

The First Electroacoustic Pieces by Karlheinz Stockhausen: Technologies and Aesthetics

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This article aims to bring to light the links between technology and aesthetics in the first electroacoustic pieces written between 1953 and 1966 by Karlheinz Stockhausen. After reviewing the technological differences of the two aesthetics of *musique concrète* (France) and *elektronische Musik* (Germany), it is possible to see how Stockhausen transcended this distinction by gradually creating more diversified material, leading to a ‘world material’, independent from the tools used. This comes along with a more global approach to the sound. The composer, by an appropriate use of the equipment, does not seek an individual control of each element or each parameter, but has a larger-scale view, in which time units are longer and are considered as a whole. This conception, while remaining as precise as an analytical approach, involves a rethinking of the time development, proposed by Stockhausen as the *Momentform*, a new musical form in which each part is independent and does not constitute the continuation of the preceding one. This reflection on non-linearity in a work, and on relative perception of time, is a key to understanding Stockhausen’s music.

1. INTRODUCTION

After the end of World War II, electroacoustic music seemed to be a rich field of research and creation. Composers were expected, for their own sake, to try to compose an electroacoustic piece, either in Paris (the Studio d’Essais was founded in 1948), in Cologne (in the studio of the Westdeutsche Rundfunk from 1951), or in any other research centre of the time. However, these composers were soon disillusioned. Indeed, technical limits (in quantity or in quality) often led to disappointing results with regard to the amount of work invested and many composers, such as Boulez or Ligeti, turned back to instrumental composition.

Unlike these composers who only made a few experiments in the studio before dedicating themselves almost entirely to instrumental music, Stockhausen continued to use electronic means in many of his works. In this way, among the 17 opuses from Stockhausen’s catalogue written between 1953, date of composition of *Elektronische Studie II*, and 1966, première of *Telemusik*, eight works use electronic means. These pieces, whose composition dates, moreover, are steadily spread in time, constitute an important testimony to the

evolution of electroacoustic music in the first 15 years of its existence. The beginning of the 1960s is characterised by a change of equipment used in studios. In parallel, a change in Stockhausen’s orientations can be perceived: the numerical serialism tends to be influenced by intuitive choices, relations between electronics and instruments are questioned (*Kontakte*, Stockhausen’s first mixed piece, is composed in 1959–60), and some experiments are made in aleatoric music. In this context, how did the innovations in studio equipment changed Stockhausen’s thinking of music? Did the concrete practice in the studio play a role in his instrumental compositions? What can we learn about the relations between aesthetics and technology?

2. MUSIQUE CONCRÈTE AND ELEKTRONISCHE MUSIK: TWO TECHNOLOGIES, TWO AESTHETICS

At the beginning of the 1950s the electronic devices that were available in studios for producing or transforming sounds were limited and intended exclusively for radio broadcast. The tape recorder, developed during World War II, was still expensive and was therefore rare. The other devices used by composers came from acoustic laboratories. They consisted mainly of spectral analysers and signal generators, which produce frequencies in the audible domain whose waveform, and therefore timbre, can vary. For this reason, two very different kinds of sounds were available for the composers.

The first category comprised tape recording of acoustic sounds. Technology at the time did not permit precise control or significant modifications of the sound other than variations in speed of the tape. Consequently, acoustic references to the sound remained, as, for example, in the *Études* by Pierre Schaeffer. This is even truer when considering the limited possibilities of mixing. Sounds were rarely integrated into a complex polyphony and it was therefore easier to perceive their acoustic reference. To go further in the understanding of this music, the listener must then go deeper than this point of reference. In the *écoute réduite* proposed by Pierre Schaeffer (Schaeffer 1966), the attention was drawn to sounds for their inner

characteristics and not for their point of reference. Therefore, working with this first category of sounds and their corresponding technologies implied some aesthetic choices. It meant not working precisely with pitches, given that they were set down directly during the recording and could not be changed without a major timbral or durational transformation (for example with variations of tape speed). Durations also depended on the sound recordings and could not be changed in the studio without unpredictable results. Rather than precise pitches, it was timbre, diversity of sound envelope or attacks, and types of pitches (*types de masses*, using Schaeffer's vocabulary) on which the musical discourse could be based. This is one meaning of the propositions written by Pierre Schaeffer in *Le Traité des objets musicaux* (Schaeffer 1966). The author sought a classification and a typology of sonic parameters, suitable to develop a discourse based on such material.

The second category of sounds available to composers at the beginning of the 1950s was one produced by equipment generally used in acoustic laboratories. This means sine wave or square wave generators as well as filters. As these are tools for control or measurement, each of their parameters can be set independently. The frequency generator, for example, can produce different signals whose pitch and intensity can be precisely controlled. Tape recorders are used as well, but only as an editing medium for the sounds. The expressive meanings for this *elektronische Musik* (electronic music) are then totally different from those of *musique concrète*. Timbre and attacks are limited to a small number of archetypes depending on the equipment used. Therefore importance is given to two main notions:

- pitch, which can be precisely controlled thanks to the frequency generator, and
- duration: sound generators can produce virtually infinite duration of sounds.

Precise control of pitch and intensity allow the use of different compositional techniques. In this way, many of the first pieces of *elektronische Musik* used serial techniques for several parameters.

In the case of *musique concrète* and *elektronische Musik*, correlation between equipment and aesthetic seems clear. Two different kinds of equipment produce two different kinds of sounds. Working with one category of sounds or the other was the choice (conscious or not) of the composer, but nevertheless it implied differences at a poietic level. Knowing the kind of equipment employed helps the analyst in trying to understand the operations realised by the composer, which determines in large part the aesthetic result.

Significant criteria are not the same in the two cases, and it would be meaningless to analyse Pierre Schaeffer's studies using the same method as for Karlheinz Stockhausen's. These differences explain the

important split that occurred between Paris and Cologne, and which remained even after technology evolved and did not allow such a clear distinction between *musique concrète* and *elektronische Musik*. In fact, the strict distinction between them lasted only for a few years, from approximately 1950 to 1956. At the same time in France and Germany, composers tried to move beyond technical limits and the aesthetic choices they imposed. To this end the *phonogène*, a device allowing the transposition of sounds while preserving their duration, was developed at GRM in Paris. It permitted composers to work with more precise pitches in *musique concrète*. Similarly, in *Gesang der Jünglinge* (1956), Stockhausen used at once sounds produced by signal generators, voice recordings, and transformations that had previously been only used in *musique concrète*.

In the end, a part of the history of electroacoustic music can be seen as a quest to mix the two points of view: the precise numeric control of *elektronische Musik*, and the diversity of timbre, the richness of sounds from acoustic recordings used in *musique concrète*. From *Elektronische Studie I* and *II*, archetypes of the *elektronische Musik*, to *Hymnen*, a long fresco using more diverse sounds, the first electroacoustic works by Stockhausen show particularly well the combination and successive enrichment of the sound material.

3. ENRICHMENT OF TIMBRE AND DIVERSIFICATION OF DEVICES

Analysing *Elektronische Studie II* (Tissot 2004) makes it possible to understand what the 'starting point' of electroacoustic music was for Stockhausen. The piece, composed in 1953 in the studio of the Westdeutsche Rundfunk (WDR) in Cologne, may be the most representative work of *elektronische Musik*. Indeed, Stockhausen used only sine waves regularly superposed into different frequency bandwidths. These sound complexes, or *Tongemischen*, composed of one to five frequencies, have their amplitude envelopes transformed using the fader. The easiest way to obtain such sounds would have been to use five wave generators in parallel. However, there were not so many devices at that time in the studio of the WDR, so Stockhausen invented a new technique. He recorded the different sounds separately, took a fragment of each and attached each one after the other. When they are heard in a reverberating room, at high speed instead of normal speed, the fragments are mixed up and the complex sound is created. However, despite the differences of bandwidth and intensity for each sound, the piece is remarkable for the uniformity of its timbre. As Karl Wörner notices, 'In both Studies, then, it was not the most varied and novel sounds that were sought, but rather an extreme homogeneity of the basic sounds and of their form' (Wörner 1973: 33). Nevertheless, it must be remembered that this piece is a study whose concept

consists in exploring one musical aspect. This is the case for example in the piano studies of the 19th century, in which composers specially wrote 'for the left hand' or 'for the octaves'. For Stockhausen, *Elektronische Studie II* does not involve timbre in order to focus on serial relations of pitches, as revealed by the sketches published by Richard Toop (Toop 1981). Regarding timbre, the *Elektronische Studien* can be considered as a starting point for further explorations.

3.1. *Gesang der Jünglinge*: new devices and timbre scale

With the voice, Stockhausen introduced an element from the acoustic world in *Gesang der Jünglinge*. Electronic material is also more differentiated, and is based on eleven elements (Decroupet and Ungeheuer 1993):

1. Sine wave.
2. Sine wave whose frequency varies periodically...
3. ... or statistically.
4. Sine wave whose amplitude varies periodically...
5. ... or statistically.
6. Sine wave whose frequency and amplitude vary periodically...
7. ... or statistically.
8. Coloured noise with constant...
9. ... or statistical variations of density.
10. Periodical...
11. ... or statistical variations of filtered impulses.

Compared to *Elektronische Studie II*, which uses only sine waves, the panel of sounds used is considerably enlarged. Of course the sine wave is still the basis of the material (numbers 1 to 8), but it is now included in a larger process taking into account time variations. Sounds used in this piece are then longer and more complex in their development than those used in *Elektronische Studie II*. This is the case, for example, for the impulses. The generator produces a noise at a regular interval, which can be set by the composer. This interval can be very short (shorter than 0.1s.), which makes the control of individual impulses impossible. It is only at a larger time scale that the speed or global register of the burst of impulsions can be controlled.

Gesang der Jünglinge is often quoted as the first piece to go beyond the simple opposition between *elektronische Musik* and *musique concrète*. If it is true that it is one of the first pieces to use both electronic and acoustic sounds, the connection goes even further. Stockhausen draws in the piece a parallel between a scale of electronic sounds (from sine wave to noise and impulses), and sung or spoken voice (from syllabic voice to multiple layers of the same voice) (figure 1). This is a significant change: not only are electronic and acoustic sounds used in the piece, but they are also treated using a comparable method. Only the use of diverse devices, other than signal generators, could lead to such an idea. Within the

continuity, which is the preferred behaviour of electronic sounds, Stockhausen establishes a discrete scale of values. Conversely, the acoustic domain, represented by the children's voice, and associated in general to a scalar principle (pitches or rhythm for example), is here treated more as a continuity by mixing several layers of the same voice to create blocks of sounds. This approach, which aims to create relations between electronic and acoustic sounds, is developed even further in *Kontakte*.

3.2. *Kontakte*: technical exploration and new procedures

Created in Cologne in 1960, *Kontakte* is an important piece in Stockhausen's catalogue, since it is his first piece to use both instruments (percussions and piano) and electronics at the same time. The composition process of this especially long piece (about 34 minutes), which lasted for about two years, is also interesting since it reveals the main preoccupations of the composer at that time. Open form in music (*Klavierstück XI* was composed in 1959), new perspectives for electronic music (and its possible use with instruments), and reflection on musical time are the three main directions of this period.

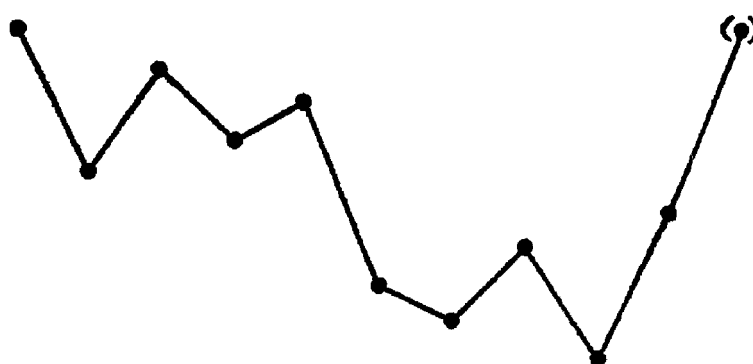
The compositional technique to obtain the material employed in *Kontakte* is completely new and original (Heikinheimo 1972). The core of the system is constituted by an impulse generator whose output is modified by several filters. To create a sound with a particular timbre, Stockhausen attached several sequences obtained with this device one after the other. All these sequences have the same pitch, and only their intensity and duration can change. For example, in the sketch shown in figure 2 the first fragment is five seconds long and has an intensity notated as 1. It is followed by a second fragment which is one second long and has intensity 5, etc. When listening to the result at normal speed, one hears only a succession of different sounds of relative lengths. On the other hand, when the tape reading speed is augmented, a continuous sound appears, whose timbre depends on the internal organisation of the different fragments. The wider the range of their durations and intensity, the wider the spectrum of the resulting sound. This discovery permitted Stockhausen to control precisely the transition between noise (wide spectrum) and harmonic sound (spectrum centred on one frequency and its multiples).

What is completely new in this way of manipulating the tape recorder is the fact that the sound result cannot be known before its actual realisation. It is only once the fragments are accelerated that the timbre is revealed. Stockhausen proceeded with multiplication of the fragments, listening, and selection of the sounds, which may explain why the composer needed two years to complete the piece, and it was not actually finished according to the original sketches. Therefore there is a

Electronic	Voice
Sine wave	Syllabic voice. No polyphony, good comprehension of the text
Sine wave whose frequency varies periodically or statistically	
Sine wave whose amplitude varies periodically or statistically	Vocal chord. Homophonic polyphony. The text is still comprehensible.
Sine wave whose frequency and amplitude vary periodically or statistically	
Coloured noise with constant or statistical variations of density	Choral mass. Voice is treated as polyphony uncontrolled in time. Apart for some words, the text is not comprehensible.
Periodic or statistical variations of filtered impulses	Choral polyphony. This is an enlargement of the choral mass. Density is serially controlled. The text is not comprehensible.

Figure 1. Scale of electronic sounds and scale of vocal sounds.

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Duration:	5	1	4	2	3	8	7	9	6	10
Amplitude:	1	5	2	4	3	8	9	7	10	6

Figure 2. Example of sketch used to create sounds in *Kontakte* (Maconie 1976).

major change in Stockhausen's poesis. The composer does not rely on material imagined before the realisation of the piece, but on material whose aspects can be heard only during their manipulation. This technique can be compared to that of *musique concrète*, which is based mainly on the listening and selection of material. The technical scores of the pieces clearly show this change. While the scores of the *Elektronische Studien* and *Gesang der Jünglinge* were written before the realisation of the pieces, by contrast the score of *Kontakte*, though remaining very precise, is written after the manipulation. This change is definitive, and Stockhausen never returned to using electronic material entirely determined before the realisation. This producing/listening/selecting method is fundamental for electroacoustic music.

There was another technical innovation used in *Kontakte* that should also be mentioned. By changing the order of the three heads in a tape recorder from the normal order 'erase-record-playback' to the succession 'playback-erase-record', it became possible to superimpose layer upon layer of material on a single tape loop automatically. This happened rather late during the composition process, but it led the composer to rethink his entire compositional procedure. The 'copy head', as it was called, permitted new possibilities of timbre synthesis, since it required much less time than the previous 'cut and stick' method. Numerical serialism, used with the former method, was seriously questioned, as it was no longer needed for a systematic exploration of timbre. The new method was more open and intuitive, and based primarily on listening.

3.3. A 'world' material

The following works in Stockhausen's catalogue have the same orientation. The material is not 'pre-thought' and 'pre-made', but is selected after listening to a great variety of sounds. This is the case in *Telemusik*, in which Stockhausen used recordings of instrumental sounds that are very diverse in their timbre (percussion, strings, voice, etc.) and in their origin (Europe, Africa, and more specifically Asia, as the piece was realised in the studios of Nippon Hoso Kyokai, the Japan Broadcasting Corporation). This shows the progressive diversification of the material, beginning with the sine wave of *Elektronische Studie I* and *Elektronische Studie II*. Then material was diversified with other electronic sounds (coloured noises, impulses) and an acoustic element (the voice) in *Gesang der Jünglinge*, then with instrumentalists (in *Kontakte* and *Mikrophonie*), and finally musical influences from around the world. This last notion is the basis of later works such as *Hymnen*, which essentially uses recordings of instrumental music, since it is based on a large panel of national anthems. These last pieces, very different from the first ones, reveal one of the main orientations of electroacoustic music: anything can be used as sound material. Even

instrumental sounds, which could be seen as hard to incorporate in electroacoustic language because of their too-obvious reference to instrumental music, are employed very early by Stockhausen. Independent from electronic devices or pre-made choices, it is the way of organising, transforming and shaping the material that constitutes the language of the composer. This is a major change in the thinking of electroacoustic music, not only for Stockhausen, but also for the history of the genre. It is accompanied by important changes, from a poetic point of view, in the manner of apprehending the global organisation of the material.

4. TOOLS FOR A MORE GLOBAL APPROACH TO THE SOUND

Indeed, an important difference in the conception of organisation exists between the first pieces, clearly inspired by the instrumental domain, and the last ones, more oriented toward preoccupations specific to electroacoustic music.

4.1. Discrete settings and serial thinking

An important characteristic of the devices used by Stockhausen for his first works is their functioning using discrete settings. In this way, the sine wave generator used for *Elektronische Studie II* can be set to precise frequencies via a rotary button, without any possibility of continuity between two frequencies. It 'jumps' from one frequency to the next. This is the case too in *Gesang der Jünglinge*, in which filters are only adjustable step by step, as shown in the technical score (Stockhausen 2001). It is then possible to make the connection between this essential characteristic of the equipment used by Stockhausen and the 'serial thinking' described by Pierre Boulez in *Relevés d'apprenti* (Boulez 1966). One characteristic of integral serialism is the decomposition of each musical parameter into a finite number of values, in order to organise them according to external laws. The devices of the beginning of the 1950s fit particularly well this goal.

From a listener's point of view, the quantisation of the different parameters can be perceived as a reference to the instrumental domain, in which pitches are discrete points on a scale and durations are quantifiable. Similarly, in *Elektronische Studie II*, the sounds used have fixed pitches, chosen from a scale and certainly not tempered, but whose idea comes from the instrumental domain. The reference is even more perceptible when considering that the average duration of the sounds is comparable to that possible on an instrument. Stockhausen did not use very long sounds (duration above 5 seconds) or very short ones (few sounds are less than 0.1 seconds long) (Tissot 2004: 49). This is a way of transposing, consciously or not, instrumental limits to the electronic domain. In this case, tape pieces are

thought of as an extension of the possibilities offered by acoustic instruments.

4.2. Another use of devices: global sound control

Soon Stockhausen introduced a more global manner of thought in his music, primarily through another use of the equipment. If the devices remained the same after *Elektronische Studie II*, the way they are used is slightly different, and the smallest unit now includes a time approach. Stockhausen described two main categories of sounds used in *Gesang der Jünglinge* (Stockhausen 1964: 56–84):

1. sounds varying in a periodic way (for example a sine wave whose frequency varies periodically), and
2. sounds varying in a statistical way.

The term ‘statistical’ as used by Stockhausen is actually characteristic of a global approach. The process described by Stockhausen (Stockhausen and Cott 1974: 78–9) consists of manipulating devices according to drawings made previously by the composer. He and two assistants worked together, one controlling the intensity and speed of the impulses, another controlling the levels and frequencies of the filters, and the last creating the amplitude envelopes and recording the sounds on tape. There was no strict synchronisation and therefore it was impossible to know the exact pitch (given by the filters) of each impulsion, but as each musician manipulated the settings according to drawings, the general orientation was known and the sounds could be controlled globally. This method is different from the one used for *Elektronische Studie II*. The composer did not seek individual control of each sound, but rather sought the creation of longer units perceptible as a whole. The use of such sounds led naturally to an increasing length of the pieces: *Elektronische Studie II* (1954) is 3' 20" long, *Gesang der Jünglinge* (1956) is 13', and *Kontakte* (1959–60) is 34' 30".

4.3. New devices and continuous transformations

When new equipment (ring modulators, amplitude modulators, different kinds of filters) was used in the studios at the beginning of the 1960s, Stockhausen would go further in this direction. These devices permit continuous transformations, and therefore make it possible to work on longer sounds and dynamic processes. In the case of the filters, for example, it is possible to realise a progressive filtering during several minutes. Much of this equipment can produce unpredictable results. The ring modulator is a device whose output signal is constituted by the sum and the difference of each input. The result is a very strong enrichment of the initial sounds by adding partials in every register. Without making a precise spectral analysis of the input signals, it is not possible to know

a priori the content of the output. It is significant, however, that Stockhausen knew the existence of the ring modulator for a long time, and could have used it since 1953 when it was a new device at the Cologne Radio. However, he may have delayed its use because of the lack of control of the resulting sound. The first use of the ring modulator is to be found in *Mixtur* (1964), a piece for orchestra whose sound is transformed in real time by the device. According to Robin Maconie (Maconie 2005: 260), the acoustic result was not completely convincing, since it lacked control, but it reveals the change in Stockhausen's orientation. Complete control on the electronic result is abandoned, in favour of a more global and continuous thinking. This shows the discrepancy that can exist between the appearance of an electronic device and its possible use by the composer, and the difficulties to determine its influence on the aesthetic. The auditory result of the use of these devices is a music mainly constituted of textures. The richness of the sounds produced, as well as the possibilities of continuous transformations, makes it possible to base the discourse on slow transformations. At the same time, the development of tape recorders, both in number and in quality, permitted more complex mixing. *Telemusik* (1966) is typical of this period, and the devices used reveal the preoccupations of the composer. The 32 sections, whose durations are based on the Fibonacci series, start with a Japanese ceremonial drum or gong before exploring a new procedure of intermodulation or style of resonance. From a technical point of view, it can be seen as an investigation of the possibilities of ring modulation. Many composition techniques are used in order to obtain continuous and rich sounds, by avoiding periodicity (and therefore predictability), and by modifying the timbre:

- accumulation (several layers of sine wave sounds, ring modulation)
- reinforcement of harmonics (amplitude modulation, triangular wave sounds)
- irregularity (random editing of short fragments, whose polyphony recreates a continuous sound)
- modification of the amplitude envelope.

The high pitch texture, present throughout the 18 minutes of the piece, can be heard to symbolise the research on continuity and slow variations conducted by Stockhausen. It is very diversified, and Stockhausen takes great care to note its realisation in detail (Stockhausen 1974):

- several layers of fixed pitch sine wave. The bandwidth is defined by the number of sounds and their frequency (example: structure 1 of the piece).
- several layers of variable pitch sine waves. The bandwidth is globally fixed, individual movements

of pitch being included in this bandwidth (example: structure 2).

- periodic or non-periodic electronic texture, other than sine waves (example: structure 3).
- several layers of discontinuous sine waves. The result is a continuous sound with internal density variations (example: structure 4).
- high pitch impulses, creating a discontinuous sound (example: structure 7).
- modification of acoustic sounds using the high frequencies produced by the ring modulation (example: structure 8).
- high pass filtering of acoustic sounds (example: structure 27).

From the beginning, the emphasis is placed on the diversity of the texture, since the first seven structures present almost all the different methods to produce it. This creates a subtle palette of nuances, which always maintains the attention of the listener.

With the significant evolution of the electronic devices in the 1950s and 1960s, Stockhausen and other composers of the time progressively rethought what could be the characteristics of an electroacoustic language. The awareness of the possibility to create macro-objects led to the realisation of a new time development. The *temps lisse* ('smooth time') according to Boulez (Boulez 1966: 99) – that is, the perception of a musical fragment which does not present internal contrasts strong enough to allow a division, a 'marking up' of the time – gained in importance. This time perception is generally obtained by using slowly evolving textures, which are particularly easy to create with electronic means. Using loops is another way to produce virtually infinite-duration sounds. This new conception of time largely influenced the instrumental world. In 1968, Stockhausen wrote *Stimmung* for six vocalists, a work based in large part on slow transformations of sound textures. More recently, composers from the spectral school, while claiming their independence from electroacoustic music, do not deny the relative importance it had in the use of transformation and process.

5. RETHINKING TIME

Time and its perception is one of the major preoccupations of Stockhausen. In 1971, he affirmed: 'All is time, I always said that, even sound vibrations are time' (Stockhausen 1971: 113). This rethinking of musical time was present since the very first experiments in the studio at the beginning of the 1950s, and became more and more important.

5.1. 'All is time': influence of technology on the composer's reflection

A pragmatic manipulation of the impulse generator, recounted in the article *...wie die Zeit vergeht...*

(Stockhausen 1957), is the basis of an important theoretical reflection. The manipulation consisted in recording impulses on a magnetic tape at a regular time interval. When playing this recording at a normal speed, one can hear a regular rhythm, or a kind of pulsation. On the other hand, while accelerating the speed, impulses get closer and tend to combine. When past a certain threshold, the ear does not perceive isolated impulses but a continuous sound, which is low-pitched at first and becomes higher and higher when the speed becomes even faster. What was rhythm, that is to say relevant to time, has become pitch. According to Stockhausen, not only are time and pitch linked, but a continuum also exists between them. Time and pitch proceed from a quantitative, and not qualitative, difference; it is only the perception we have of the phenomenon that varies. At first, Stockhausen makes conclusions of a serial nature. Since time and pitch are a single continuum, the same methods have to be applied to each (in particular by using a logarithmic scale for durations). But what is more decisive, and remains even after Stockhausen gave up strict serial writing, is the willingness to find a unity between all different aspects of music. For example, it led him later to use a 'super-formula', generative principle upon which a whole piece can be articulated, as is the case in *Mantra* (1970). To generalise, the search for a unity between music, theatre, and plastic arts in the opera *Licht*, and the fact that it was the only piece on which Stockhausen has worked since 1977, as if the composer's life and the work were one unity, are other aspects of this thinking.

5.2. *Momentform* and the collage aesthetic

Technology can have an important impact on the composer's reflection of music. A certain configuration of devices and a certain fortuitous experiment will permit the composer to develop an aspect of his language. François Bayle for example (Bayle 1993) gives much importance to the disposition of the equipment in the studio, which directly influences his way of working. Manipulating devices to create music, such as having an interface that is an intermediary between the composer and the sound result, creates a distance, a mediation with the material, which is the basis for a theoretical reflection. Moreover, as the devices are renewed relatively quickly, it permits one to see things from another perspective, and perhaps to change certain composition habits, while discovering new possibilities of reflection.

This was the case for Stockhausen in 1961. In the article *Momentform: Neue Beziehungen zwischen Aufführungsdauer, Werkdauer und Moment* (Stockhausen 1963), he proposed a new type of formal organisation he called *Momentform*. Although the general principle is simple (from a technical point of view, the *Momentform* is the juxtaposition of several fragments of different

lengths) it goes further in the reflection on time it implies. Thus, the feeling of immediacy becomes prominent in this type of organisation. The smaller unit, the *Moment*, exists without any causal link from one to the following or the preceding. It does not mean that one unit does not have anything in common with its neighbours, but that one is not the continuation of the other; they can be placed in any order. Stockhausen emphasises the absence of dramatic development. The listener should feel each unit, even the smallest one, as a whole; this concept implies ‘concentrating on now, on every now’ (Stockhausen 1963: 195).

Two parallels can be drawn between the *Momentform* and certain techniques coming from the studio. The reference to the technique of editing (sticking together two successive fragments of tape, which can be totally different in their auditive rendering) seems obvious. The ‘concentration on now’ can have an origin in the way the composer is working in the studio, completely different from his way of working on a score. The composer in the studio listens many times to small fragments of sounds in order to perceive their details and to make a choice between hundreds of small variations. This leads to a perceptive deformation of time. The smallest details, not perceived during the first listening, then take on considerable importance. Working on a small fragment can last for several hours, perhaps several days. For the composer, it literally means living with his sounds, penetrating their inner structure. Once this work is done, the composer works on another fragment, perhaps without any link to the first one. This is exactly what takes place in the *Momentform* as formulated by Stockhausen. The network of links does not develop in a contiguous way, but in a fragmented way. The *Momentform* involves a reflection on non-linearity in a work, and on the relative perception of time.

6. CONCLUSION

Working in the studio is a way, not only for Stockhausen but also for many other composers, to be more aware of the characteristics of a sound material, independent of the formal scheme from which it comes. This ‘rediscovery’ of the sound in itself can be drawn in parallel with the exploration of two main domains. On the one hand, the timbral scale is enlarged, since any sound can be used in an electroacoustic piece. On the other hand, with regard to time organisation, electroacoustic music allows very long durations (in textures, for example) or very short ones (working with micro structures of the sound). The appearance of new devices plays an important role in this process, but is only a part of it. The way the composer uses these tools is at least as important as the tools themselves. This is even truer with recent tools, which are very flexible and offer settings of all kinds. Studying precisely the use of the

equipment by a composer can then bring to the light some aesthetic preoccupations.

However, it would be a mistake to assert that one technology leads clearly to one aesthetic or, equally, to assert that adopting an aesthetic imposes the use of a certain type of equipment. The links between technology and aesthetics are multiple and fluid. Finally, knowing if a certain technology preceded in time a certain aesthetic, or vice versa, does not matter. But studying both domains in parallel – that is, understanding the global aesthetic orientation in parallel with the changes of technologies (or changes in the use of these technologies) – permits one to reveal ‘contact points’ between them. It is therefore possible to find precisely the composer’s aesthetic point of view, while placing his works in an historical continuity. In Stockhausen’s case, it seems clear that working in the studio strongly influenced his approach to musical time, based on non-linearity. This new conception of time development constitutes one of the main lines of the evolution of the music of the 20th century. Furthermore, the practice of electroacoustic music has played an important role, by enlarging the diversity of each sound parameter and by endowing them with the notion of continuity, which replaced the notion of discrete values that came from the instrumental domain. As Horacio Vaggione notices (1991: 118), ‘If such an influence could take place, it is not precisely due to an imitation, from instrumental music, of some effects coming from studio techniques ... but because the problem asked by the electroacoustic experience, along its way from analogic to numeric, opened a way toward a “deeper” (in the physical meaning of the term) conception of the sound material, by enlarging the range of the scales between local and global’ [*si une telle influence a bien pu avoir lieu, ce n’est pas précisément dû à une imitation, par l’écriture instrumentale, de certains effets issus des techniques de studio [...] mais parce que la problématique posée par l’expérience électroacoustique, au fil de son cheminement de l’analogique au numérique, a ouvert la voie vers une conception plus ‘profonde’ (au sens physique du terme) du matériau sonore, en élargissant l’étendue des échelles de grandeur entre le local et le global*]. At a key moment of the history of the music of the 20th century, the contribution made by Stockhausen is still current.

REFERENCES

- Bayle, F. 1993. *Musique acousmatique: propositions, positions*. Paris: Ina-Buchet/Chastel.
- Boulez, P. 1966. *Relevés d’apprenti*. Paris: Le Seuil.
- Decroupet, P., and Ungeheuer, E. 1993. Son pur, bruit, médiations: matières, matériaux et formes dans *Gesang der Jünglinge* de Karlheinz Stockhausen. *Genesis: Revue internationale de critique génétique* 4: 69–85.

- Heikinheimo, S. 1972. *The Electronic Music of Karlheinz Stockhausen: Studies on the Esthetical and Formal Problems of its First Phase*. Helsinki: Acta musicologica fennica.
- Maconie, R. 1976. *The Works of Karlheinz Stockhausen*. Oxford: Charendon.
- Maconie, R. 2005. *Other Planets: The Music of Karlheinz Stockhausen*. Lanham, MD: The Scarecrow Press.
- Schaeffer, P. 1966. *Traité des objets musicaux: essai interdisciplines*. Paris: Le Seuil.
- Stockhausen, K. 1957. ...wie die Zeit vergeht... *Die Reihe* 3: 13–42.
- Stockhausen, K. 1963. Momentform: Neue Beziehungen zwischen Aufführungsdauer, Werkdauer und Moment. In *Texte zur elektronischen und instrumentalen Musik, vol. 1: Aufsätze 1952–1962 zur Theorie des Komponierens*. Cologne: DuMont Schauberg, pp. 189–210.
- Stockhausen, K. 1964. Musik und Sprache III. In *Texte vol. 2: Zu eigenen Werken zur Kunst anderer Aktuelles: Aufsätze 1952–1962 zur musikalischen Praxis*. Cologne: DuMont Schauberg, pp. 58–64.
- Stockhausen, K. 1971. Entretien. *VH 101* 4: 112–14.
- Stockhausen, K., and Cott, J. 1974. *Karlheinz Stockhausen: Conversations with the Composer*. London: Robson Books.
- Tissot, G. 2004. *Les premières oeuvres électroacoustiques de Stockhausen: unité et évolution*. Master thesis, University of Toulouse (France), available online at: http://doctorantsparnasse.xwiki.com/xwiki/bin/download.Main/Maitrise/Tissot_OeuvresStockhausen.pdf.
- Toop, R. 1981. Stockhausen's Electronic Works: Sketches and Work-Sheets from 1952–1967. *Interface* 10(3–4): 149–97.
- Vaggione, H. 1991. *Jeux d'espaces: conjonctions et disjonctions*, in *L'Espace du son*, II, *Lien* numéro spécial: 117–19.
- Wörner, K. 1973. *Stockhausen: Life and Work*. London: Faber & Faber.

SCORES

- Stockhausen, K. 1960. *Kontakte Nr. 12*. London: Universal Edition.
- Stockhausen, K. 1974. *Mikrophonie I für Tamtam, 2 Mikrophone, 2 Filter und Regler*. London: Universal Edition.
- Stockhausen, K. 1974. *Telemusik*. London: Universal Edition.
- Stockhausen, K. 2000. *Elektronische Studie II*. Kürten: Stockhausen Verlag.
- Stockhausen, K. 2001. *Gesang der Jünglinge*. Kürten: Stockhausen Verlag.