. You tend to forget a chord that doesn't move.

Trills may serve a similar purpose.

Exactly. Beethoven used them a lot, especially in his late works. They make the sound richer. Like the vibrato, the trill ought to be executed much more elaborately than is generally the case. It's difficult to get musicians to play them properly unless you notate them in a complex way. But then, of course, they will never play them, or it takes too long to train them, except when you're writing for a soloist. And even then . . . So you see another aesthetic means to change the sound is to go from a smooth tone to a more or less rapid vibrato and then slow down again.

Very often you prescribe non-vibrato.

Absolutely. I hate vibrato because it tends to be mechanical. It sounds so silly it spoils the music – either the melodic pattern or the style of the composition. There's a European vibrato which has existed for two or three centuries – it didn't exist before – and which students are encouraged to use all the time: it's absolutely

silly. If, however, you can control it vibrato can be a very interesting aesthetic tool, for we're certainly very sensitive to it.

Another instruction you give your players is 'Hold the note until the next one'.

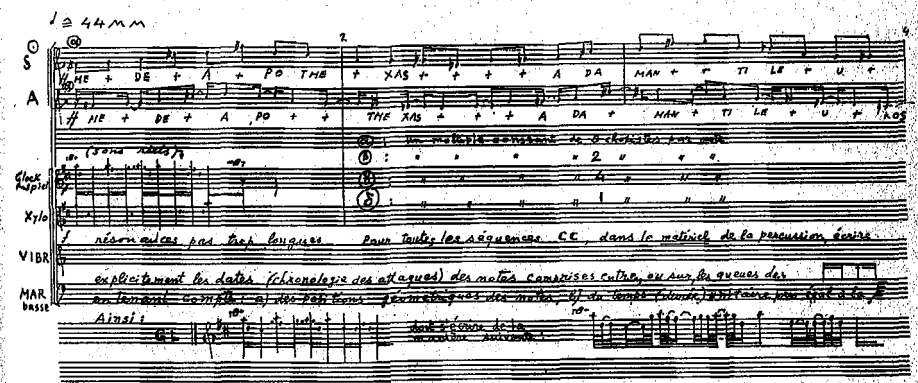
That's because players usually fail to do so. I don't know why – perhaps they have to breathe or just relax [*laughs*]. Notes must be held until the next one. Of course, for a pronounced legato the end of one note and the beginning of the next may overlap. This occurs in tape music a lot. But instrumentalists, especially if you don't have many players, should observe this instruction to avoid gaps in sound: these add rhythms that aren't intended by the composer.

Yet another important instruction is for players to observe the geometric position of the notes.

That has to do with notation.

Instead of writing out fully 16ths, 32nds, 64ths etc. in the intended rhythmic pattern I place them within vertical bars. If I were to notate the patterns in detail they'd never be played properly – it would simply be too difficult. Instead I decided on this kind of approximate notation, which also facilitates reading the score. Of course each unit is small enough to ensure reasonable accuracy.

The only score where an explanation is given for this new notational system is Idmen A *(Example 5):*



5 *Idmen A*, section CC, p. 1: explanation of the notation of the first bar of the glockenspiel.

No explanation is provided elsewhere – as in Keqrops *where you employ this kind of notation for the piano. The soloist has no way of knowing, unless he consults you, how the two hands are to be synchronized. Are they completely independent of one another?*

Yes, of course. On page 16 (Example 6), for instance, it should flow, going up. The piano part shouldn't sound like chords or melodic patterns because you forget them very fast. One line is going up, one is retarded and so on. You have a kind of flow made up of steps.

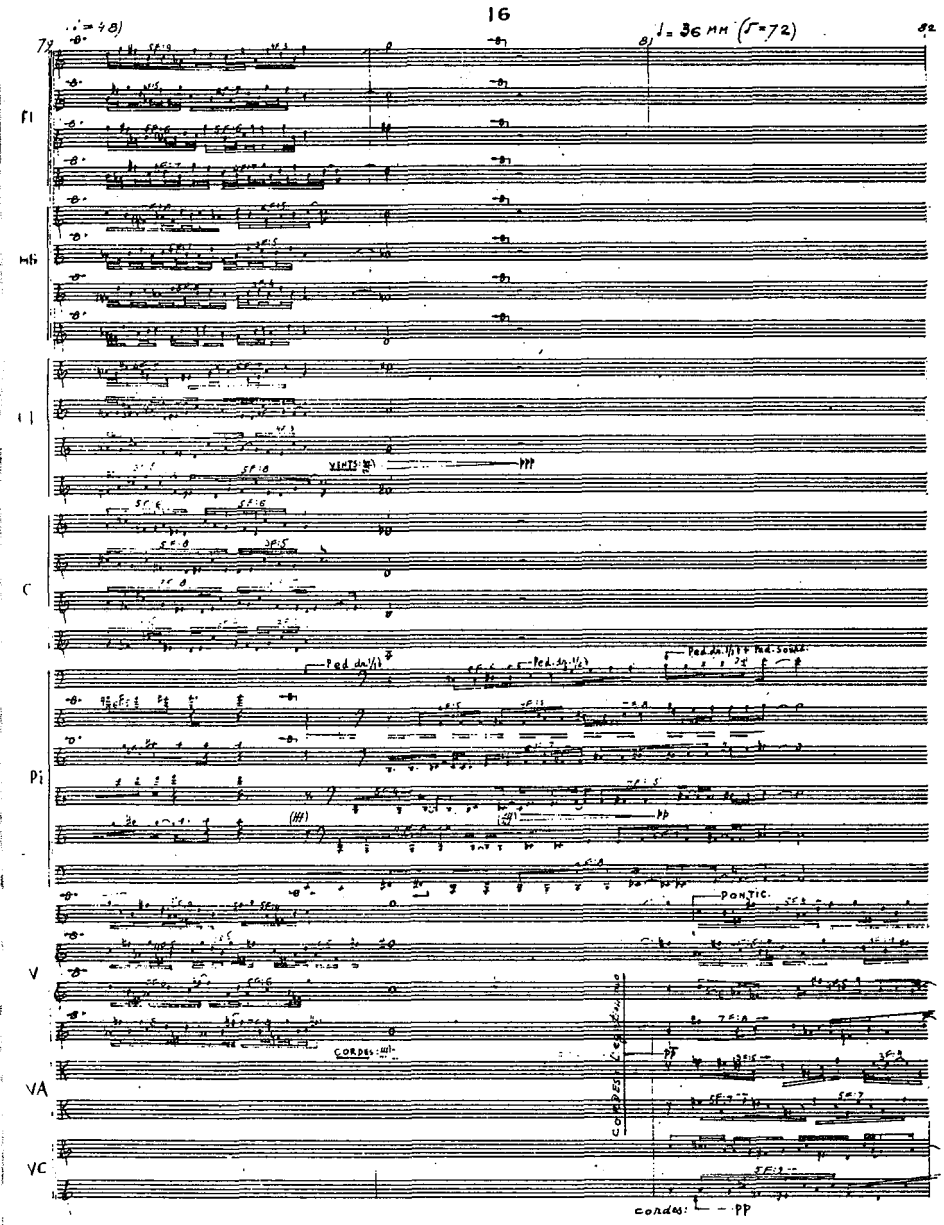
Remembering how much you were against aleatoricism in music I hesitate to venture the remark that this system of notation is reminiscent of a certain kind of controlled aleatoricism.

This kind of notation is actually devised to control the player rather than give him freedom. The notes can only be played in two or three different orders, and, that's good enough for me. The performer isn't really free because, as I said earlier on, the time-span of each unit is so short. Aleatoricism, to my mind, was a fake. It was a kind of boasting on the part of composers, a means to demonstrate that they were scientifically *à la mode*.

The piano writing in Keqrops *brings me to another point: the sheer technical difficulty of your instrumental or vocal pieces. Apart from that and a few notable exceptions, such as* Naama, A l'île de Gorée, Kassandra *or* Aïs, *you no longer put such tremendous difficulties before performers.*

The music I write for soloists is still quite difficult but perhaps less so than in the past. One of my latest pieces, *Echange* for bass clarinet and chamber ensemble, isn't technically very demanding but it raises another kind of difficulty: the tension of the sound itself. You have to be able to maintain it despite the slow tempo. *Epicycles* for cello and chamber ensemble, which recently had its première, is similar in this respect. I've moved the aesthetic value to another domain.

Will you elaborate?



6 *Keqrops*, p. 16.

The most difficult test of good musicianship is to ask a performer to hold a note. The sound is one of the most difficult things to control – to produce a timbre of beauty. You can recognize a genuine musician purely by the way he plays, from the sound itself, whether he can hold it and make it live. This test should be introduced into conservatoires, instead of getting students to play complicated pieces fast. If you ask a string-player to hold a note the bow will move slightly and as a result the timbre, the harmonics, everything will be changing. The Arditti Quartet is a rare exception – they can hold the sound with undiminished beauty.

The dynamic level of your music still favours f *to* fff.

That's because I'm growing more deaf.

Do you really mean that?

No. But with advancing age high pitches are lost to the ear.

*I know you're interested in the music of Morton Feldman. When I asked him why his music was so soft he told me that was the only way you can hear the sounds. [*Xenakis laughs.*] You can hear the attack and how the sound dies away. With loud sounds all that is inaudible.*

That's correct. Yes.

Any other comment?

I agree with him. The only difference between us is that his average level is very soft and my average level is very high [*laughs*].

Most concert halls have poor acoustical properties. If you build one seating 2,000 people you lose the soft sounds. That's one explanation for my large volume of sound.

Another may be the fact that your material demands it. You make forceful gestures which simply call for a high dynamic level.

Yes. It also drives the musicians to much greater efforts, both

physically and mentally. It pushes them to extremes, and that's also interesting. They have to form and project the sound in a powerful manner.

Will you explain the appearance in your music of modal harmonies or scales?

They look modal but they're not. So-called modal music was copied in tonal music in the nineteenth century. Composers were influenced by traditional church music following the discovery of old manuscripts in the Abbaye de Solesmes. In Russia, too, the composers of the Five – Musorgsky especially – were influenced by the music of the Russian Orthodox church and also by folk music. That's how so-called modal music became fashionable.

My work has nothing to do with modal music, but I do admit that it may sometimes create that impression because of the non-tonal or tempered chromatic scale. The problem of the scales which I call sieves is basic to instrumental music and also to sound synthesis. Most composers choose to ignore it. They simply pick up notes as if they were all at their disposal. That's not the case, because they have to think of the basic structure. That's why I think the problem of scales is so important, both from a melodic and a harmonic point of view.

To wind up this preliminary survey of new features in your music since 1980, may I make a comment on the way your pieces begin and end?

They start in two ways: either as if they had been going on for some time and the listener had switched on in mid-stream, so to speak; or with a strong and emphatic announcement: the piece has now begun. Am I right?

I'm sure you're right. The former creates the impression of searching for direction, for a path for the music to set out on. With the latter an explosion clears the way and you continue in that direction. It's a matter of rhetoric, in the original, ancient sense of the term.

Rhetoric was established roughly in the 4th century BC. An introduction was followed by a development section, then

continued with three parts which led on to the end. That was the typical rhetorical scheme. Today, of course, it's no longer valid. You can have a static piece of music without any articulation through the composition: it ends the way it began. Many composers work like that. Or you can start with a kind of introduction, followed by a development, and the ending is also clearly indicated. This is one of the ways in which I work. Yet another solution is to start with something that's not static and change it all the time without an introduction and without development. You can go from one point to another, avoiding a development altogether – that is, each point is a section by itself, linked to the preceding one. It's like the Sonata Form which consists of self-standing movements each linked to the one that comes before it. I leave out of account the circular architecture of cyclic construction in the music of César Franck.

Your endings either die away or use strong chords, like a Beethoven symphony, almost as if the piece were fighting against the inevitable ending.

Scherchen used to say that Beethoven's Fifth Symphony, and some of the other symphonies, ends like someone taking his leave and shaking hands, but unable to finish the hand-shake.

2 *Aïs I*

I wonder if you agree that your works can be divided into two groups based on whether or not they express something beyond music. For me, Aïs, Nekuia, l'Ile de Gorée *and* Lichens I *form one group, whereas* Mists *or* Akea *belong to the other. It seems to me that in some compositions you speak directly to the listener, whereas in others you seem interested mainly in the science of composing, so to speak. These last are very abstract pieces.*

Could be. In *Aïs*, *Nekuia* and *l'Ile de Gorée*, however, I didn't want to write programmatic music, in any sense. I wanted the music to be self-sufficient without a need to know what it's about.

Even if one hasn't read your introduction to Aïs *it appears less abstract than* Mists.

You mean it has more coherence? I don't know. Perhaps the soloist, because of his voice, adds something that isn't in the music. That's a problem with vocal music: singers tend to add expression that isn't there. The same is true of the piano. I remember rehearsing *Evryali* with Marie-Françoise Bucquet. She was a pupil of Brendel and I was trying to convince her not to put 'expression' where it wasn't required. It's even more difficult with singers.

Well, in Pour Maurice *(which, incidentally, I also include in the 'abstract' group of your compositions) you succeeded in creating a vocal line where, so far as I can see, it is indeed impossible to inject any expression . . .*

Yes, because it's so high for the baritone! [*Laughs.*]

In our conversation nine years ago you admitted that you were still moved by certain melodies – Greek or otherwise – despite yourself. It

seems to me that you have this battle with yourself: you don't want to be the highly sensitive, intensely feeling person that you are. In some pieces you can't help it, in others you can.

Perhaps you're right. You see and hear from the outside, so it's difficult for me to say . . .

Forgive me for attempting to psychoanalyse you . . . You see, I've been deeply moved by the sheer emotional power of Aïs *and I simply can't accept that it's because of me – that I project ideas and emotions into it which aren't there. You claim it's all because of the voice. In talking to Enzo Restagno,*[59] *you said the vocal line was inspired by a particular bird whose night cries had a fearful, chilling effect on you. Another source of emotional involvement was provided by the choice of texts: the* Odyssey *(you write in the introduction: 'These fragments express the irreversibility of death and they are even more terrible since the being most cherished by Ulysses, his mother, is impalpable, a dream that flies away in spite of three vain attempts to take her into his arms. So little, so miserable are the remains of the living.'); Sappho ('the desire to live is mixed with a nostalgia for death as if to conjure it'); and the* Iliad *('the ignominious death of the beautiful and valiant Patroclos, struck down in his youth and ardour by the conjugated wills of the gods and men').*

Finally, to prove my point, here's another quotation from your introduction: 'The orchestra underlines or invokes the feelings, the sensations, of the dead-living couple which we are and in which these feelings and sensations exist without any possible escape.'

I do know from our first conversation how close you were to your mother and how deeply you were affected by her death. I can't help feeling that Aïs *must be a requiem for your mother.*

I don't know. That's another piece of psychoanalysis [*laughs*]. But it's true that the bird has a very interesting cry. It's a kind of petrel or seagull still to be found in the Mediterranean. It has a brownish colour and never rests on the rocks but floats on the sea and fishes during the day. Sometimes at night they gather above their nests on the seashore or the rocks, fly around and give out cries which

sound as if children were being assassinated. I first heard them in Corsica where I was camping and wondered what was happening. I thought some Corsicans were killing some other Corsicans . . .

. . . which they sometimes do.

Yes, quite often. But then I identified the bird (which has since disappeared from Corsica) as the ones I'd heard in Greece on a deserted island in the Aegean.

I have used something similar to these cries also because the bird has a mysterious quality in mythology and folklore – as if it were the voice of Destiny. In ancient times these birds were used for divination: when they flew to the left the augury was bad, when they flew to the right it was good. Later on, in Greek poems (but perhaps in other literatures as well), the birds are made to speak and they tell the truth. There's a very beautiful one in Greek about a mother of nine sons and a daughter. The sons die, only the daughter survives, and she is about to marry somebody who is far away in Babylon. On her deathbed the mother expresses the wish to see her. She talks to her dead son: you promised to fetch her but now you're dead. So he leaves his tomb and goes to Babylon. His sister asks him: You are so different, what's happened to you? Never mind, he answers, come, our mother is waiting for us. The birds along the road say: 'Who's that? Is it not strange, he comes from a tomb.' The girl hears them and asks: What are they saying? Oh, it's nothing, pay no heed to them, it doesn't concern us. They arrive home and find their mother dead. That's the story.

Well, you're certainly not above attributing meaning to sounds such as bird-cries which, of course, the birds don't mean.

No.

So perhaps it's not surprising that I should attribute meanings to your music which aren't there.

It's a kind of symbolism. Yes, you're right.

The deep register of the baritone reminds me very much of the deep register in Kassandra *where it represents the wise men of Argos.*

You see, nobody knows what the chant in ancient tragedies sounded like. The only solution for me was to follow the prosody of the poems – that is, the rhythm of the long and short syllables. Also, the accents which were given much later may give an idea of the melodic pattern of the voice.

What do you mean by 'accents given much later'?

In Greek, whenever you see an ancient text like Homer or Sappho, it will be written with accents invented by scholars in Alexandria in the second century BC. Their object was to preserve the phonetics of the Attic language. They were still pretty close to them, even though from the fifth to the second century 300 years had passed. So all the ancient texts were notated again with accents which hadn't previously existed – for instance, the texts of Plato had no accents.

'Prosody' in Greek means a kind of chanting ('*od*' means song, '*pros*' means close to). The scholars who worked on ancient phonetics, whether Greek or Latin, came to the conclusion that they were in fact dealing with prosody.

I've tried to save this combination of long and short syllables together with a tonic accent in the bass: it's a kind of comment. I don't imagine that the poems of Homer were sung with such a low voice but it serves to create detachment. It emerges from the depth of the past. It also sets off the contrast with the higher register, especially in *Aïs*.

In some of your writings you say that in Aïs *you succeeded in finding a new scale which you applied again in later works.*

The scale had been in the making for some time. It's a matter of sieves, you see. There's a scale at the beginning of *Jonchaies* which is very close to the *pelog*. It's treated there in a way that is my

invention: instead of having one line there are many lines, but all in the same range using the same scales. It makes a kind of flux, or vapour, of music. In *Aïs* I modified this scale slightly in order to make it less recognizable, to be different and yet retain a kind of specific tension.

3 *Aïs II (Cogito ergo sum)*

Is there any particular reason why you should have treated the subject of death in two successive compositions, Aïs *and* Nekuia*?*

It was a period when the problem of death was more vivid than at other times.

Death, however, is something I think about all the time. Not only my own passing away, of course, but also in a more general dimension: death in Nature, in human society, in our actions, in the past which is finished but not completely finished.

I have rediscovered for myself Heraclitus who says that there's no difference between life and death. He probably meant that the two are equivalent. Existence is not something in progression and neither is non-existence. You find the same ideas in Buddhism. Both Heraclitus and Buddha lived roughly in the same period, that is, the fifth century BC – it's curious that they should have been so far apart in geographical terms.

You paraphrased that in one of your writings that was printed in the Gravesaner Blätter *in 1958.*[60]

It was Parmenides who said: 'For it is the same thing to think and to be.'

And you rephrased it to read: 'For it is the same thing to be and not to be.' If life means so much to you and you don't believe in an after-life, how could you say that?

Because they are the same. Before I was born there was nothing. Now I exist for the time being and I know 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.

Parmenides was much more logical. In a beautiful poem he said that if something exists it's unique, it occupies the whole universe, with no interruption. It's of one piece. That was in the same poem where you find the phrase 'For it is the same thing to be and to think.' There's an equality there.

There's a school of thought in the history of philosophy which considered that thinking stems from being: that there's an objective world, and thought reflects that world. Another school of thought claims that my mind can create the universe. Berkeley said that and so did Descartes: '*Je pense, donc je suis.*' For Parmenides the two were equally true, whereas the history of philosophy had two discrete views.

Science unites these views: there is experimentation and there are theories. Sometimes theories lead to experiment or experiments may create ideas. The two are closely interlinked.

My paraphrase was a logical conclusion and it was also a homage to Heraclitus, an allusion to the vanity of life, and so on and so forth.

I also had compositional considerations. The paraphrase stems from 1958, the year after I wrote *Achorripsis*. At the time I was engrossed in the question, What does composition mean? It is as governed by rules as anything else. But suppose there were no rules? Can we conceive of anything with no rules? That is, no causality? Which means that no connection exists between phenomena, which in its turn equates 'to be' with 'not to be'.

I thought of the example of a series of waves that appear and disappear in the absolute void. Not an emptiness but real nothingness. It's those waves, which appear and disappear, that create our universal causality and time, the nothingness creates the being which is absorbed into nothingness again.

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. Of course, probability rules, with their own coherence, do exist. Can anything exist at all that doesn't obey even these probability rules? I don't know.

Those ideas were exercising my mind over thirty years ago. Recently I read a paper by astrophysicists about the Big Bang

theory. They said the reason it's so difficult to understand what happened in the very first moment of Big Bang is because we imagine it came from nihil, from nothing. So, they asked, why not take another step and say that the universe came out of nothing? Those astrophysicists are, to my mind, poets. They work with observations, theories, mathematics, but they are poets nevertheless because they can't prove what they say. And that's nice too.

The interesting thing about it for me is that the problem of the birth of the universe corresponds to an approach to composition which holds that composing has to do with rather profound ideas that are also current outside the realm of music. That's why I'm convinced that music is a way of thinking through sounds, through events and forms that you create. I say 'create', but that needs some qualification, of course, because here we come to the question of originality.

To say the universe was born out of nothing is to posit a case of absolute originality, for something has come from nothing. If, however, there was something, and you have obtained something different, you are speaking of a causality, a link which reduces the degree of originality.

The next question I ask myself (I can't answer it but I can nevertheless pose it) is: Is originality possible? Is originality something natural – to mankind, for instance, and, on a more general level, to animals, to particles, to the universe? I tend to say yes, even though in the case of man there's little to indicate his evolution in a biological sense. You can, however, trace the evolution of animals backwards, from mammals to dinosaurs to fish and so on, right back to cells, and then we are again faced with various theories as to whence those may originate. A pre-war Russian theoretician traced them back to ultra-violet radiation reaching the earth, whereas after the war Fred Hoyle held the view that the first cells came about from organic matter in interstellar gases.

Our constitution, then, may come from interstellar space.

Of the two theories about creation – the one that claimed it as an act of God and the Darwinian theory which claimed the species evolved out of each other as a kind of consequence – I prefer the latter, because it's much more challenging. It also proves that

creativity is a possibility for mankind, as it is to the animal world and even to plants. For the same evolution has occurred there, and indeed probably also among sub-atomic particles, of which we know so little.

All that is linked to questions related to music: to questions of form, of the tools at our disposal, of technique and so on.

4 From *Serment* to *Taurhiphanie*

I originally intended this chapter to cover each composition written since 1980. As indicated in the Preface, however, this did not work out in practice: my comments were often of a purely subjective nature, open to acceptance or rejection but unsuitable for the composer to elaborate on.

What follows is, therefore, a selection of fragments of our dialogue which may be of potential interest for the reader.

I wonder if you'd mind discussing one aspect of your music which is true of Serment *and of a number of other compositions as well: you seem to conjure up ancient rituals, slow processions, perhaps funeral marches. Is there any truth in this association?*

I don't know. Perhaps. You see, when you're part of a culture the rites that are still alive there penetrate into what you do. If, however, you're part of many cultures, as I think I am, you're much freer to think and behave in a more general way. Rituals exist everywhere. For instance, elections are a kind of ritual. So are public speeches. Everyday behaviour is exactly the same thing.

At the beginning of the piece, where they sing the vowels A–O–U–A, it sounded to me like 'Hallelujah', and where they sing U–A–O–I–A, it put me in mind of 'Gloria'. Is that association far-fetched?

Yes. Very early on vowels were chanted for ritual purposes, at least in the Middle East, but my music has nothing to do with that. The problem is of a more general nature: consonants are usually swallowed by singers, in conservatoires and elsewhere. The only exception is Germany, where they pronounce them with brutality, but even they are not sufficiently consistent. My conclusion has been: I don't need consonants! Elsewhere, however, I

do use them, because musically they can have great importance.

In your short introduction to Komboï *you mention temporal sieves. What are they?*

Scales – that is, durations that aren't periodic and that are produced by means of logical equations. The problem of the sieves can be applied to pitches, to time and also to intensity, although there it's much more rudimentary. Also to sound synthesis, although nobody has done that yet. I intend to work with it at CEMAMu.[61]

Some of the material in Komboï *reminds me of the two kinds of material you use in* Mists, *one to do with random walks and the other with arborescences. Did you use the same procedures?*

Yes.

Unlike Mists, *however,* Komboï *is in part meditative music, especially the harpsichord part. I found the same meditative, calm atmosphere at the end of* A l'Ile de Gorée.

Yes. Meditative and nostalgic. Could be. I'm sorry. [*Laughs.*]

I wonder if Pour la paix *can be described as a* Hörspiel. *It has two versions, one for a cappella chorus and one for chorus, an UPIC-produced layer and narrators.*[62] *This second version is obviously not intended for concert performance but has to be listened to on the radio.*

Yes, *Pour la paix* should have been entered for the Prix d'Italia. As it happens it was never sent because I was betrayed by French Radio. They asked me to write the piece but it turned out that the competition that year didn't cover that particular category.

This piece has some of the simplest, the most innocent and lyrical music you have written (in 1980 we agreed that lyricism was not part of your

make-up!) but it also has terrible visions and hallucations. Perhaps you wanted to conjure up all the horrors of war as a warning and in order to remind people to appreciate peace?

It's based on a text by Françoise[63] which is not about any specific war but about war in general, the unjust treatment of people. Two friends find themselves in two opposing camps and have to fight each other. They find each other eventually but are killed in an explosion.

The UPIC material has a way of ending abruptly, as if cut off.

Yes, it's a kind of comment in between sentences and it illustrates indirectly the message of the words.

I'd like to make a detour at this point to discuss your attitude to abstract music, abstract art in general. You've written on this subject and it's obvious that you regard abstract painting and sculpture, and indeed abstract music, as superior to anything more concrete. Pour la paix, *however, with its explosions and other sound effects, is not your only work which can't be described as abstract. In* Serment, *for instance, the loud inhaling and exhaling made by the singers evokes the sound of masses of people. Again, there's nothing abstract about it.*

Serment is a setting of the Hippocratic oath (I wrote it for an international cardiovascular congress that was held in Athens). Patients sigh like that when they're suffering – that's why I put it in, as a very concrete aspect of the healing of the sick. In *Pour la paix* I intended to reproduce the explosion of a grenade as faithfully as possible on the UPIC system. So you're right. Sometimes I use concrete effects by way of symbols, illustrations of the message of the music. But it occurs rather seldom, I think. If you perceive similar effects in other pieces where they're not intended, then that's my mistake.

It's more likely to be my fault. But my question really is: Why do you consider abstraction to be superior?

Abstraction is one of the means whereby the human mind understands and memorizes.

The value of Renaissance paintings depicting saints and so on lies not so much in the stories they tell (although for religious people the identity of the characters is of significance) as in the relationships of the colours and the forms. It is that, quite irrespective of their semantic value, that accords them a place in the history of art.

The same is true of ancient Egyptian art, which we don't understand, because we have little notion of the mental or psychological environment in which it was created. What remains for us to judge is the relationship of forms and colours.

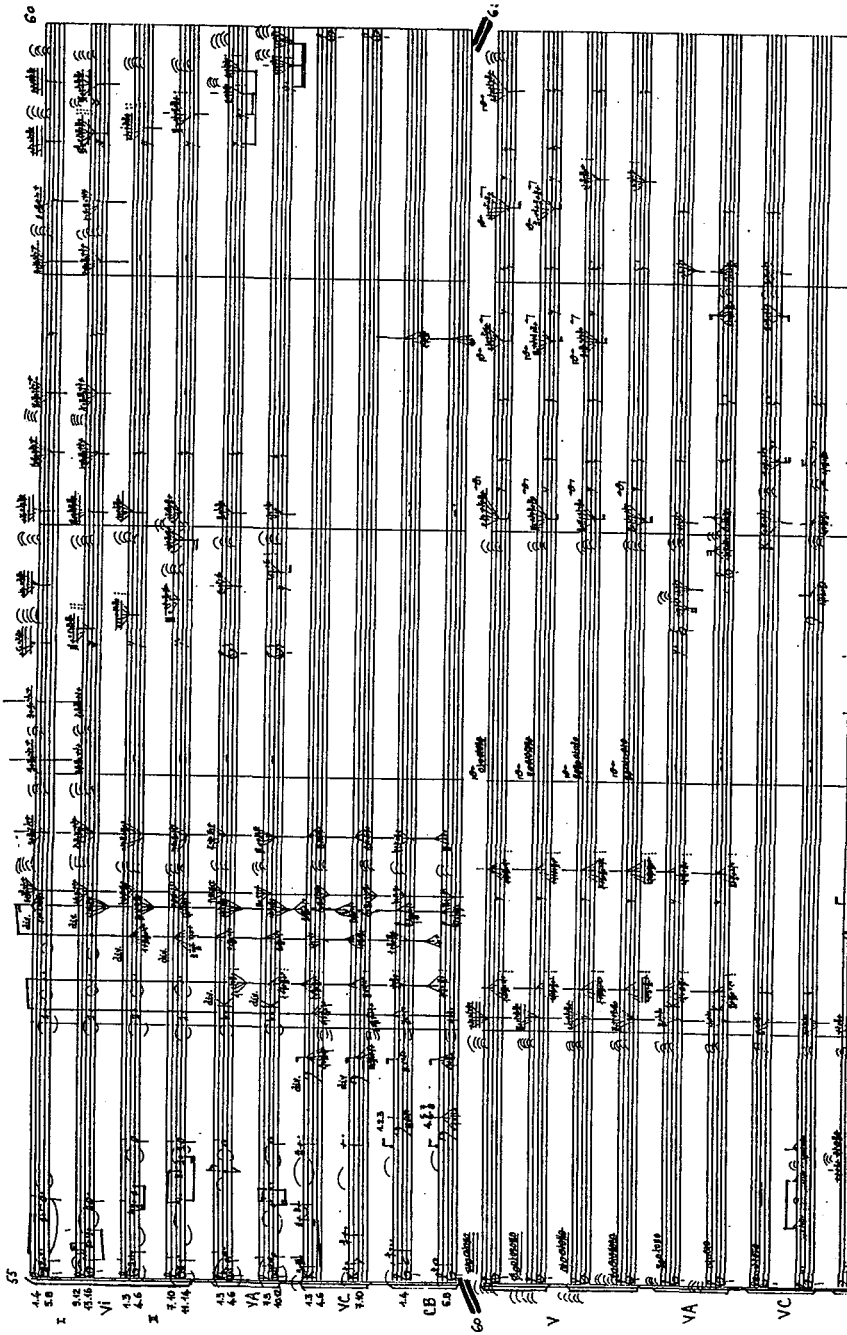
Who knows what rituals lay behind the Altamira wall paintings? For us they are no longer sacred. What we admire and love in them is the strength of line, the colours and shapes – it doesn't concern us if they happen to depict a bull or whatever.

The same is true of Bach's liturgical compositions. I don't care about their religious aspect, I like them because of the music itself.

I recently saw a Malewitch exhibition in Amsterdam. He endeavoured to sever his links with traditional painting and tended more and more towards abstraction. Of course, he was part of a widespread movement of the élite, especially in Russia, but also in Holland and perhaps in France as well. Picasso was painting both very concrete and very abstract pictures at the same time. To my mind, what remains of *Guernica*, for instance, is not the depiction of the tragedy of war and destruction but the shapes and colours. This is what I mean.

To return to the discussion of your compositions – the most interesting aspect of Shaar *for me is a dialogue of clusters, each consisting of three, four or five notes a quarter-tone apart. Their composition accounts for the unique timbre they produce.*

In Example 7, for instance, the chords are like blocks of sound, very narrow, which produce a different timbre than the sum total of the individual notes would indicate. They are blocks with an inner colour of their own. If these chords sound in different registers you can obtain a kind of melodic pattern.



7 *Shaar*, p.5.

I was also intrigued by the glissandos connected with tremolos and accents at the same time. And there's also a violin solo that is repeated by the whole string orchestra but shifted. I was wondering what sort of calculations determine these shifts.

They are based essentially on the scale. Each instrument plays the same scale in the same range but shifted. However, not the same scale in the same order: the permutations of the notes are different, so you get a cloud of sounds with a specific articulation based on the scale. I have employed this procedure in many other pieces as well – in *Keqrops*, for instance.

Thalleïn *seems to me to be of central significance in your oeuvre. It's a summary of the output of the previous years, with a great many new and unique features. It's more transparent than most of your other works, with more of a chamber music character than others written for a similar ensemble, and it's also more varied.*

Yes . . . [*looking at the score*] . . . plenty of notes . . .

Would you agree that this is a central work?

I don't know. It depends on your mood, how you hear the music and things like that. I don't classify what I do in a kind of hierarchy.

There's a beautiful, relaxed section marked by bird-song. Harry Halbreich thought this was intended as a homage to Messiaen.[64]

It's not a homage: birds are common property. That particular section may sound like birds but I certainly didn't intend any such thing.

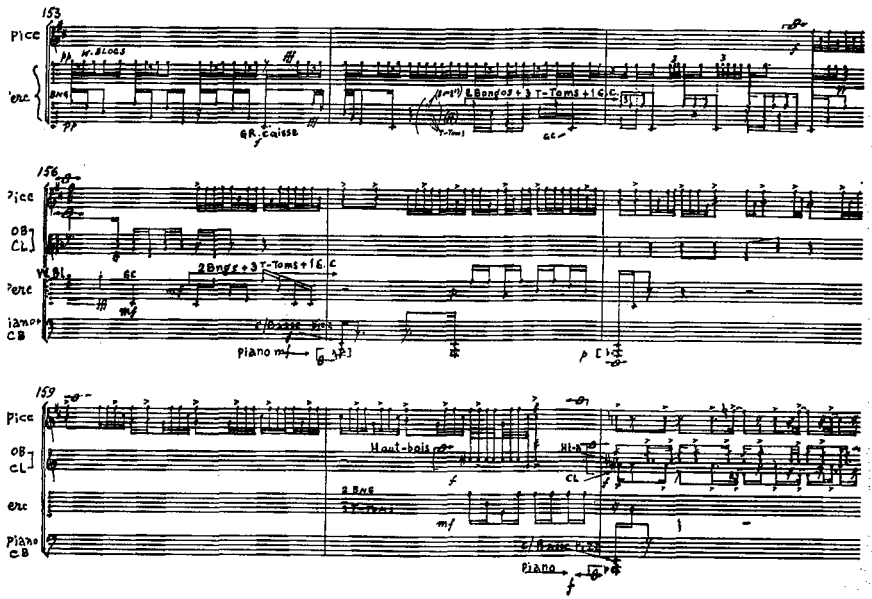
What was your intention, then?

Just a melodic pattern with thin lines. Perhaps memories of gypsy violin-playing came up. Perhaps. I don't know.

I meant in the piccolo part.

Oh, really? Oh . . . not the violin?[65]

No, the piccolo (Example 8).



8 *Thalleïn*, p.20, bars 153–61.

The piccolo reminds me to ask you if you think of instruments as having particular personalities.

In what sense?

Well, one associates certain characteristics with the harpsichord or the harp, and composers often treat these instruments in keeping with those characteristics. Of course, you approach the harpsichord differently from everybody else.

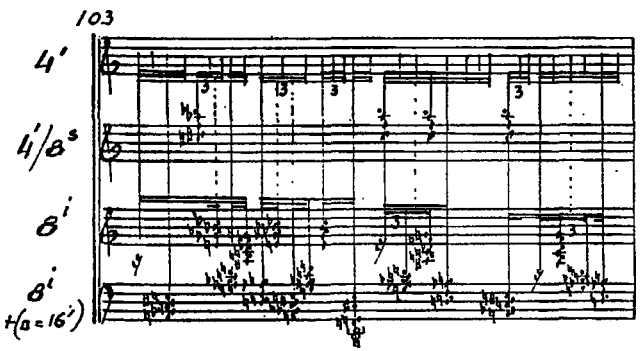
I was just wondering whether you wrote for the harpsichord because you like the sound of it, you think of it as a particular sound-making body, or whether it was because Elisabeth Chojnacka asked you to write some music for her.

When she first asked me, many years ago, I wasn't sure I wanted to. But then I heard her play – it was probably a piece by Luc Ferrari – and I was captivated by the sound. I wrote a piece with that acute, point-like sound in mind. I was also attracted by the fact that the harpsichord has two keyboards and pedals, and the combinations of timbre those make possible. I was particularly interested in the lute timbre, as well as in the range of the instrument – one of the highest of all keyboard instruments.

The combination with percussion in *Komboï* was also a challenge. Obviously the harpsichord was to be amplified, but that's not an easy thing to do. If done properly it has interesting results. The dialectic of this thin but acute and penetrating sound with the large volume of the percussion presented me with a fascinating assignment. They're like two people, two personalities, as you said.

Did you consult with Chojnacka about the considerable technical difficulties of Naama? *It demands the pinnacle of instrumental virtuosity: each finger ought to have a built-in computer, for each plays a different rhythmic pattern.* Keqrops, *of course, is similar in this respect.*

Yes, it's very difficult, for the various rhythms intermingle in conflicting situations. It's a game with pedals and keyboards. In some places, such as Example 9, I have added 16 feet to enhance the accents.



9 *Naama*, bar 103.

Mastering the piece took Chojnacka a great deal of time and effort. But I think she loves *Naama.*

Did she ever discuss the difficulties with you?

From time to time. For instance, how to make the opening line more obvious. Often I thought I'd made a mistake, for on the harpsichord chords of closely placed notes can easily sound like noise. Elisabeth then found a different way of rehearsing them and achieved a much clearer music.

Naama is indeed very difficult, and so is *Khoaï,* which has only been played and remarkably well recorded by Jukka Tiensuu. Nobody else has come near them.[66]

Like Thalleïn, Alax *seems to me to occupy a position of prominence in your recent music. In our first session you referred to the passage where the three harps play by themselves as an 'island', and you refused to attach any particular significance to it. After a crescendo ending in* fff, *in what you call in the score a* 'stop brutal', *there appears a wonderful, soft, harp sonority. Would you want me to believe that all you intended was a sharp contrast, that the beautiful melody the harps are given to play wasn't intended as such?*

It was intended as a contrast and also as a line of music which is interesting without being serial or tonal or anything like that. I don't know if I succeeded. I also used the harp in *Keqrops,* in dialogue with the piano. The two timbres – one soft and mellow, a female sound against the strong male character of the piano – are in sharp contrast.

Later on in Alax *the harps combine with the percussion to produce a unique timbre. At bar 55 you actually do describe the next section as* 'hiératique'. *It is indeed a beautiful, slow funeral march. Was that your intention?*

Maybe not a funeral march but certainly a sad one. I wrote that in order to give the performers or the conductor a notion of what I

had in mind. It has nothing to do with religious worship, but there must be a sombre air about it.

I want to discuss the spatial aspect of Alax *– that is, the role you now allocate to spatial effects. Space, however, might also have a part in* Idmen A *and* B. *First of all: which version do you prefer? Each performed separately or when the two are combined?*

I prefer the two alternating in a single performance. I left open the possibility of the two being played separately because I thought it was difficult for a percussion group to enlist the services of a choir, and vice versa.

Here you worked out a way to deploy the percussion instruments in very many different ways. I haven't heard the piece but I can imagine that the sound is highly diversified, with different groups and different numbers of instruments playing all the time.

Yes. I was thinking of the different spacing of the instruments. The effect varies according to the number of instruments playing, and you also shift from one group to another with meaningful results. The sound is, as you say, varied, but percussion instruments are somehow too homogeneous. At the time of writing *Idmen A* and *B* I was studying African percussion-playing in some depth. I didn't base the variations of the rhythmic patterns on African music, but I was intrigued to observe players in Senegal. I recorded them on my portable machine and studied their technique on my return home.

Idmen B tackles the problem of pure rhythm. Writing for percussion is somewhat like writing for piano rather than for orchestra. The piano has a more homogeneous sound and is consequently much more difficult to write for interestingly: it has just one colour. It was similarly a challenge to produce a worthwhile percussion work just for skins, for instance. The first such piece was *Persephassa*, I think, followed by *Psappha*, then by *Pléïades* and so on. *Idmen B* belongs with this group of compositions.

I understand you've invented a new instrument, the Six-Xen, which may have been born out of this desire to enrich the all-too-homogeneous percussion sound.

It was intended for the six players of Les Percussions de Strasbourg ('*Xen*' stands for Xenakis and '*Six*' for the number of players) and their performance of *Pléïades*. I wanted a sound that would be different from the keyboard instruments, the vibraphone and the marimba, which have more or less classified sonorities – 'nice' sounds, let's say. I wanted something stronger, closer to a metallic sound without using bells or things like that. I described what I had in mind and several attempts have been made to produce it, but so far none has been satisfactory. They simply don't seem to know how to do it. Of course, it's difficult to obtain the quality of sound I'm asking for. I told them it was to differ from the so-called percussion instruments, whether hit by hammer or otherwise. It's also difficult to decide what the shape should be: should it be a flat plate or ought it to have a U-shape? I tend towards the latter. It shouldn't produce a tempered scale – the six instruments should have sounds close to nineteen previously fixed notes which act as tone centres. In other words each of the six players plays a particular note belonging to one of the centres, so that the six notes of one tone centre differ slightly from one another. In this way you create beats and a kind of complex sound around the same note. I would have the nineteen prefixed central pitches spread quite wide apart, and the intervals would be produced with a 'sieve' so that they wouldn't be the same everywhere. In this way you get a kind of aura around a note played by the six percussionists.

Do you have any particular alloy in mind?

No. I don't think so. So far brass and aluminium have been experimented with, but I think steel would be better. It has yet to be worked out properly. A great deal of money is needed, of course, so it's not easy to find people ready to devote their time and energy to the project. Yamaha in Japan was going to be involved but I don't know how far that has developed.

In A l'île de Gorée, *a harpsichord concerto, I noted the partnership of the solo instrument and the high winds, while the strings supply the background, filling in the sound picture.*

In terms of the balance between the instruments this piece is very difficult to perform. The orchestra must play quietly in order for the harpsichord to be heard. Of course, if the amplification is properly done the orchestra can let itself go a little more. Balance isn't merely a compositional problem – it's also a problem for the conductor. I must say I haven't been pleased with all the performances, by any means.

The musical material gives the listener the impression of a tremendous battle going on, as if the harpsichord and the orchestra were trying to overcome obstacles and mustered a strong will to do so.

I suppose that's true. I don't know why I wrote it like that. I supplied the title only after writing the piece. *Gorée* is an island which had a flourishing slave market in the nineteenth century.

Yes, I think it might be worth quoting two paragraphs from your introduction in the score: 'This piece is a homage to the blacks who, forcibly taken from their lands into appalling slavery, have managed to win for themselves leading positions in some of the "civilized" countries to which they had been deported.

'It's a homage also to black heroes and victims of apartheid in South Africa, last bastion of a hysterical racism.'

As I said earlier, I regard Akea *as one of your 'abstract' compositions. It was surprising, therefore, to find an instruction at the end of the piece of the kind that occurs very rarely indeed in your scores:* 'avec chaleur pessimiste'. *I was nonplussed on this occasion by the suggestion that* Akea *should have any emotional content at all.*

I wanted to call performers' attention to the style I had in mind, and this instruction is probably the closest to that. If they take it into account they may produce an approximation. I want them to do something different than is suggested by the notes.

Keqrops *seems to summarize all the features of your recent music. The chords on the piano at the beginning remind me of the first movement of Bartók's Second Piano Concerto. Is there a connection?*

Are they the same?

Of course not.

Thank goodness!

But it certainly recalls the Bartók concerto. It was unintentional, then?

Yes, yes.

You use oscillation which becomes a glissando – rather an interesting effect. Rallentando also makes a strong impact. The piano part reminds me in places of the harpsichord part in Naama. *At one point it's spread out on as many as six staves.*

Yes, in order to make it absolutely clear for the soloist (Roger Woodward) who has to play various ascending patterns.

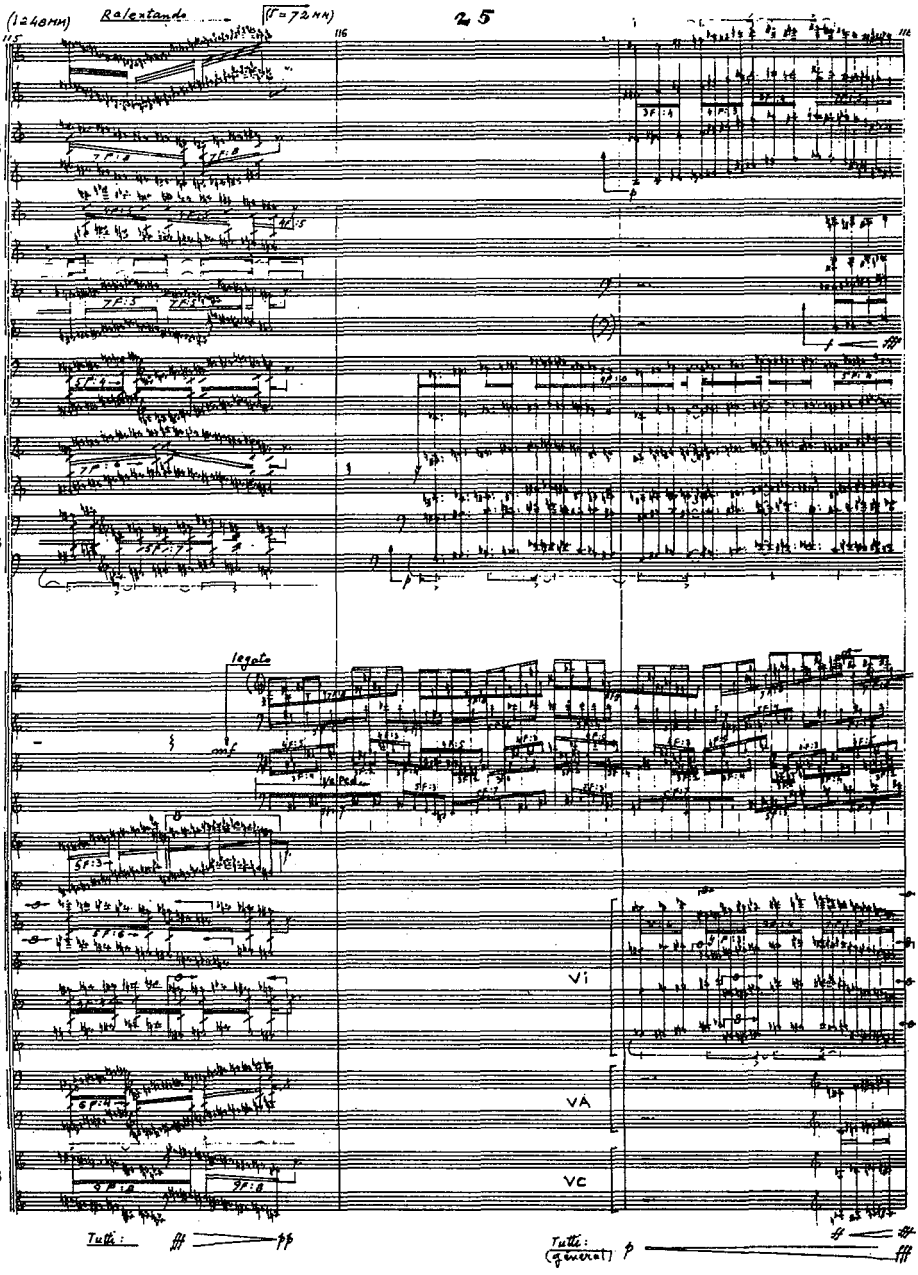
The ascending scales are more or less regular and where there are so many it's better to notate them separately, otherwise it's impossible to decipher them. You've heard the beautiful job that Roger Woodward has done. There are other difficult bits as well, such as bar 116 (Example 10), even though the notation is clear, with indications of what should sound together.

Do you check on the piano that what you've written is playable?

Sometimes I have to.

Horos *stands out among your compositions of the past years as a major achievement. As in* Thalleïn *and* Alax *you are true to yourself and have also succeeded in renewing your language.*

It's in this piece that I used the cellular automata[67] to determine the succession of chords. Bars 10 and 16, for instance, are areas



10 *Keqrops*, p.25, bars 115–117.

created in this way, calculated with my pocket computer (Example 11).

I have already noted the very beautiful sound produced by oboes and clarinets. Their appearance at that particular spot is reminiscent of the surprise appearance of the three harps in Alax. *Suddenly there emerges this beautiful, consonant sound.*

There's a similar passage in *Shaar* as well. I know. Perhaps I've used it too much.

The writing of the score required real craftsmanship. It's almost an engineer's job. Is it your own handwriting?

Yes it is. It wasn't an engineer's job for me!

Let me ask at this point: do you work from sketches? Is the printed score a fair copy of a draft?

No, no, no. There are principles. I have different starting points.

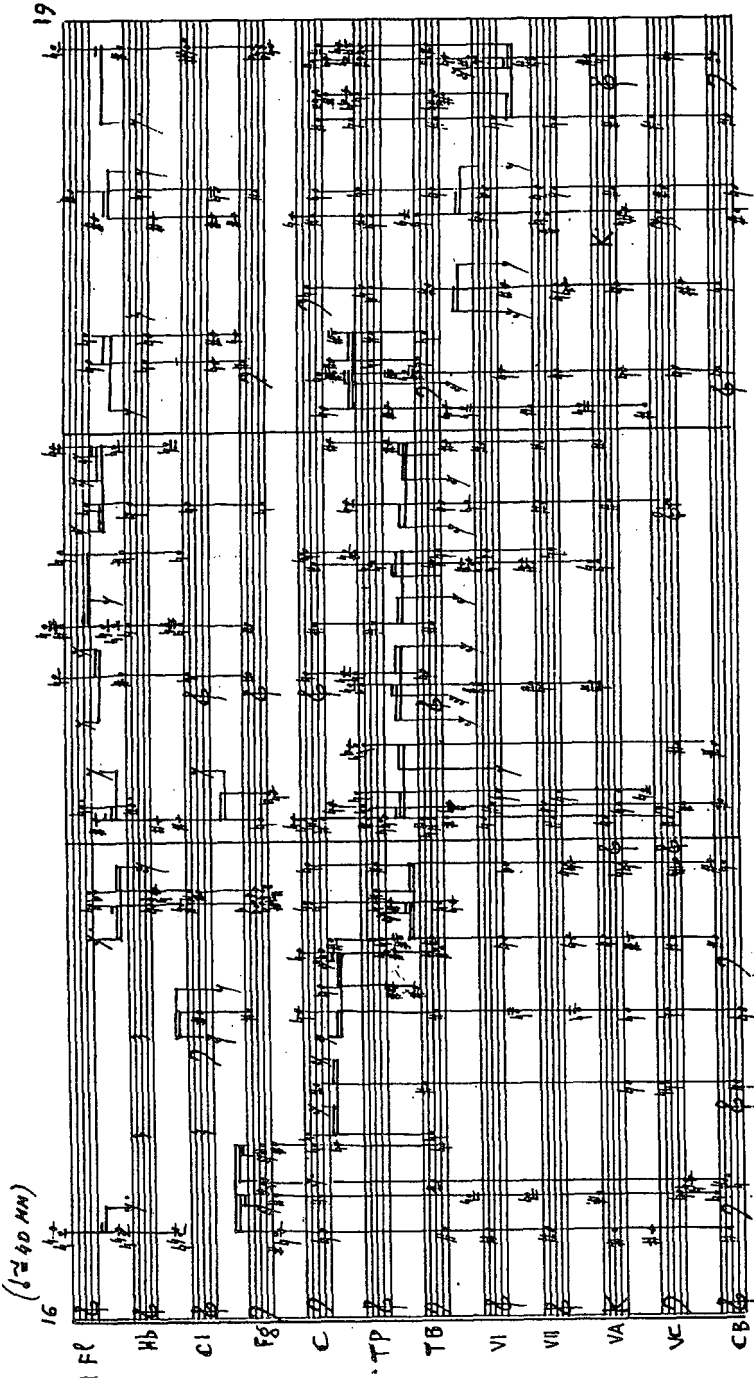
For instance, in Example 12 the patterns appear gradually out of phase. First the woodwinds, then the strings play more or less the same pattern. They are ascending, then descending but out of phase, that is, not starting at the same time. The time unit, however, is identical. This produces a kind of turbulence inside the flow, going up or down or reversing inside. It should be like a liquid.

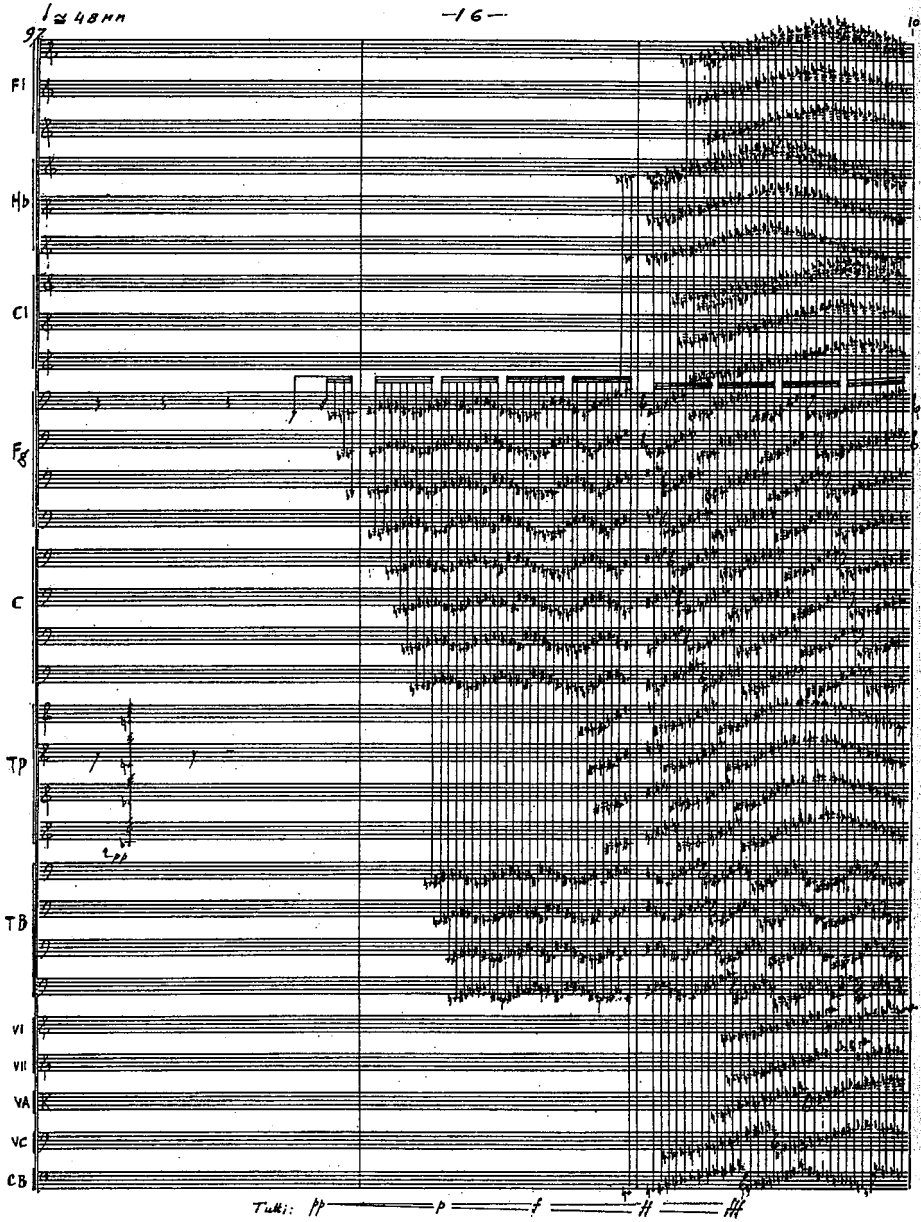
Do you ever work from sketches?

Sometimes, but not so much now. Sketches or notes.

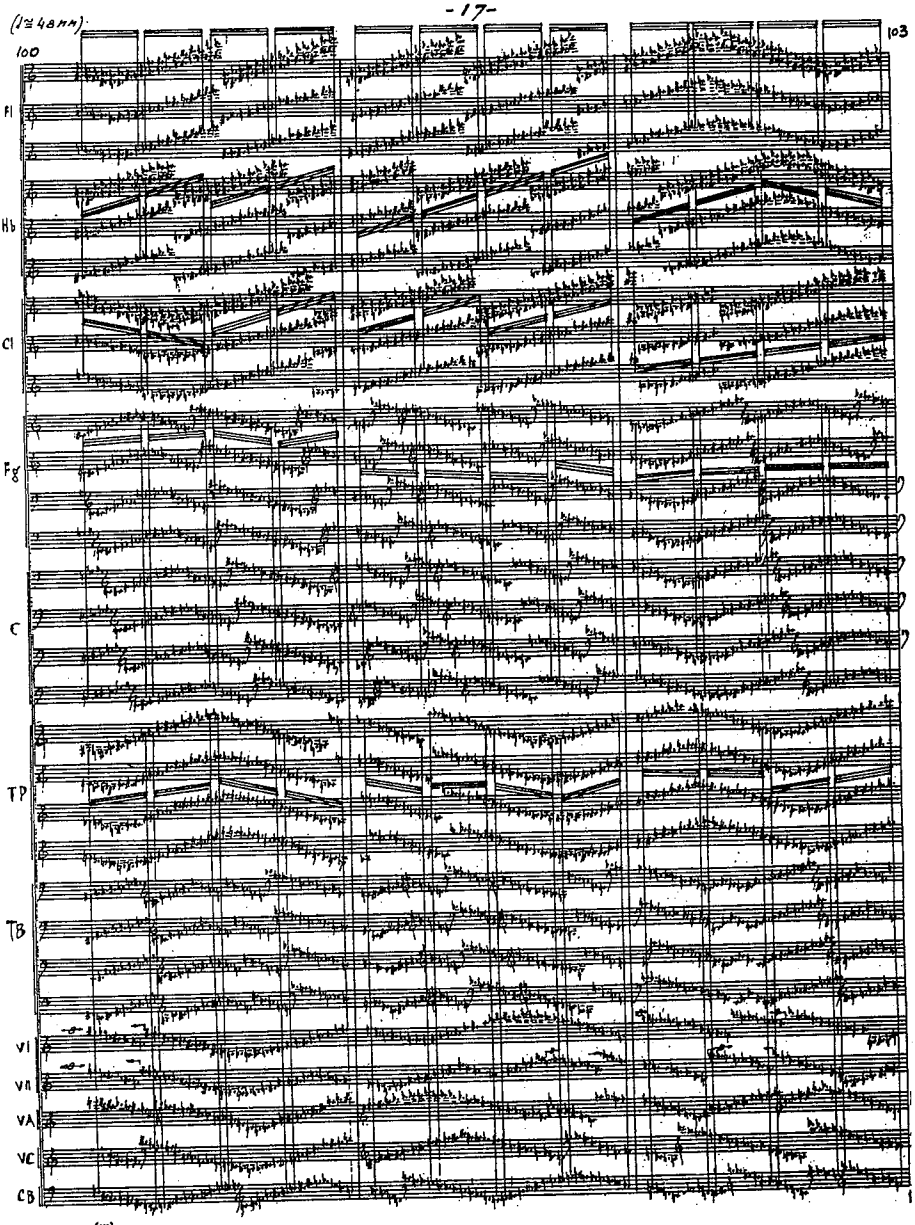
What do you have in front of you when you start writing a score like this?

The notes of a scale, for instance. Or a sieve. Or other notations about the synthesis with cellular automata, or pages with staves so that I can start writing, combining the various materials. And


(♩= 40 MM)
16
19
Fl
Hb
Cl
Fg
C
TP
TB
VI
VII
VA
VC
CB
Tutti: ## →



12 *Horos*, pp.16–17, bars 97–102.


- 17 -
(♩= 48 mm)
100
103
Fl
Hb
Cl
Fg
C
TP
TB
VI
VA
VC
CB
Tutti (III)

then I change my mind . . . Everything could be useful at any one time.

When you're writing a very complex web of sounds you have an overall impression of the aural result in your inner ear, but can you possibly hear every detail?

Almost. I also take risks in proposing new solutions, the outcome of which is impossible to predict. Changes may have to be executed after the first performance, especially because of the balance of instrumental groups inside an orchestra. Of course, a great deal depends on the actual players, their training, and also on the conductor. As a result each performance may be different. On average, however, I get what I intended. In most cases I know by experience what the sound will be like, but even then acoustics and the performers affect the end result.

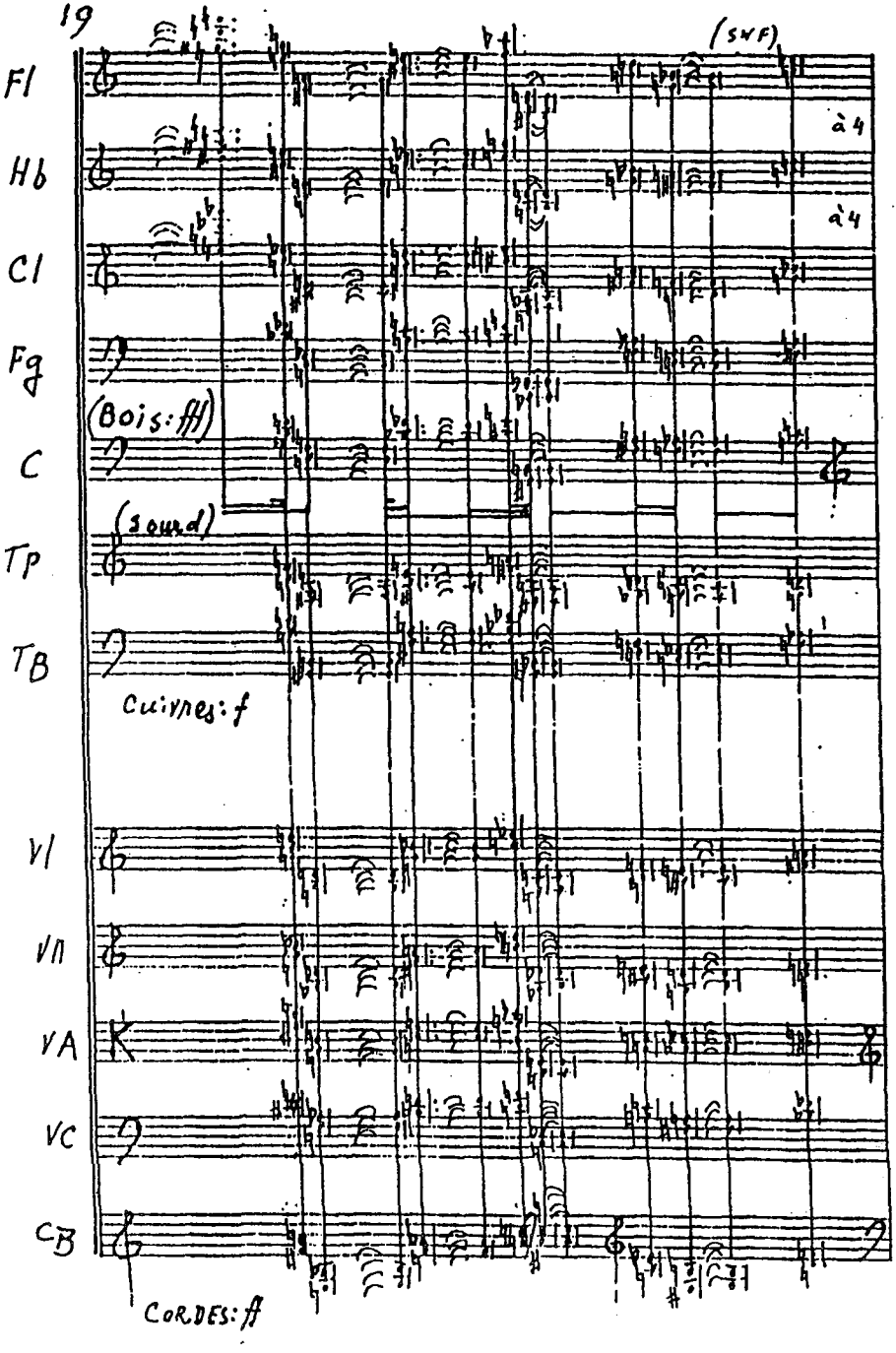
The problem with orchestras is that they're not made up of individual players in the Arditti or Woodward mould. If your music doesn't sound the way you imagined it's likely to be because of the performance, not because of you.

Absolutely. That's why in writing for an orchestra I have to make allowances for the limitations of the musicians. Chamber works can be more demanding and I can afford to write really challenging pieces for outstanding soloists.

In Ata *you once again treat the orchestra as one huge instrument. In a way you carry solutions previously applied to the extreme.*

Maybe. In *Ata* these solutions are simplified in a way. The timbres are worked out very carefully. For instance, the bassoon is used almost throughout with the brass, in agreement with the horn. The brass play forte, the woodwind fortissimo, whereas the trumpet is muted because it's too loud (Example 13).

The same occurs later, in bar 33 for instance, where the bassoon plays together with the horn. The many notes have been selected with the help of a sieve and the timbre is of a specific kind.


19
(sw f)
Fl
Hb
à 4
à 4
Cl
Fg
(Bois: ff)
C
(sourd)
Tp
Tb
Cuivres: f
Vl
Vl
VA
Vc
Cb
Cordes: ff

I don't have a tuba in *Ata*. A pity, but I suppose I was afraid of it at the time, I didn't know what to do with it. I have used it recently, in some chamber pieces, because I've now got the hang of it. It has a very large sound which covers everything. The trombones and trumpets are muted to make them softer and to get rid of their 'brassy' colour. It's too marked, you see. If they join the woodwind or the strings it's better to have an alchemy of sound, thanks also to the scales, that is, the sieves.

If you were afraid of the tuba at one time, did you have no reservations about the saxophones? I'm thinking of Xas, *of course. They have an unmistakable jazzy colour and, especially when they play high notes, they tend to shriek.*

The saxophone quartet that asked me to write the piece, the Rascher Quartet, is American but they live in Germany and have a less jazzy style. The sound is much more mellow, it doesn't shriek, it's not 'saxophonic'. I certainly don't want any jazz sound.

Why would you accede to such a request? After all, a saxophone quartet is rather an esoteric medium.

They were so nice! And they kept on asking me, for a long time. Finally I said yes.

My favourite passage is towards the end, where the music seems to freeze and you have long sustained notes.

Next: Kassandra. *It puts me in mind of a visit I made to Japan. When in Tokyo I watched many traditional theatre performances on television, with the female parts taken by men talking in a high, stylized voice. The high, exotic voice of Spyros Sakkas was not unlike that of Japanese actors.*

There were no female actors in ancient drama – that's one reason why *Kassandra* reminded you of traditional Japanese music like the Noh or even the Kabuki.

Kassandra, like *Aïs,* is based on the rhythm of the ancient text, on prosody. The baritone has an octave in the treble range which

isn't much but gave me sufficient scope. The chant, the recitative, should avoid singing individual notes, it should be one continuous flow.

Initially the baritone sounds hysterical in the soprano range, but because the mood never varies one accepts it as a style and forgets about the hysteria.

Kassandra was a very unfortunate girl – she was filled with fear by the horrors she divined and then related.

But you do ask the performer to refrain from the expression of emotion: 'L'interprétation doit éviter toute expression de sentiments car le danger est grand de superposer des clichés actuels au texte d'Aeschyle.'[68]

Yes, because otherwise it becomes very naturalistic. The vocal line with its accents is treated like an instrumental part.

At one point there's a very quick alternation between the low and the high registers, creating the impression almost of polyphony. It's the culmination of the whole composition.

Yes, it's very difficult.

Kassandra, *like a number of other works of yours, is strongly theatrical. Are you attracted by the genre?*

I don't know. I've been asked to write an opera but I feel I can't because the style has no validity today.

But it would be your *opera.*

I have written music for *Oresteia* and *Medea*, based on the tragedies of Aeschylus and Seneca, in an attempt to conjure up the music of the times. After so many readings of ancient tragedies the attempt was bound to be subjective in nature. That's why it ought not to go beyond the domain of music. If staged, the tragedies must do without it. Originally, of course, *Oresteia* was

meant to be incidental music for the tragedy, commissioned for a festival in Michigan. Inhabitants of the city of Ypsilanti discovered that the name was that of a Greek revolutionary[69] who fought against the Turks at the beginning of the nineteenth century. OK, they said, in that case we must have a Greek theatre. I saw the drafts – it was to have had a Greek façade. But the money was stolen and the theatre was never built. Instead, *Oresteia* was played on a baseball field through the summer. It might have been in 1965 or 1966. The director was Alexis Solomos, a Greek who had staged tragedies at Epidauros.

Subsequently I fashioned a suite out of the main numbers, based on the choruses of the ancient drama – choruses, that is, in the sense of dances ('*choros*' = dance). In ancient times they used to sing and dance in two semi-circles.

I added *Kassandra* to the suite two years ago, when it was performed in Sicily at a festival called Oresteiada. It was established by Ludovico Corrao the mayor of Gibellina, a village destroyed by an earthquake twenty years ago. The mayor had founded a new village, Gibellina Nuova, a few kilometres from the original site; it has some interesting avant-garde architecture and also sculptures by Italian artists. The festival takes place on the ruins of the old village, mostly covered by concrete painted in white by Burri.[70]

I wrote *Kassandra* because Aeschylus is buried at Gela, a few kilometres away from Gibellina.

And what prompted you to write Taurhiphanie*?*

That's a different story. I was asked to create a work which would involve the bulls and horses of the Camargue. Now, bulls are linked with ancient religious tradition in Crete. Remember also Zeus and Europa, Baal in Phoenicia, the Golden Calf of the Jews, who were not monotheistic at the time, as well as Apis, the bull of the Egyptians.

The idea attracted me strongly, the more so since the bull is such a beautiful animal, so savage still. I accepted the commission on the understanding that the performance would take place in the Roman amphitheatre of Arles, where at one time Christians

were slaughtered. I asked for a hundred bulls but the organizers got cold feet and only gave me twenty . . .

You imitate the bellowing of the bulls briefly in the piece, produced on the UPIC equipment.

Yes, because it was a challenge to find out why the bulls sound the way they do . . .

I also loved the horses – they were fine, white animals, so delicate with their long manes and tails. It was a memorable experience.

Your music lasts ten minutes and forty seconds. Was it played through several loudspeakers in the arena?

We built a wooden tower in the middle of the amphitheatre and on top of it, about two or three metres above ground, was a table. The UPIC equipment was placed beneath it, inside the tower, so that I could improvise as the performance was going on. This is now possible with the system. I also had control of the speakers.

In addition, there were about twelve percussionists placed all over the arena with the public sitting above them. Six of the players were those of Les Percussions de Strasbourg. The dozen or so performers were conducted very nicely by Sylvio Gualda. *Pléïades* was played, together with another percussion piece. *Taurhiphanie* formed the middle of the programme. The title comes from *'tauros'* (bull), *'hippos'* (horse) and *'epiphany'* (apparition).

What were the animals supposed to do?

They moved around. I had wanted to put microphones on their heads and behinds in the hope that they would make some noise. In the event they were very quiet . . . I was disappointed. That's why I imitated the sound of the bulls in the piece, because I knew there was no chance of the real thing.

Did the horses and the bulls not mind each other?

They were brought in separately.

5 UPIC

Xenakis took me on a long journey in the metro, out into one of the suburbs of Paris, to see how the UPIC equipment works. The premises – three rather cramped rooms in a modern block – provided ample explanation for the composer's bitterness about the meagre funds placed at his disposal. The contrast with the underground phalanstery of IRCAM is all too stark.

The actual UPIC machine is housed in a small, narrow room. I had expected its operation to be child's play after hearing how simple and straightforward it was. In fact it's quite complicated and my attempts were rather less than successful. When called upon to draw any picture on the board I decided, rather predictably, on Xenakis' name, to find out what it sounded like. I had to start several times for I kept forgetting that I was supposed to move the electric pencil in one direction only. Another requirement I was hard put to observe was that each parameter (such as, for instance, the tempo) of my 'piece' had to be separately fed into the equipment, by bringing the pencil in contact with different points of a diagram. Eventually the shape, which resembled 'Xenakis' only remotely, produced a repetition of the same note – not uncharacteristically, perhaps. In any case the experience taught me that producing worthwhile results on the UPIC needs patience and a great deal of experience. It takes time, too.

I read your interview with Henning Lohner in the Computer Music Journal.[71] *He was obviously speaking from the point of view of an expert, and quite frankly I couldn't fathom all the technicalities. I did come to the conclusion, however, that UPIC has its limitations – something you readily admitted.*

Of course. Everything has its limitations.

You talked about UPIC 2. In what respect does it differ from the original machine?

UPIC is a system linked to a computer to produce music by drawing on a board. It's close to the traditional way of designing music with a pencil. There are no built-in timbres or sound sources: you have to decide everything. It's all done by design – of the wave form, the intensity envelope, the combination of them into time, that is, the score itself.

UPIC 2 is much faster. You don't have to wait for hours, having designed a complicated page. It works in real time. It also has many other graphic facilities, like automatic transformations of the design, inversion, rotation, reduction and enlargement, zooming, filtering and extraction. We have also implemented frequency modulation.[72] In other words, the principle is the same as that of the original equipment but UPIC 2 offers richer possibilities on the level of the page.

For instance, you feed a sound into the system and you can take part of it and use it as a wave form. Now we are about to introduce UPIC 3, which is based on personal computers.[73] They're so common nowadays that much lower prices can be negotiated. The graphic facilities will be even more varied, incorporating the latest developments in the field evolved by graphic computers, which are very expensive indeed.

Have you had a hand in this progress? Did you inspire the changes and have them realized by experts?

The software and hardware specialists at CEMAMu carried out what I asked them to do. Small computers process the graphic input – the designs, that is – very quickly, in real time. We have built them all at CEMAMu, with the financial support of the Ministry of Culture. The personal computers are much more sophisticated, more open and more accessible to software than INTEL, which we used before and which was rather awkward to operate.

I believe you've been using UPIC more in recent years, but it still accounts for a minor proportion of your output.

That's right. Why? Because I'm asked to write instrumental

music. My income is drawn from commissions so I can't afford to ignore them.

You couldn't combine the two?

I have done, as in the case of *Pour la paix*. But in general I don't know. It's too complicated. Traditional instruments still offer plenty of scope, whatever Varèse may have said in the 1950s about the imminent demise of the orchestra. It still has a long life, however conventional and reactionary it may be!

I know you welcome composers to CEMAMu with open arms. How well known is the institute in the world? Are you satisfied that it's being properly exploited?

CEMAMu is the laboratory where equipment is built. There's also another organization, Les Ateliers UPIC, which is run by François-Bernard Mâche and Alain Desprès. CEMAMu produces UPIC. The atelier takes the machines from CEMAMu and exploits them, either within the framework of workshops around the world or at seminars. At the end of June [1989] there'll be an international seminar at La Villette where the atelier is situated, and it will be attended by composers from all over the world. First they will learn how to use it and then they will produce music on it.

The point is that these composers are not rich. Because the organization is self-supporting it has to charge them a fee. Scholarships are offered to help them find the money but, again, securing funds for that purpose is not easy. Those attending the seminar in June are all supported by scholarships, so they can come and work freely for a period of time. A number of interesting compositions have been written in the past by people like Julio Estrada of Mexico, Peter Nelson of Scotland, Rich Barrett of England and some others.

Are you available for consultation?

No, that's not my job any more. Initially it was interesting and

necessary but now there's an organization to care for and monitor them.

You used not to be happy with the subsidy provided by the Ministry of Culture, especially in comparison with the money placed at the disposal of IRCAM. Has the situation changed at all?

It was much better during the first socialist government because we were helped by the director of music, Maurice Fleuret. Then a right-wing government came to power and subsidies were cut by half. We have to reapply every year. This means that people working there have no security. They persevere nevertheless because they're really devoted to their work.[74] It also means we can't have the best equipment, nor can we employ as large a staff as we need. That's why we have to concentrate our efforts on UPIC rather than doing research in other fields as well – something which would interest me a great deal. So it's a matter of money for us, as it is for other laboratories. If the authorities who hold the purse-strings don't appreciate what we're trying to do, then we have to live with that. That's another reason why I haven't done too much work there.

So this has been a disappointment for you.

Yes. It could all have happened much quicker, you see. Let me give you an example.

In the 1950s I proposed a theory about sound synthesis based on the quanta sound. The acoustic quanta goes back to a theory by Einstein around 1917 to do with phonons. It's all connected with the observation that the transmission of heat and of sound through the molecules of atoms is by energy jumps, just as in the case of photons. They are controlled by the same equation, the Planck equation.

I'd developed my theory purely by intuition and realized only later that it had already been proposed in physics. Young composers in the United States and also in France have recently taken up this idea. I could have developed it to the full if only I'd had people working with me. There are other projects as well that

could have been launched if I'd had the support. Had I embarked on them by myself, I'd have had no time left for anything else.

If you'd received all the support you needed you would have composed less. Perhaps it's just as well . . .

Oh, I don't know. I could have managed that.

6 Theories

Many of your recent scores have appeared without any explanatory remarks. If there's an introduction it usually explains the meaning of the title or the circumstances of composition. In the past, however, your prefaces served as indispensable source material for writers of programme notes, for you explained or at least hinted at the theoretical and technical background to the composition in question. Why the change?

Because 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 on them in a sporadic and sequential manner. Theories now are dominated by the general approach, the architecture of the composition itself.

Why no new theories? I don't know. Perhaps because I concentrated on constructing pieces which should be architecturally more . . . I don't know how to put it. In all these years I've been working on the theoretical construction of sieves – that is, of scales, with the help also of the computer. Apart from that the only new procedure I've used is the so-called cellular automata. *Horos* was the first piece where I put them to use. The method helps in deciding how to go from the notes of one chord to those of another within a rational, perceptible structure. All I need to have recourse to is my small pocket computer.

Can you go into more detail?

Let's say you have a grid on your screen, with vertical and horizontal lines forming small squares, that is, cells. These are empty. It's for the composer (whether working with pictures or with sounds) to fill them. How? One way is through probabilities, for instance by using the Poisson distribution, as I did 30 years ago in

Achorripsis. There's also another way, with the help of a rule that you work out for yourself. Let's suppose the vertical lines on your screen stand for time divisions and the horizontal lines represent a chromatic scale, or semitones, quarter-tones and so on. Any kind. You start at a given moment, that is, at the given vertical line, at a given pitch – in order words, a cell – and you say: here's a note played by an assigned instrument. What's the next moment going to be? What notes? In accordance with your rule, the cell which has been filled gives birth to say, one or two adjacent cells. In the next step each cell will create one or two other notes. Your rule helps to fill the entire grid. These are the cellular automata. They are very simple rules which can create structures on very large surfaces. It's related to the nature of fluids, for instance. For me the sound is a kind of fluid in time – that's what gave me the idea to transfer one area to the other. I was also attracted by the simplicity of it: it's a repetitious, a dynamic procedure which can create a very rich output.

The first 30 years of your life as a composer were devoted to developing theories; now you can afford to reap the harvest by picking whatever happens to suit your needs.

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.

Do you really think so?

What's 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't be analysed. If, however, you can stand back and observe them, so that you can decide which one's 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.

I think we've arrived upon a rather basic question. Before posing it, I'd like to quote a passage from Le Corbusier's book The Modulor.

> *I have devoted watchful attention to the use of the 'Modulor', and to the supervision of its use. Sometimes I have seen on the drawing-boards designs that were displeasing, badly put together: 'But it was done with the Modulor.' – 'Well then, forget about the Modulor. Do you imagine that the Modulor is a panacea for clumsiness or carelessness? Scrap it. If all you can do with the Modulor is to produce such horrors as these, drop it. Your eyes are your judges, the only ones you should know. Judge with your eyes, gentlemen. Let us repeat together, in simple good faith, that the Modulor is a working tool, a precision instrument; a keyboard, shall we say, a piano, a* tuned *piano. The piano has been tuned: it is up to you to play it well. The Modulor does not confer talent, still less genius. It does not make the dull subtle: it only offers them the facility of a sure measure. But out of the unlimited choice of combinations of the Modulor, the* choice *is yours.*[75]

You have your theories and you subject your material to processes in accordance with those theories. What interests me is the extent to which you're prepared to forget about the theory if what comes out fails to satisfy your ear.

Yes, well, I try to do so all the time. I've always endeavoured to adjust the one to the other, right from the very beginning. When I used programs to produce music like *ST/4*, *ST/10* or *ST/48*, the output sometimes lacked interest. So I had to change. I reserved that freedom for myself. Other composers, like Barbaud, have acted differently. He did some programs using serial principles and declared: The machine gave me that so I have to respect it. This is totally wrong, because it was he who gave the machine the rule. My approach is similar to Le Corbusier's, because he pitched his sights higher than the rules.

A rule governs just one aspect of the music. If a composer says: I've kept to the rules, everything is under control, he's wrong,

because in fact he controls only a segment of it. He has no control over the patterns he uses, over the instruments which were given him by tradition or the placing of the musicians. A composer can never boast that he has everything under control. Complete control simply doesn't exist, it never has done. Nor is it likely to exist in the future unless you say: All right, I'm going to construct everything. But even then I have to change my mind, because it was given to me and the universe itself. To create a different universe to live in.

There we have arrived at a deep problem – about originality and the existence of originality in the universe – which concerns the laws of physics. Are the laws the same now as they were millions of years ago, or have they been changing? Nobody can answer this question. Astrophysicists are trying to understand the universe on the basis of today's laws. Maybe they're wrong. That's why I call them poets. They invent theories about the creation of the universe based on limited information. Nobody can check their validity because you can't experiment with creating a new universe today. You have to make do with conjectures, that's all.

7 Form and Shapes

In the course of discussing the block-like construction of some of your compositions we touched upon the question of form. Your conception of form, however, has never come up in detail.

In some instances I've approached form from a theoretical point of view. *Nomos alpha*, for example, is based on abstract group structures. The *ST* programs were straightforward applications of stochastic rules.

The best solution is, I think, to live with form. That is, one builds it day by day, bit by bit. You may, of course, start out of a general idea, or a particular one, which you transform as the work progresses. Music is a kind of organism, it's slow to take shape, like the gestation of babies. This is the best strategy, for it ensures that the music will be deep and alive and will conform to all your past experience, in that domain and in other domains as well. I can't think of another way.

I read Harry Holbreich's analysis of your work,[76] *and he claims, for instance, that in* Alax *the harps appear at the point of the golden section of the composition as a whole. Was that a conscious decision on your part?*

He may be right. I don't know – but it certainly wasn't intentional.

Do such considerations ever motivate your work?

Not always.

In other words they do sometimes?

Yes, of course. In *Metastasis*, for instance, it was a conscious

decision. The lengths of sections of different density were computed in this way, the acceleration in the middle follows the golden section, and so do the departure points of the glissandos at the beginning. But this is by no means the rule. Musicologists may analyse scores and come up with their conclusions – and they may be perfectly right – but their findings need not indicate anything conscious on my part.

You know that he divides your work into so many sections – twelve, in the case of Nekuia, *for example. That's not something you intended?*

No, no, no. Composing is a battle. It should be an unconscious battle, provided you're there to criticize yourself. Things grow, as I've said, in an interesting way, or in an uninteresting way.

Work hasn't become any easier with the passage of years . . .

It's a struggle to produce something interesting. Of course, I can't define what I mean by that. From my point of view it can't be defined.

I think music must have an inner necessity, but again, nobody can define necessity, even in the case of traditional music. Analysis is no explanation – it's only a description of what's in the score. Analysts are observers who say: Here he has that and then he has that – they see the links, and see relationships, and they think this explains everything. But maybe it's not the case at all.

You want to create living organisms that have a life of their own, rules of their own, their own way of beginning and ending, and what happens in between should have a logical life of its own.

Logical or irrational. I think this is linked to a deeper tendency of human beings (perhaps the word 'human' can be omitted) as demonstrated by automata or by religion. Religion is a collective invention of man regarding his environment: it was the 'scientific' approach of the past to the universe. Science today endeavours to understand phenomena, and it also produces 'living' beings, such as robots or automata. This endeavour has characterized

mankind throughout history. When people wanted to draw water they built a machine to help, rather than doing it themselves. Today, with the help of computer science and electronics, whole systems are produced to control the manufacture of cars, aeroplanes etc., automatically. They are material beings that produce objects.

The next step would be to produce structures as well. The first attempts in that direction were the automata, which functioned according to set rules. As I told you before, the fugue is a forerunner of such an automaton.

Today a whole new area of science, 'Experimental Mathematics', affords some fascinating insights, especially relating to automatic dynamic systems, employing maths and computer graphics. Thus, many structures like the already mentioned cellular automata, or like those that possess self-similarities such as the Julia or Mandelbrot sets, are studied and visualized. These studies bring one right to the frontiers of determinism and indeterminism. Chaos to symmetry and the reverse orientation are now studied again and are quite fashionable! They open up new horizons, although for me these results are rather novel aspects of the equivalent compositional problems which I started dealing with about 35 years ago. This is why I'm interested in and working on these subjects.

Science in general and industry aim at creating abstract and physical automata. The work in this field is just beginning. First we shall arrive at a kind of computer based on biological matter on an ever smaller scale, and then at a kind of automaton based on a very complicated relationship of cells and eventually of atoms and particles comparable to our body and our brain.

It's amazing that all the components of our own bodies are beyond our control. We control our movements but our muscles receive impulses from the brain without any conscious knowledge on our part of the electric discharges in our cells. The same is true on many levels. What does a human being do? He eats, assimilates his food, works to produce food, makes love because that has also been part of his make-up for millions of years, relaxes, enjoys, kills or is killed. However, he is absolutely unaware of what kind of life is enjoyed by the cells in his organism which

belong to another layer. But there they are. Particles which are even smaller than cells also lead an existence of their own, in total independence. That's the smallest scale we've reached to date. But I'm sure there are even smaller, deeper scales than that. In the opposite direction you have all the systems of the universe, which is itself probably set into a larger universe. Religious people believe that these systems are worked by God. I don't think we need to use God as an explanation, unless you say that God itself is the universe. These layers are so immense and so distinct as to have no direct bearing on what we are. We are Russian dolls or a *mille-feuille* (the many-layered French pastry). We don't know much.

When you came to Budapest in October 1980 you expressed a desire to visit the Museum of Military History, to see the shields, swords and armoury on display. When I asked why you replied that you were interested in shapes. To this day I wonder what you meant. Does the shape of a helmet bear an indirect relationship to musical form?

Probably not much. It has to do with the history of helmets. There are all sorts of shapes, some of which recur at various points in history, whether intentionally or not. For instance, the resemblance of the one in use in the American army to that of ancient times was probably purely coincidental. The Germans, however, consciously copied theirs on ancient Greek helmets.

It's true, however, that the question of shapes has wide-ranging connotations. Think of the undulating snake shape, for instance. It occurs in many different places: streams flow in the form of sine waves not just in mountainous areas but also across flat lands. Einstein provided an interesting explanation for that: in his view it comes down to the rotation of the earth.

This is of importance also in music: the presence and absence of tension. Also in another time-art: films. In human life, too. Shapes are everywhere at various levels, forms corresponding to some inner necessity.

They're sometimes close to all sorts of projections of our mind. When you say cloud – all right, but a cloud of what? Of mosquitoes – that's one example. Or a cloud of vapour in the sky. Or a cloud of people – that is, a crowd. Or a flock of sheep. The cloud,

then, is a form that occurs in many places. How to produce one or how to make it change is an intriguing question – it wasn't one that music was concerned with because it didn't have the necessary tools until I arrived [*laughs*] and realized that ideas and techniques used in science – that is, probabilities and the statistical approach – could be employed.

I believe that is what is lacking today: a theory about shapes. Perhaps in twenty, thirty, forty years' time, fundamental shapes will be classified, along with their applications and expressions in different fields of observation and production.

Another fantastic shape is that of trees. Arborescences. Veins and nerves have that shape. Lightning has it. All software is based on a tree-like construction. This is another widespread form. And what's the meaning of a line? How does it come about? It's as if a point gave birth to a next point and so on until you get a line. What is a line of electromagnetic field, or of a photon that travels in space? What does it mean?

I was recently asked to write a paper about time.[77] I wrote that time was a kind of illusion, and that in fact time is an aspect of space. However, space may also be an illusion. It could itself be just a manifestation of the rebirth of a point – that is, of some entity like the photon or like energy. It's rebirth, and when you say rebirth you create at the same time both space and time.

Therefore the idea of the tree shape is basic, both in nature and in logic, and potentially also in music. I've used it in music in the form of bushes, arborescences. Because instead of having melodic patterns and polyphony made up of single lines, you can have a full bush and transform it by rotations, zooms, alterations of all kinds.

8 Space and Acoustics

In Terretektorh *and* Nomos gamma *the musicians are seated among the audience to obtain a spatial effect. In* Alax *you use three ensembles which can be placed at three different points in the hall. Nevertheless, you don't seem to have devoted much attention to space.*

I haven't thought about it in a novel way, nor have I written music with space in mind. Tape-music lends itself more to that kind of treatment, because speakers can be placed more easily.

Indirectly, however, I have been involved with this question: I participated in an architectural contest for the Cité de la Musique at the Parc de la Villette.[78] My entry passed through two or three juries but failed to be selected in the last stage.

I designed a concert hall of an entirely new shape – like a bucket, not square but round, and asymmetrical for acoustic reasons. The floor is made out of cubes a metre in width so that you can form all sorts of reliefs. It allows for the traditional concert hall, with the orchestra out in front, or for steps, as in a amphitheatre, or for an elevation in the middle and the rest at a lower level – all sorts of shapes like that.

There's also a spiral gangway inside, for the public and also for the performers, as well as for speakers and lighting. The sound control is in the middle. Today, in concert halls, sound control is placed at the back, behind everybody, and you can't control anything. It's ridiculous.

The walls are made of concrete coated with wooden panels with large openings covered with absorbent or reflecting material, all over the hall, so that you can control the sound reverberation.

I've also introduced a novel feature which has never before been attempted: the bucket has been given a torsion because it favours the bouncing of the sound, eliminating its inertia. Think of the way water runs down a sink. In the northern hemisphere it

runs counter-clockwise and in the southern hemisphere it runs clockwise because of the Coriolis acceleration. This phenomenon helps to reinforce the richness of sound.

The bucket is placed inside a larger shell with the shape of a hyperbolic paraboloid, like the Philips pavilion, or the *Diatope* that I designed for the Centre Pompidou, or the one I did for Scherchen for his studio at Gravesano but which was never realized. The space around the bucket under the large shell is empty, with a very large spiral gangway going all the way down to the ground, so that space is also suitable for performances. But I failed.

Was any reason given?

No. The decision was taken by somebody close to Mitterand who had no taste in architecture. I was told that Boulez was also against my project – I don't know if that's true. Juries tend to favour the average. In the days of enlightened princes, they took the decision themselves. Today, in the age of juries, no prince is there to take responsibility. And those who do lack taste.

The same is true of music competitions: the winner usually lacks real originality. More often than not he will disappear, sooner or later.

That's why I hardly ever accept invitations to sit on juries.

I've read your article on space and stereophonic acoustics. You discuss static and kinetic stereophony. In the former the music comes from all the speakers placed at different points in space; in the latter it comes from a line of speakers.

Yes, that's the point. You can simulate the movement of the sound by fading out from one speaker to another, and the result is a kind of kinetic sound. In the *Diatope* I could control the paths of the sound by computer. Certain rules have to be observed. When you want to fade out the sound and give the impression that it goes to another spot, the fading out must follow a certain curve. Changes in the intensity of the second loudspeaker you have to reach must

also follow a symmetrical curve. In the *Diatope* I used an experimental curve that can be controlled automatically. If, however, you want a more realistic approach, you should take the Doppler effect[80] into account. You know, the effect by which a sound seems to rise higher and higher in pitch as it approaches you, and to sink in pitch if it goes in the opposite direction.

Have you ever considered the quality of the loudspeakers? This is a subject that Péter Eötvös has now decided to experiment with.[81] *He says that, if you put an instrumentalist and a speaker behind a curtain, you can immediately tell the machine-produced sound from the live one. He would like to develop speakers where you can't distinguish between the two.*

That's impossible for the time being. It's a matter of technology. The loudspeaker is the end of a chain. Even if you have very good tapes, analogue or digital, the sound will either be distorted as it passes through the speakers, or it will acquire a particular timbre which you can identify as that of the speaker. This is because speakers have a built-in colour; it can of course be improved, but it won't be easy.

Has this been worrying you at all?

Yes, of course. I know that the speaker has an unmistakable colour which is the speaker colour. Now there are good speakers and bad speakers. There are ones used for pop music where large volumes of sound are needed. The instruments they use and the voices are in the middle range anyway. In order to have power they introduce filtering which removes the high frequencies that ensure quality.

9 The Composer in Society

At the ending of István Szabó's film Mephisto, *based on Klaus Mann's novel of the same title, the actor Hendrik Höfgen, who is the main character (he was modelled on the actor Gustav Gründgens, a former friend of Mann's), is forced into a situation where he says, to save his skin: I'm only an actor! The star of Nazi Germany, for all his powers, now protests his insignificance in the social hierarchy.*

In April 1933, when Otto Klemperer appeared before a labour tribunal, he was eventually forced into a situation where he said: After all, I'm just a conductor. As in the film, Klemperer, a god in his own realm, protested his actual insignificance in the social hierarchy.

Could the same happen to a composer? Can anyone conceivably refer to a composer as 'only' that? What is his position in life? How seriously is he taken?

To cut it short: how do you see your role in society?

I can't see myself as having any role. I feel less and less optimistic about it. I think whatever one does can be taken for granted or rejected.

In the past, when sailing ships were plying the oceans, they would put a message in a bottle and throw it in the water to signal they were in distress. Eventually it would be found by somebody who would, hopefully, call for help. It is this role that art is called upon to play. Many artists fight each other, for power, money, recognition – but in the final analysis that is what it comes down to: you throw a bottle in the water and somebody picks it up.

It follows that what you are doing is only your concern – society shouldn't be involved. When you're trying to do something you should feel absolutely alone, like a spark in the blackness of the universe. That's all. You're all by yourself. This connects with what I said on a more philosophical level about originality. On the level of the individual, that's how he should feel when he is creating something.

I remember, in the early days, when I was trying to compose, I was very much in love with Bartók. The pieces I wrote sometimes bore traces of his influence. Slowly it dawned on me that I had to be much freer, much more individual.

Was that before Sacrifice*?*

Yes. I had to be different, otherwise it was no use. Bartók had done what he did much better than I could. I was also in love with Brahms but that didn't mean I had to compose like him. Equally, I've expressed my admiration for Varèse and people have jumped to the conclusion that I must be a pupil of his, or have been influenced by him. But I wasn't influenced by Brahms, at least not directly, or by Varèse. Because you admire something, it doesn't necessarily mean you resemble it. Imitation is an existential mistake. So, to escape from that trivial cycle of relationships in music, the musician, the artist, must be absolutely independent, which means absolutely alone. You must be convinced that you're doing what you must be doing, with the means at your disposal, at that particular time. If you had other means you'd be doing something different.

There may be a trend running through centuries and millennia more or less independently of local culture. Perhaps it explains how ideas invented thousands of years ago remain valid, in our beliefs, in our appreciation. Who knows what rules have kept these ideas alive and powerful. They may disappear temporarily to emerge again later. Egyptian art vanished with the Greek or Persian invasion in the fifth century BC and was rediscovered only in the nineteenth century. The so-called pagan art of antiquity came to light again in the Renaissance.

Figuratively speaking, when you are composing you lower a bucket into the well of your ideas. Aren't you afraid the well may one day go dry?

That happens every day. Is it worthwhile, what I'm doing? Will I make the right decisions? How do I know the answer to that? These are questions that I keep asking myself.

You told me earlier that your ideas emerge from your unconscious and that you have to decide if they're interesting or not. If they are, you keep them; if not, you push them right back where they came from. But what happens if the ideas stop coming?

Look. I made decisions in the past because I thought at the time they were necessary. I wasn't convinced they were new. This is again something you can't control: whether something is worthwhile or not. You must nevertheless go on working. This lack of stability is in fact one of the interesting aspects of composing [*laughs*].

Notes

1 Edouard Branly (1844–1940), French physicist and chemist.
2 Mikhail Mikhailovitch Ippolitov-Ivanov (1859–1935), Russian composer.
3 Galeazzo Ciano (1903–44), Italian Foreign Minister under Mussolini.
4 Ioannis Metaxas (1871–1941), Greek general, from 1936 Premier and Foreign Minister.
5 Le Corbusier, *Modulor 2, 1955 (Let the user speak next); Continuation of 'The Modulor', 1948*, translated by Peter de Francia and Anna Bostock. London: Faber and Faber, 1958, p. 326.
6 A hyperbolic paraboloid is a three-dimensional geometric shape, symmetrical about the *x*–*z* and *y*–*z* axes. The section of the surface by every plane parallel to the z axis is a parabola, and the section of the surface by every plane perpendicular to the z axis is a hyperbola. There are a number of ways to generate this surface, including translating a parabola that is convex downwards along a parabola that is convex upwards.
7 Iannis Xenakis, 'La crise de la musique sérielle', in *Gravesener Blätter*, vol. 1 (1955), pp. 2–4.
8 Matila Ghyka, *Geometry in Nature and Art*. Dover, 1978.
9 François-Bernard Mâche (born 1935), French composer.
10 Aristoxenos of Tarent (*c.*350 BC), Greek music theorist.
11 Werner Meyer-Eppler (1913–60), German physicist and phonetologist, joint founder in 1951 of the electronic studios of WDR (then NWDR). With others, he wrote the standard text book *The Basis and Applications of Information Theory*.
12 Friedrich Trautwein (1888–1956), German engineer, inventor of the Trautonium, an electronic instrument.
13 See A. M. Springer, 'Acoustical time regulator', in *Journal of the Acoustic Society of America*, vol. 29, no. 3 (1957), pp. 341–3. Springer's design of a multiple head rotating against the tape also made possible the alteration of the pitch while the tape speed remained constant.
14 Monodrama for soprano and orchestra (op. 17, 1909) by Arnold Schoenberg, with text by Marie Pappenheim.
15 See p. 107f.
16 See Bibliography.

17 Jean-Baptiste Joseph Fourier (1768–1830), French mathematician and physicist.
18 Herbert Eimert (1897–1972), German composer, founder in 1951 of the electronic studios at WDR (then NWDR), which he led until 1962.
19 'La ville cosmique', in *Musique. Architecture*, pp. 153–63.
20 Max Planck (1858–1947), German theoretical physicist, inventor of Quantum theory.
21 Ernst Mach (1838–1916), German physicist and philosopher.
22 During our Warsaw conversation Xenakis defined the word 'stochastic' as follows: 'The word comes from Greek and was first used in connection with the theory of probabilities by Jacques Bernoulli in the seventeenth century. What is probability? When something repeats itself, but not exactly. When we toss a coin, we already know that the result will be either heads or tails. When we toss it ten times, we can't say beforehand how often it will land on one side or the other; we only know that either one side or the other will land face up. When we repeat this many times and the coin is symmetrical, then the proportion of heads to tails approaches asymptotically the value of ½. It is therefore a matter of convergence, of your "meeting at a target point". That point is the *stochos*, that is to say, in the original meaning of the term, the "target". Today it has come to mean probability in general.'
23 'Aleatoric variable' or 'chance variable': a chance variable is a numerical function, the occurrence of which is assigned a numerical value. For example, we can define the chance variable of x when tossing the coin if we assign the occurrence of 'heads' the value of 1, and 'tails' the value of -1. Marie-Hélène Serra, 'Stochastic Composition and Stochastic Timbre: *Gendy3* by Iannis Xenakis', in *Perspectives of New Music*, no. 31 (1993).
24 See p. 107f.
25 Parmenides (*c.*500 BC), Greek philosopher.
26 Zeno has four paradoxes about motion. The second is known as 'Achilles' and posits a race between the athletic Achilles and the tortoise. It states that Achilles can never overtake the tortoise since he must first arrive at the point the tortoise has just left. By then the tortoise will have moved on a little, and therefore will always be slightly ahead.
27 Werner Heisenberg (1901–1976), German physicist, co-founder of the theory of quantum mechanics. The so-called 'uncertainty principle' that bears his name states that it is impossible to determine simultaneously both the exact position and exact momentum of an electron, and that therefore these values must be expressed as a probability. Classical Newtonian mechanics assumed that a physical

system can be kept under continuous observation without thereby disturbing it, but at the subatomic level there can be no measuring device that does not interfere with the location or velocity of particles.

28 Ludwig Eduard Boltzmann (1844–1906), Austrian physicist.

29 James Clerk Maxwell (1831–1879), British physicist.

30 Pierre Simon Marquis de Laplace (1749–1827), French mathematician and astronomer; Carl Friedrich Gauss (1777–1855), German mathematician, astronomer and physicist.

31 Denis Poisson (1781–1840), French mathematician and physicist.

32 A detailed description of this approach is given by Marie-Hélène Serra, 'Stochastic Composition and Stochastic Timbre: *Gendy3* by Iannis Xenakis', in *Perspectives of New Music*, no. 31 (1993).

33 Andrei Andreievitch Markov (1856–1922), Russian mathematician.

34 Noam Chomsky (born 1928), American linguistic theorist, lecturer since 1955 at the Massachusetts Institute of Technology. His theory of generative grammar laid the ground work for linguistic theory and computer theory.

35 Jean Piaget (1896–1980), Swiss psychologist. His study of the cognitive capacities of people was the foundation of modern teaching practice.

36 A quick succession of numerical samples of signal amplitude which can be stored in a digital recording medium, for example a CD.

37 George Boole (1815–1864), British mathematician.

38 The four properties are, in the order in which Xenakis describes them: 1, the set is completed by the opposite binary operation; 2, the operation is associative; 3, the neutral element in the operation is contained in the set; 4, for each element the corresponding inverse element is also contained in the set.

39 Literally, 'whose rotations cause parts of it to occupy the space of other parts'. Both formulations are logically equivalent.

40 Besides cubes and tetrahedrons, we find in *Nomos gamma* figures with sides of triangles and pentagrams.

41 See p. 118ff.

42 Brownian motion is the random movement observed among microscopic particles suspended in a fluid medium. The English botanist Robert Brown, who in 1927 observed such motion in colloids, thought it was due to living organisms. When the molecular-kinetic theory was developed in 1905 it became clear that it was due to the thermal agitation of the suspending medium. Smoke particles in air, for example, are bombarded on all sides by the high-speed air molecules, but statistical inequalities can produce motion observable under high-powered magnification.

43 'Chromatic' in the sense of 'equidistant'.

44 Heraclitus (*c.*500 BC), Greek philosopher.

45 Iannis Xenakis, *Antikhthon*, preface to the score.
46 See Iannis Xenakis, *Note sur la musique du Théâtre Antique* (1966–7), typescript in the archive of the Centre de Documentation de la Musique Contemporaine, Paris. See also p. 170ff.
47 In this context, an irreversible move to randomness.
48 A table that shows the gain and loss from every possible combination of tactics the two players employ.
49 It is a matter here, therefore, of a logarithm of base 3.
50 See Iannis Xenakis, *Musique. Architecture*, second edn, pp. 185–7. Reprinted in Xenakis, *Arts/Sciences. Alliages*, pp. 16–18.
51 A Greek word, but used in French.
52 See note 50.
53 This is UPIC, a system for composing by drawing lines on an electromagnetic table which converts the lines into music via a computer. It was developed at CEMAMu during the 1980s.
54 The latest version of UPIC works in real-time, see p. 194ff.
55 Institut de Recherches et Coordination Acoustique–Musique.
56 Françoise Xenakis, *Moi, J'Aime pas la Mer*. Paris: Gallimard.
57 Euclid (*c.*300 BC), Greek mathematician.
58 See also Simha Arom, 'Du pied à la main: les fondements métriques traditionnels d'Afrique Centrale', in *Analyse musicale*, Spring 1988.
59 See Bibliography.
60 Iannis Xenakis, 'Auf der Suche nach einer Stochastischen Musik', in *Gravesaner Blätter* vol. 3, no. 11–12 (1958), pp. 98–111.
61 See p. 118ff.
62 See note 53.
63 Françoise Xenakis, *Ecoute*. Paris: Gallimard, 1972
64 Harry Halbreich, *De 'Cendrées' à 'Waarg'. Quinze ans de création*, reprinted in Enzo Restagno, *Xenakis*, p. 153ff.
65 Xenakis is apparently referring to the violin solo in bars 123–5.
66 *Khoaï* has now been recorded, along with *Komboï*, *A l'Ile de Gorée* and *Naama* by Elisabeth Chojnacka (see Discography).
67 See p. 199ff.
68 'The interpretation must avoid all expression of sentiment, because there is a great danger of imposing clichés on Aeschylus's text.' From the score.
69 There were, in fact, two Greek freedom fighters of that name: Alexander (1792–1828) and Demetrios (1793–1832).
70 Alberto Burri (1915–95), Italian painter.
71 Henning Lohner, 'Interview with Iannis Xenakis', *Computer Music Journal*, vol. 10, no. 4 (winter 1986), pp. 48–53.
72 A common process of sound synthesis which consists of several frequency-controlled tone-generators.
73 See Gérard Marino, Jean-Michel Raczinski, Marie-Hélène Serra, 'The

new UPIC system', in *Proceedings of the International Computer Music Conference Glasgow*, 1990. Reprinted in Iannis Xenakis, *Formalized Music*, revised edn, pp. 329–34.

74 Four electronic engineers and programmers are working at the CEMAMu Centre: Jean-Michel Radzinski, Gérard Marino, Marie-Hélène Serra and Fabrice Arnaud.

75 Le Corbusier, *The Modulor*, London: Faber, 1954. Quoted in Donald Mitchell, *The Language of Modern Music*, London: Faber, 1963, pp. 14–15.

76 See note 64.

77 Iannis Xenakis, 'Sur le temps', in *Redécouvrir le Temps*, no. 1–2. Editions de l'Université de Bruxelles, 1988, pp. 193–200. English translation 'Concerning Time', in *Perspectives of New Music*, 27 (1989), pp. 84–92. Revised version, 'Concerning time, space and music', in Xenakis, *Formalized Music*, revised edition, pp. 255–67.

78 See Bruno Suner, *Cité de la Musique. Construire à l'oreille. Vérification d'une hypothèse*, URBA 206 (March 1985).

79 Gaspard Gustave Coriolis (1792–1843), French physicist. The acceleration named after him may be observed in bodies moving relative to a frame of reference (such as the earth). An example of this is Foucault's pendulum, which is diverted from its regular swing by the rotation of the earth.

80 Christian Doppler (1803–1853), Austrian physicist and mathematician.

81 Péter Eötvös (born 1944), Hungarian composer and conductor; from 1979 to 1992 he was music director of the Ensemble InterContemporain.

Chronological List of Compositions

The following catalogue is based on the work list from Editions Salabert, Paris, 1993, in which, with the exception of correspondingly indicated early works, all compositions of Xenakis are listed. This version was produced with the assistance of Radu Stan as well as Michael Rohn. A detailed documentation of works up to 1986 is given by Henning Lohner in Heinz-Klaus Metzger and Rainer Riehn (eds), *Xenakis* (see Bibliography). Revised version by Henrietta Brougham.

Unless indicated otherwise, all works are published by Editions Salabert, Paris. 1,1,1,1–1,1,1,1, etc. indicates the numbers of woodwind and brass instruments in the following order: flute, oboe, clarinet, bassoon – horn, trumpet, trombone, tuba. The number of string instruments required is indicated in the order: first violin, second violin, viola, cello, double bass (1,1,1,1,1), etc.

Further abbreviations used in the catalogue and discography are listed below:

afl	alto flute	ob	oboe
bar	baritone	perc	percussion
bcl	bass clarinet	pf	piano
bfl	bass flute	pic	piccolo flute
bn	bassoon	ptpt	piccolo trumpet
ca	cor anglais	sax	saxophone
cbn	contrabassoon	sop	soprano
ccl	contrabass clarinet	timp	timpani
cl	clarinet in A or B flat	tpt	trumpet
ctrb	contra-bass trombone	trb	trombone
ctu	contra-bass tuba	tba	tuba
db	double bass	va	viola
dir.	director or conductor	vc	cello
ecl	E flat clarinet	vn	violin
fl	flute	wb	woodblock
hn	horn	xyl	xylophone
hp	harp	+	doubling
hpscd	harpsichord		

1 *Zyia* 1952
For soprano, men's choir (ten minimum), flute and piano

Duration: *c.*12′
First performed: 5 April 1994, Festival Musique Contemporaine d'Evreux; Les Jeunes Solistes, dir. Rachid Safir
Text based on traditional Greek verse

2 *Le Sacrifice (Anastenaria)* 1952–3
For orchestra, 1(+pic),1(+ca),1(+bcl),1(+cbn)–2,2,1,1, timp, 3perc, pf, strings (8,8,6,6,4)
Duration: 5′
(Withdrawn)

3 *Metastasis* 1953–4
For orchestra of 60 musicians: 2(+pic),2,1(+bcl),0–3,2,2,0, timp, perc, strings (12,12,8,8,6)
Duration: 7′
First performed: 16 October 1955, Donaueschingen Festival; Südwestfunkorchester, dir. Hans Rosbaud
Publisher: Boosey & Hawkes
CD 6

4 *Pithoprakta* 1955–6
For orchestra of 49 musicians: 2 tbn, perc (xyl, wb), strings (12,12,8,8,6)
Duration: 10′
First performed: 8 March 1957, Munich, Festival Musica Viva; Sinfonieorchester des Bayerischen Rundfunks, dir. Hermann Scherchen
Publisher: Boosey & Hawkes
CD 6

5 *Achorripsis* 1956–7
For ensemble of 21 musicians: 1(+pic),1,2(+ecl;+bcl),2(+cbn)–0,2,1,0, 3perc, strings (3,0,0,3,3)
Duration: 7′
First performed: 20 July 1958, Buenos Aires, Colón Theatre; Colón Theatre Orchestra, dir. Hermann Scherchen
Publisher: Bote & Bock

6 *Diamorphoses* 1957
For four-channel tape. Created at GRM (Groupe de Recherches Musicales), Paris
Duration: 7′
First performed: 5 October 1958, Brussels

7 *Concret PH* 1958
For two-channel tape. Created at GRM (Groupe de Recherches Musicales), Paris
Duration: 2′45″
First performed: 1958, Brussels, Philips Pavillion

8 *Syrmos* 1959

For string orchestra (6,6,0,4,2 or double)
Duration: 14′
First performed: 20 May 1969, Paris; Ensemble Instrumental de Musique Contemporaine, dir. Konstantin Simonovitch

9a *Analogique A* 1958
For string ensemble (3,0,0,3,3). Must be played with *Analogique B*
Duration: 7′
First performed: 1959, Gravesano Festival; Festival Orchestra, dir. Hermann Scherchen

9b *Analogique B* 1959
For four-channel tape, must be played with *Analogique A*. Created at GRM (Groupe de Recherches Musicales), Paris
Duration: 7′
First performed: 1959, Gravesano Festival; dir. Hermann Scherchen

10 *Duel* 1959
Game for 56 musicians divided in two orchestras with two conductors: 2(+2pic),2,4(+2ecl;+2bcl),4(+2cbn)–0,4,2,0, 2perc, strings (12,12,0,8,4)
Duration: variable, *c.*10′
First performed: 18 October 1971, Hilversum; Radio Orchestra, dirs. Diego Masson and Fernand Terby

11 *Orient–Occident* 1960
For two-channel tape. Music for Enrico Fulchignoni's film of the same name. Created at GRM (Groupe de Recherches Musicales), Paris
Duration: 12′
First performed: May 1960, Cannes

12 *Vasarely* 1960
For tape. Music for film by P. Kassowitz and E. Szabo for the Exposition Vasarely
Duration: ?
First performed: 1960, Paris
(Withdrawn)

13 *Formes Rouges* 1961
For seven musicians. Music for film by P. Kamler
Duration: 5′
First performed: 1961, Paris
(Withdrawn)

14 *ST/4 (ST/4–1,080262)* 1956–62
For string quartet
Duration: 11′
First performed: 1962, Paris; Quatuor Bernède
Publisher: Boosey & Hawkes
CD 3

15 *Herma* 1960–61
For solo piano
Duration: 10′
First performed: 2 February 1962, Tokyo; Yuji Takahashi
Publisher: Boosey & Hawkes
CD 3, 20

16 *Morsima–Amorsima (ST/4–1,030762)* 1962
For piano, violin, cello and double bass
Duration: 11′
First performed: 16 December 1962, Athens; ensemble dir. Lukas Foss
Publisher: Boosey & Hawkes

17 *Amorsima–Morsima (ST 10–2,080262)* 1962
For ensemble of ten musicians: fl, cl, bcl, hn, tpt, perc, strings (1,1,1,1,0)
Duration: ?
First performed: 16 December 1962, Athens; ensemble dir. Lukas Foss
Withdrawn

18 *ST/10 (ST 10–1,080262)* 1962
For ensemble of ten musicians: cl, bcl, 2 hn, hp, perc, strings (1,1,1,1,0)
Duration: 12′
First performed: May 1962, Paris, IBM, Place Vendôme; Ensemble Instrumental de Musique Contemporaine, dir. Konstantin Simonovitch
Publisher: Boosey & Hawkes

19 *Atrées (ST 10–3, 060962 – Hommage à Blaise Pascal)* 1956–62
For ensemble of eleven musicians: fl, cl, bcl, hn, tpt, tbn, 3 perc, vn, vc
Duration: 15′
First performed: 28 June 1962, Paris; Ensemble Instrumental de Musique Contemporaine, dir. Konstantin Simonovitch

20 *ST/48 (ST/48–1,240162)* 1962
For orchestra of 48 musicians: 2(+pic),2,2(+bc)l,2(+cbn)–2,2,2,0, timp, perc, strings (8,8,6,6,4)
Duration: 11′
First performed: 1968, Paris; Orchestre National de l'ORTF, dir. Lukas Foss
Publisher: Boosey & Hawkes

21 *Bohor* 1962
For eight- or four-channel tape. Created at GRM (Groupe de Recherches Musicales), Paris
Duration: 21′30″
First performed: 15 December 1962, Paris, Salle de l'ancien Conservatoire

22 *Stratégie* 1962
Game for 82 musicians divided in two orchestras with two conductors: 4(+2pic),4,6(+2ecl;+2bcl),4(+2cbn)–4,4,4,2, 4perc, strings (12,12,8,8,6)
Duration: variable, from 10′ to 30′
First performed: 25 April 1963, Venice Biennale; Festival Orchestra, dir. Bruno Maderna and Konstantin Simonovitch
Publisher: Boosey & Hawkes
CD 43

23 *Polla ta Dhina* 1962
For children's choir (twenty voices) and orchestra of 48 musicians: 2(+pic),2,2(+bcl),2(+cbn)–2,2,2,0, timp, perc, strings (8,8,6,6,4)
Duration: 6′
First performed: 25 October 1962, Stuttgart; Südfunk Symphonieorchester, dir. Hermann Scherchen
Texts: *Antigone* by Sophocles
Publisher: Edition Modern

24 *Eonta* 1963
Sextet for piano and brass quintet (2 tpt, 3 t tbn)
Duration: 18′
First performed: 16 December 1964, Paris; Domaine Musical, Ensemble de Domaine Musical, Yuji Takahashi (pf), dir. Pierre Boulez
Publisher: Boosey & Hawkes
CD 5, 6, 19, 48

25 *Hiketides (Les Suppliantes d'Eschyle)* 1964
Instrumental suite for brass (2 tpt, 2 tbn) and strings (6,6,0,8,4 or multiples). Initially written for 50 voice women's choir and 2 tpt, 2 tbn, strings (2,2,2,2,2)
Duration: 10′
First performed: July/August 1964, Epidaurus; Ensemble of the Greek National Theatre

26 *Akrata* 1964–5
For sixteen wind instruments: fl (+pic), ob, 3 cl (+ecl;+bcl;+ccl), 3 bn (+2cbn), 2 hn, 3 tpt, 2 tbn, tba
Duration: 11′
First performed: 28 June 1966, St Catherine's College Hall, Oxford, English Bach Festival; Ensemble Instrumental de Musique Contemporaine de Paris, dir. Charles Bruck
Publisher: Boosey & Hawkes

27 *Nomos Alpha* 1966
For solo cello
Duration: 17′
First performed: 5 May 1966, Bremen; Siegfried Palm

Publisher: Boosey & Hawkes
CD 3, 8

28 *Terretektorh* 1965–6
For orchestra of 88 musicians dispersed among the audience: 3(+pic),3,3(+ecl;+bcl),3(+cbn)–4,4,4,1, 3perc, strings (16,14,12,10,8). Each musician also has wb, whip, maracas, siren
Duration: 18′
First performed: 3 April 1966, Royan Festival; Orchestre Philharmonique de l'ORTF, dir. Hermann Scherchen

29 *Oresteïa* 1965–6
Music drama for children's choir, mixed choir (eighteen men and eighteen women minimum) and ensemble: 1(+pic),1,2(+ecl;+ccl),1(+cbn)–1,1(+ptpt),1,1, perc, vc. Must be performed with solo sections *Kassandra* (1987) and *La Déesse Athéna* (1992), listed separately
Duration: 60′
First performed: 14 June 1966, Ypsilanti (Michigan, USA); Greek Theatre Choir and Ensemble, dir. Konstantin Simonovitch. Version for mixed choir and chamber orchestra first performed 8 December 1967, Paris; dir. Konstantin Simonovitch
Texts from Aeschylus' trilogy: *Agamemnon, Choëphori* and *Eumenides*
Publisher: Boosey & Hawkes
CD 12

30 *Nuits* 1967
For twelve unaccompanied solo voices or mixed choir
Duration: 12′
First performed: 7 April 1968, Royan Festival; Soloists of the ORTF Choir, dir. Marcel Couraud
Phonemic text

31 *Polytope de Montréal* 1967
Installation of light and sound, with four identical orchestras, each comprising fifteen musicians: fl (+pic), 2 cl (+ecl;+ccb), bn (+cbn), tpt, tbn, perc, 4vn, 4vc
Duration: 6′
First performed: 1967, Montreal, Pavillon Français de l'Exposition Universelle; Ensemble Instrumental de Musique Contemporaine, dir. Konstantin Simonovitch
Publisher: Boosey & Hawkes

32 *Medea–Senecae* 1967
Stage music for men's choir (also playing rhythms on pebbles) and five instrumentalists: cl, bn (+cbn), tbn, perc, vc. Stage designer, Jorge Lavelli
Duration: 25′

First performed: 29 March 1967, Paris; Compagnie de l'Odéon-Théâtre de France, dir. Diego Masson
Text by Seneca

33 *Nomos Gamma* 1967–8
For orchestra of 98 musicians dispersed among the audience: 3(+pic),3,3(+ecl;+bcl),5(+3cbn)–6,5,4,1, timp, 7perc, strings (16,14,12,10,8)
Duration: 15′
First performed: 4 April 1969, Royan Festival; Orchestre Philharmonique de l'ORTF, dir. Charles Bruck

34 *Kraanerg* 1968–9
Ballet music for orchestra and four-channel tape: 1(+pic),1,2(+ecl;+ccl),1(+cbn)–2,2,2,0, strings (3,3,2,2,2 or multiples).
Choreography, Roland Petit; stage design, Victor Vasarely
Duration: 75′
First performed: 2 June 1969, Ottawa, inauguration of the National Arts Centre; National Ballet Guild of Canada, dir. Lukas Foss
Publisher: Boosey & Hawkes
CD 10

35 *Persephassa* 1969
For six percussionists
Duration: 24′
First performed: 9 September 1969, Persepolis; Shiraz Festival (Iran), Percussions de Strasbourg
CD 13

36 *Anaktoria* 1969
For ensemble of eight musicians: cl, bn (+cbn *ad lib*), hn, 2 vn, vla, vc, db
Duration: 11′
First performed: 3 July 1969, Avignon Festival; Octuor de Paris

37 *Synaphaï* 1969
For solo piano and orchestra: 3,3,3,3–4,4,4,1 3perc, strings (16,14,10,10,8)
Duration: 14′
First performed: 6 April 1971, Royan Festival; Georges Pludermacher (pf), Orchestre de l'ORTF, dir. Michel Tabachnik

38 *Hibiki Hana Ma* 1969–70
For eight-channel tape. Created at NHK, Tokyo
Duration: 18′
First performed: 1970, Osaka, Expo

39 *Mikka* 1971
For solo violin
Duration: 4′
First performed: 27 October 1972, Paris; Musée d'Art Moderne, Ivry Gitlis

CD 3

40 *Charisma* 1971
For clarinet and cello
Duration: 4′
First performed: 16 April 1971, Royan Festival; Guy Deplus and Jacques Wiederker
CD 18

41 *Persepolis* 1971
For light and sound (:eight-channel tape). Created at Studio Acousti, Paris
Duration: 56′
First performed: 6 August 1971, Persepolis; Shiraz Festival (Iran)

42 *Antikhthon* 1971
Ballet music for 86 or 60 musicians: 3(+pic),3,3,3(+cbn)–4,3,3,1, timp, 2perc, strings (16,14,12,10,8) or (10,8,6,6,4)
Duration: 23′
First performed: 21 September 1974, Bonn, Xenakis Festival; dir. Michel Tabachnik

43 *Aroura* 1971
For string ensemble (4,3,2,2,1 or multiples)
Duration: 12′
First performed: 24 August 1971, Lucerne Festival; Festival Ensemble, dir. Rudolf Baumgartner

44 *Linaia–Agon* 1972
Game music for tpt, tbn and tba
Duration: variable
First performed: 26 April 1972, London, English Bach Festival

45 *Polytope de Cluny* 1972
Installation of light and sound; eight- or four-channel tape. Created at Studio Acousti, Paris
Duration: 24′
First performed: first version, 13 October 1972, Paris, Musée de Cluny; second version, *Polytope II de Cluny*: 17 October 1972

46 *Evryali* 1973
For solo piano
Duration: 11′
First performed: 23 October 1973, New York, Lincoln Centre; Marie-Françoise Bucquet
CD 3, 20

47 *Cendrées* 1973
For mixed choir of 72 voices (or 36 minimum) and orchestra: 2(+pic),2,2(+bcl),2–2,2,2,1, strings (16,14,10,10,8)
Duration: 25′
First performed: 20 June 1974, Lisbon; Choir and Orchestra of the

Gulbenkian Foundation, dir. Michel Tabachnik
Phonemic text by Iannis Xenakis

48 *Eridanos* 1972
For orchestra of 68 musicians: 0,0,0,0–2,2,2,2, strings (16,14,12,10,8)
Duration: 11′
First performed: 13 April 1973, La Rochelle Festival; Ensemble Européen de Musique Contemporaine, dir. Michel Tabachnik

49 *Gmeeoorh* 1974
For organ (of 61 or 56 notes)
Duration: 20′
First performed: 1972, Hartford University, Connecticut, International Contemporary Organ Music Festival; Clyde Holloway

50 *Noomena* 1974
For orchestra of 103 musicians: 4(+pic),4(+ca),5(+ecl;+bcl),4(+cbn)–6,5,4,1, strings (18,16,14,12,10)
Duration: 17′
First performed: 16 October 1974, Paris; Orchestre de Paris, dir. Sir Georg Solti

51 *Erikhthon* 1974
For solo piano and orchestra: 3(+pic),3,4(+bcl),4,cbn–4,4,4,1, perc, strings (16,14,12,10,8)
Duration: 15′
First performed: 21 May 1974, Paris; Claude Helffer (pf), Orchestre de l'ORTF, dir. Michel Tabachnik

52 *Psappha* 1975
For solo percussion
Duration: 13′
First performed: 2 May 1976, London, English Bach Festival; Sylvio Gualda
CD 37, 38, 39, 40, 41

53 *N'Shima* 1975
For two mezzo-sopranos (or altos) and five musicians: 2hn, 2tbn, vc
Duration: 17′
First performed: February 1976, Jerusalem; voices and ensemble of the Testimonium Festival, dir. Juan-Pablo Izquierdo
Hebrew words and phonemic text by Iannis Xenakis
CD 32, 48

54 *Phlegra* 1975
For ensemble of eleven musicians: fl (+pic), ob, cl (+bcl), bn, hn, tpt, tbn, vn, vla, vc, db
Duration: 14′
First performed: 28 January 1976, London, Queen Elizabeth Hall; London Sinfonietta, dir. Michel Tabachnik
CD 8

55 *Empreintes* 1975
For orchestra of 85 musicians: 3(+pic),3(+ca),3(+ecl;+bcl),3(+cbn)–4,4,4,1, strings (16,14,12,10,8)
Duration: 12′
First performed: 29 June 1975, La Rochelle Festival; Netherlands Radio Philharmonic Orchestra, dir. Michel Tabachnik

56 *Theraps* 1975–6
For solo double bass
Duration: 11′
First performed: 26 March 1976, Royan Festival; Fernando Grillo
CD 44

57 *Khoaï* 1976
For solo harpsichord
Duration: 15′
First performed: 5 May 1976, Cologne, Westdeutscher Rundfunk; Elisabeth Chojnacka
CD 9

58 *Mikka 'S'* 1976
For solo violin
Duration: 5′
First performed: 11 March 1976, Semaines Musicales d'Orléans; Régis Pasquier
CD 3

59 *Dmaathen* 1976
For oboe and percussion
Duration: 10′
First performed: May 1977, New York, Carnegie Hall; Nora Post and Jan Williams

60 *Epeï* 1976
For sextet: ob (+ca), cl, tpt, 2 tbn, db
Duration: 13′
First performed: 9 December 1976, Montreal; Ensemble de la Société de Musique Contemporaine de Québec, dir. Serge Garant
CD 2

61 *Retours–Windungen* 1976
For twelve cellos
Duration: 8′
First performed: 20 February 1976, Bonn; twelve cellists of the Berlin Philharmonic Orchestra
CD 42

62 *Kottos* 1977
For solo cello
Duration: 8′
First performed: 28 June 1977, La Rochelle Festival, for the

Rostropovitch International Cello Competition
CD 3, 27, 28, 29

63 *La Légende d'Eer* and *Le Diatope* 1977
Eight-channel tape (*La Légende d'Eer*) and composition for light (*Le Diatope*) for the Diatope installation. Created at CEMAMu, Paris, and WDR, Cologne
Duration: 14'48"
First performed: 11 February 1978, Paris, for the inauguration of the Georges Pompidou Centre
CD 11

64 *Akanthos* 1977
For soprano and eight musicians: fl (+pic;+afl), cl (+bcl), pf, 2 vn, vla, vc, db
Duration: 11'
First performed: 17 June 1977, Strasbourg; Ensemble Studio 111
Phonemic text by Iannis Xenakis
CD 2, 48

65 *A Hélène* 1977
For unaccompanied solo women's voices or women's choir (or men's choir)
Duration: 10'
First performed: July 1977, Epidaurus Theatre; Choir of the National Theatre of Greece
Texts taken from *Helen* by Euripides

66 *A Colone* 1977
For choir (men or women, twenty voices minimum) and eighteen instrumentalists: 5 hn, 3 tbn, 6 vc, 4 db
Duration: 14'
First performed: 19 November 1977, Metz, Rencontres Internationales de Musique Contemporaine
Texts from *Oedipus at Colonus* by Sophocles

67 *Jonchaies* 1977
For orchestra of 109 musicians:
4(+2pic),4(+2ca),6(+ecl;+2bcl;+ccl),4(+2cbn)–6,4,4,1(ctb), timp, 5perc, strings (18,16,14,12,10)
Duration: 17'
First performed: 21 December 1977, Paris; Orchestre National de France, dir. Michel Tabachnik
CD 23

68 *Ikhoor* 1978
For string trio (vn, va, vc)
Duration: 11'
First performed: 2 April 1978, Paris, Palais Garnier; Le Trio à Cordes Français (Gérard Jarry, Serge Collot, Michel Tournus)

CD 3, 21

69 *Mycènes Alpha* 1978
For two-channel tape. Created on the UPIC at CEMAMu, Paris, for the light and sound installation at Mycene
Duration: 10′
First performed: 2 August 1978, Mycène

70 *Dikhthas* 1979
For violin and piano
Duration: 12′
First performed: 4 June 1980, Bonn, Beethoven Festival; Salvatore Accardo and Bruno Canino
CD 2, 3

71 *Pléïades* 1978
For six percussionists
Duration: 46′
First performed: 17 May 1979, Strasbourg; Les Percussions de Strasbourg
CD 7, 13, 14, 15, 16, 17

72 *Palimpsest* 1979
For ensemble of eleven musicians: ob (+ca), cl (+bcl), bn, hn, perc, pf, strings (1,1,1,1,1)
Duration: 11′
First performed: 3 March 1979, Aquila, Italy; Divertimento Ensemble, dir. Sandro Gorli
CD 2, 5

73 *Anemoessa* 1979
For mixed choir of 82 voices (or 42 minimum) and orchestra of 90 musicians: 4(+pic),4,4,4(+cbn)–4,4,4,1, perc, strings (16,14,12,10,8)
Duration: 15′
First performed: 21 June 1979, Holland Festival; Amsterdam Concertgebouw, Radio Hilversum Orchestra, dir. Richard Dufallo
Phonemic text

74 *Aïs* 1979
For amplified baritone, solo percussion and orchestra of 92 musicians: 4(+pic),4(+ca),4(+ecl),4(+cbn)–4,4,4,1, timp, perc, pf, strings (16,14,12,10,8)
Duration: 17′
First performed: 13 February 1981, Munich; Spyros Sakkas (ba), Sylvio Gualda (perc), Sinfonieorchester des Bayerischen Rundfunks, dir. Michel Tabachnik
Texts from Homer's *Iliad* and *Odyssey*, and from Sappho
CD 1

75 *Embellie* 1981
For solo viola

Duration: 7′
First performed: 1981, Paris; Geneviève Renon-McLaughlin
CD 3

76 *Mists* 1981
For solo piano
Duration: 12′
First performed: August 1981, Edinburgh Festival; Roger Woodward
CD 3, 31

77 *Pour la Paix* 1981
Four versions: I, unaccompanied mixed choir (32 voices minimum); II, mixed choir, four reciters (two men, two women) and stereo tape; III, four reciters and stereo tape (choir and electro-acoustic music pre-recorded); IV, stereo tape only (combining choir, reciters and electro-acoustic music)
Duration: I, 10′; II, III and IV, 26′45″
First performed: 23 April 1982, Radio France Studio 104, Paris; Danielle Delorme, Françoise Xenakis, Philippe Bardy and Maxens Maylfort (reciters), choir of Radio France, dir. Michel Tranchant
Text from *Écoute* and *Les Morts Pleureront* by Françoise Xenakis (English version by Nouritza Matossian), and phonemic text by Iannis Xenakis

78 *Komboï* 1981
For harpsichord and percussion
Duration: 17′
First performed: 22 November 1981, Metz, Festival de Rencontres Internationales de Musique Contemporaine; Elisabeth Chojnacka (hpscd), Sylvio Gualda (perc)
CD9

79 *Serment–Orkos* 1981
For unaccompanied mixed choir (32 voices minimum)
Duration: 7′
First performed: 1981, Athens; Choir of Radio Greece
Text by Hippocrates

80 *Nekuïa* 1981
For mixed choir of 80 voices (or 54 minimum) and orchestra of 89 musicians: 4(+pic),4,4,4(+cbn)–6,4,4,1, timp, 3perc, 2hp, pf, strings (16,14,12,10,8)
Duration: 26′
First performed: 26 March 1982, Cologne; Kölner Rundfunk–Symphonieorchester/Kölner Rundfunkchor, dir. Michel Tabachnik
Phonemic text and extracts from *Siebenkäs* by Jean-Paul Richter and *Écoute* by Françoise Xenakis

81 *Pour Maurice* 1982

For baritone and piano
Duration: 4′
First performed: 18 October 1982, Brussels, Festival Europalia; Spyros Sakka (ba) and Claude Helffer (pf)
Phonemic text

82 *Pour les Baleines* 1982
For large string orchestra (16,14,12,10,8)
Duration: 2′30″
First performed: 2 December 1983, Semaines Musicales d'Orléans; Orchestre Colonne, dir. Diego Masson

83 *Tetras* 1983
For string quartet
Duration: 16′
First performed: 8 June 1983, Lisbon; Arditti String Quartet
CD 3

84 *Khal Perr* 1983
For brass quintet and percussion: hn, 2 tpt (+2 ptpt), tbn, tba, 2 perc
Duration: 10′30″
First performed: 15 July 1983, Hospices de Beaune; Quintette Arban and Alsace Percussions

85 *Chant des Soleils* 1983
For mixed choir, childrens' choir, brass (6,6,6,0 or multiples) and percussion
Duration: 8′
First performed: 21 June 1983: simultaneously in several towns in the Nord-Pas-de Calais region, France
Texts by Xenakis after Peletier du Mans, sixteenth century

86 *Shaar* 1983
For large string orchestra (16,14,12,10,8)
Duration: 14′
First performed: 3 February 1983, Tel Aviv; Jerusalem Sinfonietta, dir. Juan-Pablo Izquierdo

87 *Lichens I* 1983
For orchestra of 96 musicians: 4(+pic),4(+ca),4,3(+cbn)–4,4,6(+2ctbn),1(+ctba), timp, 4perc, pf, strings (16,14,12,10,8)
Duration: 16′
First performed: 16 April 1984; Orchestre Philharmonique de Liège, dir. Pierre Bartholomée

88 *Naama* 1984
For solo harpsichord
Duration: 16′
First performed: 20 May 1984, Luxembourg; Elisabeth Chojnacka
CD 9

89 *Thalleïn* 1984

For ensemble of fourteen musicians: 1(+pic),1,1,1–1,1(+ptpt),1,0, perc, pf, strings (1,1,1,1,1)
Duration: 17′
First performed: 14 February 1984, London; London Sinfonietta, dir. Elgar Howarth
CD 1, 8

90 *Nyûyô (Soleil couchant)* 1985
For four musicians: shakuhachi, sangen and two kotos
Duration: 11′
First performed: October 1985, Angers Festival; Yonin-No-Kaï Ensemble of Tokyo

91a *Idmen A* 1985
For mixed choir (64 voices minimum) and four percussionists (variety of mallet or skinned instruments). *Idmen A* may be performed with *Idmen B*
Duration: 14′
First performed: 24 July 1985, Strasbourg; Europa Cantat Strasbourg and Les Percussions de Strasbourg
Phonemic text from *Theogony* by Hesiod
CD 7

91b *Idmen B* 1985
For six percussionists and optional choir (see *Idmen A*). *Idmen B* may be performed with *Idmen A*
Duration: 13′30″
First performed: 24 July 1985, Strasbourg; Europa Cantat Strasbourg and Les Percussions de Strasbourg
Phonemic text from *Theogony* by Hesiod
CD 7

92 *Alax* 1985
For thirty musicians divided into three ensembles: 3,0,3,0–6,0,3,0, 3hp, 3perc, 3vn, 6vc
Duration: 22′
First performed: 15 September 1985, Cologne; Westdeutscher Rundfunk, Ensemble Modern (Frankfurt), Köln Ensemble, Gruppe für Neue Musik Hanns Eisler (Leipzig), dir. Ernest Bour

93 *Akea* 1986
For piano and string quartet
Duration: 12′
First performed: 15 December 1986, Paris, Festival d'Automne; Claude Helffer and Arditti String Quartet
CD 3, 4

94 *A l'Ile de Gorée* 1986
For amplified solo harpsichord and ensemble: 1(+pic),1,1,1–1,1,1,0, strings (1,1,1,1,1)

Duration: 14′
First performed: 4 July 1986, Amsterdam; Elisabeth Chojnacka, Xenakis Ensemble, dir. Huub Kerstens
CD 9

95 *Keren* 1986
For solo trombone
Duration: 6′
First performed: 19 September 1986, Festival Musica Strasbourg; Benny Sluchin
CD 8, 24, 25

96 *Keqrops* 1986
For solo piano and orchestra of 92 musicians: 4,4,4(+bcl),4(+cbn)–4,4,4, 1hp, timp, perc, strings (16,14,12,10,8)
Duration: 17′
First performed: 31 November 1986, New York, Lincoln Centre; Roger Woodward, New York Philharmonic Orchestra, dir. Zubin Mehta

97 *Horos* 1986
For orchestra of 89 musicians: 4,4,4,4–4,4,4,0, perc, strings (16,14,12,10,8)
Duration: 16′
First performed: 24 October 1986, inauguration of Santory Hall, Tokyo; The Japan Philharmonic Orchestra, dir. Hiroyuki Iwaki

98 *Jalons* 1986
For ensemble of fifteen musicians: 1(+pic),1,2(+bcl;+ccl),1(+cbn)–1,1,1,1, hp, strings (1,1,1,1,1)
Duration: 15′
First performed: 26 January 1987, Paris, Théâtre de la Ville, for the tenth anniversary of the Ensemble InterContemporain, dir. Pierre Boulez
CD 8, 22

99 *XAS* 1987
For saxophone quartet (S,A,T,Bar)
Duration: 9′
First performed: 17 November 1987, Lille; Raschèr Quartett
CD 45, 46, 47

100 *A.r. (Hommage à Ravel)* 1987
For solo piano
Duration: 3′
First performed: 2 August 1987, Festival International de Radio France et de Montpellier; Håkon Austbö
CD 3

101 *Ata* 1987
For orchestra of 89 musicians: 4,4,4,4–4,4,4,0, perc, strings

(16,14,12,10,8)
Duration: 16′
First performed: 3 May 1988, Baden-Baden, Sinfonieorchester des Südwestfunks Baden-Baden, dir. Michael Gielen

102 *Tracées* 1987
For orchestra of 94 musicians: 4,4,4,4–4,4,4,1, timp, 3perc, pf, strings (16,14,12,10,8)
Duration: 6′
First performed: 17 September 1987, Paris; Orchestre National de Lille, dir. Jean-Claude Casadesus

103 *Kassandra* 1987
Second part of *Oresteïa*, but may be performed separately. For amplified baritone also playing a twenty-string psaltery and percussionist
Duration: 14′
First performed: 21 August 1987, Gibellina, Italy; Spyros Sakkas and Sylvio Gualda
Texts by Aeschylus
CD 12

104 *Taurhiphanie* 1987
For two-channel tape. Music created on the UPIC at CEMAMu, Paris
Duration: 10′45″
First performed: 13 July 1988, the Arena at Arles; Festival International de Radio France et de Montpellier
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105 *Rebonds* 1988
For solo percussion
Duration: 8′
First performed: 1 July 1988, Festival Roma Europa, Villa Medici; Sylvio Gualda
CD 4, 41, 48

106 *Waarg* 1988
For ensemble of thirteen musicians: 1(+pic),1,1,1–1,1,1,1, strings (1,1,1,1,1)
Duration: 16′
First performed: 6 May 1988, London, Queen Elizabeth Hall; London Sinfonietta, dir. Elgar Howarth
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107 *Echange* 1989
For solo bass clarinet and ensemble: 1,1,1,1–1,1,1,1, strings (1,1,1,1,1)
Duration: 14′
First performed: 26 April 1989, Amsterdam; Harry Sparnaay, ASKO Ensemble, dir. David Porcelijn
CD 5

108 *Epicycle* 1989
For solo cello and ensemble: 1,1,1,1–1,1,1,1, strings (1,1,1,0,1)
Duration: 12′
First performed: 18 May 1989, London, Greek Festival; Rohan de Saram, Spectrum, dir. Guy Protheroe
CD 4

109 *Okho* 1989
For three percussionists playing three djembe and one large African drum
Duration: 13′30″
First performed: 20 October 1989, Paris, Festival d'Automne, Opéra Comique; Trio Le Cercle (Willy Coquillat, Jean-Pierre Drouet, Gaston Sylvestre)
CD 35

110 *Oophaa* 1989
For harpsichord and percussion
Duration: 9′
First performed: 17 September 1989, Warsaw Autumn Festival; Elisabeth Chojnacka (hpscd) and Sylvio Gualda (perc)
CD 36

111 *Voyage absolu des Unari vers Andromède* 1989
For two-channel tape. Created on the UPIC at CEMAMu, Paris
Duration: 15′30″
First performed: 1 April 1989, Himeji (Osaka), Temple Kamejama Hontokuji, for the International Kite Exhibition organized by the Goethe Institute, Osaka

112 *Knephas* 1990
For unaccompanied mixed choir (32 voices minimum)
Duration: 10′
First performed: 24 June 1990, London, Almeida Festival; New London Chamber Choir, dir. James Wood
Phonemic text by Iannis Xenakis

113 *Tuorakemsu* 1990
For orchestra of 90 musicians: 4,4,4,4–4,4,4,1, hp, strings (16,14,12,10,8)
Duration: 3′40″
First performed: 9 October 1990, Tokyo, Suntory Hall for Toru Takemitsu's sixtieth birthday; Shinsei Nippon Symphony Orchestra, dir. Hiroyuki Iwaki

114 *Kyania* 1990
For orchestra of 90 musicians: 4,4(+ca),4(+bcl),4–4,4,4,1, pf, strings (16,14,12,10,8)
Duration: 23′
First performed: 7 December 1990, Montpellier; Orchestre

Philharmonique de Montpellier, dir. Zoltán Peskó
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115 *Tetora* 1990
For string quartet
Duration: 17′
First performed: 27 April 1991, Witten, Wittener Tage für Neue Kammermusik; Arditti String Quartet
CD 3

116 *Dox–Orkh* 1991
For solo violin and orchestra: 4,4,4,4–4,4,4,1, strings (16,14,12,10,8)
Duration: 20′
First performed: 6 October 1991, Strasbourg, Festival Musica; Irvine Arditti, BBC Symphony Orchestra, dir. Arturo Tamayo

117 *Gendy3* 1991
For two-channel tape. Created stochastically on a computer at CEMAMu, Paris
Duration: 20′
First performed: 17 November 1991, Metz, Rencontres Internationales de Musique Contemporaine
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118 *Krinoïdi* 1991
For orchestra of 71 musicians: 3,3,3,3–3,3,3,0, strings (14,12,10,8,6)
Duration: 15′
First performed: May 1992, Parma; Orchestra Sinfonica dell'Emilia-Romagna 'Arturo Toscanini', Parma, dir. Ramon Encinar

119 *Roaï* 1991
For orchestra of 90 musicians: 4,4,4,4–4,4,4,1, pf, strings (16,14,12,10,8)
Duration: 17′
First performed: 24 March 1992, Berlin, concert for the fortieth birthday of the Association Européenne des Festivals de Musique; Radio-Symphonie-Orchester, dir. Olaf Henzold

120 *Troorkh* 1991
For solo trombone and orchestra of 89 musicians: 4,4,4,4–4,4,4,1, strings (16,14,12,10,8)
Duration: 17′
First performed: 26 March 1993, Stockholm, Berwald Hall; Christian Lindberg, Swedish Radio Orchestra, dir. Esa-Pekka Salonen

121 *La Déesse Athéna* 1992
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Duration: 9′
First performed: 3 May 1992, Athens; Spyros Sakkas, Ensemble of Athens Radio and Television, dir. Michel Tabachnik

Text by Aeschylus

122 *Paille in the wind* 1992
For cello and piano
Duration: 4′
First performed: 14 December 1992, Milan, Scala de Milano; Jacopo Scalfi (vc) and Roger Woodward (pf)

123 *Pu wijnuej we fyp* 1992
For unaccompanied children's choir
Duration: 10′
First performed: 5 December 1992, Paris; Maîtrise de Radio France, dir. Denis Dupays
Text by Arthur Rimbaud

124 *Bakxai Evrvpidov (Les Bacchantes d'Euripide)* 1993
For solo baritone (or alto or soprano and baritone), women's choir (sixteen voices minimum), two groups play maracas, and ensemble: 1(+pic),1,0,1(+cbn)–1,1,1,0, 3perc
Duration: 60′
First performed: 1 September 1993, London; Joe Baxton, Premiere Ensemble/Opera Factory, dir. Nicholas Kok
Texts by Euripides

125 *Mosaïques* 1993
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Duration: 8′
First performed: 23 July 1993, La Major cathedral, Marseille; Orchestre des Jeunes de la Méditerranée, dir. Michel Tabachnik

126 *Plektó (Flechte)* 1993
For sextet: fl, cl, pf, perc, vn, vc
Duration: 14′
First performed: 24 April 1994, Witten Festival; Ensemble Köln, dir. Robert Platz
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127 *Dämmerschein* 1993–4
For orchestra of 89 musicians: 4,4,4,4–4,4,4,1, strings (16,14,12,10,8)
Duration: 14′
First performed: 9 June 1994, Lisbon; Kölner Rundfunk-Sinfonie-Orchester, dir. Zoltán Peskó

128 *Sea Nymphs* 1994
For unaccompanied mixed choir (24 voices minimum)
Duration: 8′
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129 *Mnamas Xapin Witoldowi Lutosławskiemu* 1994
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133 *Kaï* 1995
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Duration: 8′
First performed: 15 November 1995; Oldenburg, Ensemble Oh Ton, dir. Friedemann Schmidt-Mechau

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First performed: 16 November 1995, Munich, Herkulessaal; Münchener Kammerorchester, dir. Christoph Poppen

135 *Kuïlenn* 1995
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137 *Iolkoos* 1996
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First performed: 9 August 1996, New York

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