Of Rules and Canons

Raaijmakers' Reflection on Morphology

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Abstract

The *Canons* are a series of five electronic compositions by Dick Raaijmakers. They were composed between 1964 and 1967. These compositions are the result of his research into the foundations of electroacoustic music composition. This research, which started in the autumn of 1963, led him to thoroughly define a compositional approach formed around ideas of morphology.

Although later in his life, Raaijmakers has very often touched upon this subject in lectures and writings, how exactly the *Canons* were made always remained a bit of mystery. Of course, Raaijmakers himself had made these works, but he had forgotten the details of what he had been doing in the sixties. Specifically, the method that he had used to step by step build up these compositions—the actual work in the studio—was no longer exactly in his memory.

However, Raaijmakers meticulously and abundantly documented the process of making the *Canons*, both in correspondence and in notes. Based on this documentation and a number of conversations with Raaijmakers,[1] the challenge has been to reconstruct the line of thought and the decisions taken in the studio that led to the *Canons*. Starting with the notion that *Canon-1* was the most fundamental example of the entire series,[2] my research has aimed towards uncovering the steps of decision-making that created this composition.

The chapter after the prologue is based on correspondence between Raaijmakers and Jaap Spek. By reporting on his findings and discoveries to Spek, Raaijmakers documented his research from the beginning. In the third chapter the construction of *Canon-1* is explained, both in terms of its structure and the materials used. The fourth chapter gives a critical reflection, both on Raaijmakers' research as well as the resulting *Canon-1*. Finally, in the fifth chapter the *Canons* are evaluated in relation to Karlheinz Stockhausen's composition *Kontakte*.

Dedication

To:

Dick Raaijmakers
Paul Berg
Daisaku Ikeda

Acknowledgements

Thank you:
My harmonious family, Richard Barrett, Justin Bennett, Henk Borgdorff,
Lex van den Broek, Martijn Padding, Robert Pravda, Kees Tazelaar,
Anne Wellmer and everyone in the Master's circle.

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1.

Prologue

The setting up of a private electronic studio in 1963 together with Jan Boerman must have marked a fresh start for Dick Raaijmakers. Raaijmakers had been working in the electronic studio at Philips Research Laboratories (NatLab) until November 1960, and continued working in that studio after it had moved to Utrecht University, where it continued under the name STEM. Raaijmakers had decided to leave in April 1962 because of a conflict over the artistic direction that was being taken. For about a year he had had no access to a studio and proper equipment to work on his own compositions.[3]

But that all changed in 1963. A private studio not only secured continuous access to equipment, it also implied complete artistic freedom. Still, several commissions from Philips for soundtracks for film took precious time away from his own projects. But towards the end of 1963 Raaijmakers had taken up something that he had been brooding upon for a while.

Raaijmakers had already for some time been considering the praxis of electronic music composition and what that meant for himself as well as for contemporary music as a whole. In forming those ideas, he was very much influenced by fine arts. In a letter to Miep Oddens, dated 2 February 1961, he wrote:

> *Now I want to write you and tell you my ideas with respect to a pure practice of electronic music.*
> *I would say that music is a comprehensible arrangement of sounds. Up to now, the sounds we hear have been carriers of signs and symbols in a system of notes, so that ultimately the arrangement of series of pitches into melodies or harmonies constitutes the essence of music-making (= art).*
> *Timbre then contributes to artistic perfection (for example, through the diligent study of piano or violin playing – improvement of touch – sensitive stroking.)*
> *Yet sounds in nature are caused by physical phenomena of objects (as side effects).*
> *That is, if we can speak of the plasticity of certain objects (or their physical behaviors), we must also be able to speak of "the plastic qualities of sounds," and this is certainly true.*
> *And also, if materials can be shaped or reshaped, in a meaningfully and artistically and plastically good way, then it must also be possible to form and arrange "sound sculptures" so that they are real in their own right, and able to exist.* [Bron vermelden]

The work he had been doing in the Philips studio had allowed him to gain an enormous experience with the equipment available. Because of that work he had been able to experience the development of new equipment from nearby. According to Raaijmakers, however, what composers were doing with this new equipment was in essence still rooted very strongly in an instrumental approach to music composition. It is not that Raaijmakers wanted to deny the instrumental tradition or denigrate it: he imagined that new ideas, yet to be formed, about music composition would spark a new movement with unimaginable outcome. Raaijmakers envisioned the outcome as "sound sculptures", although how they were going to be created or what they would sound like was still unknown to him.

Instead of focussing on a specific final result, Raaijmakers wanted to fundamentally understand the meaning of sound in the context of electroacoustic music composition. Therefor he returned to the starting point: sound itself. In order to resonate his ideas, he corresponded frequently with his friend Jaap Spek,[4] who had moved to Cologne in August of 1963 to work as an assistant for Karlheinz Stockhausen.[5]

2.

A New Morphology

On 14 September 1963, in a letter addressed to Jaap Spek, Dick Raaijmakers wrote these words:

> *Structuring the morphity of sound is a first step in approaching and changing the otherwise fixed aggregate state of an electronic composition during its performance.*

This letter was the first of the correspondence between the two through which Raaijmakers reported on a regular basis on the progress of the important work that he had just started and which would continue for the next two and a half years. In this very first letter, the term morphity[6] was introduced in an attempt to get grip on a fundamental element of the praxis of electro-acoustic music composition.

2.1 Sound as Morphity

In the same letter, he continued:

> *Electronic music on tape can be understood as being a fixed aggregate state of a certain sound structure. […] Crucial however is to become aware that sound is in a momentarily aggregate state […], and hence can constantly change. These changes indeed can be structured."*

And:

> *"In order to have access to the options that allow adequate differentiation, it is required to develop equipment that can alter a variety of phenomena of a sound in the smallest possible steps."*

In a nutshell, he analyzed that it had become common in electronic composition to see sounds as things or constructions that in a studio would be built and fixed on tape together with other sounds, from which they were reproduced in a concert situation. Without mentioning it explicitly, Raaijmakers' analysis and problematization implied that such praxis was not capable of fully bringing out the potential of electronic apparatus—or simply said electricity—that had been introduced in music composition.

In order to fundamentally rethink the situation, Raaijmakers challenged himself by rejecting any convention and return to the very basics, taking the phenomena of sound as the starting point. It seems that by introducing the term morphity, he attempted to define its most fundamental characteristic, and in extension the logical point of departure for electro-acoustic music composition.

Since he had no idea how to technically arrive at that point of departure, or what the procedures of morphological change would be like, he expressed that new technology was a requirement that would allow the kind of manipulation necessary to accomplish morphological composition. Whatever that technology would look like, it was clear to him that it had to be something very different from the basic tape recorder that had become that standard tool in any electronic music studio.

However, for the time being there was no other tool available than the tape recorder, so it was with this tool that he had started carrying out experiments. Those experiments comprised of building so called aggregates from a variety of recorded sounds.

> *It is unbelievable but through hundreds of steps an 'instrumental' group of points turns into an 'airplane'! Sounds with sharp attacks become continuous sounds full of movement.*

This first two-page letter in which Raaijmakers briefly sketched out some

ideas he had been brooding upon formed the starting point of a research that he continued for more than two years. The aim of this research was outlined in a letter two weeks later.

> *If we really want to take full advantage of the use of electro-acoustic tools for music in space, it is required to quickly develop a method that allows the structuring of morphity for musical reasons.*[7]

2.2 Building Morphities

As we can learn from the first letter, Raaijmakers had already been busy conducting experiments in order to experience morphity. This was done by creating dense sound clusters. He described how had he transformed a short instrumental sound to something reminiscent of an airplane. Also, he mentioned that this transformation had been achieved in hundreds of steps. Probably this number was an exaggeration, but it could very well be that the final sound would indeed consist of so many layers of sounds added together.

Most likely this was done with two tape recorders, one recording and the other playing and feeding back into the first. Unavoidable in this setup was that with each cycle of feeding back, the noise on the tape would be summed as well, adding noticeably to the result.

A work by Raaijmakers that was not included in his collected works with the name Aioon might very well have been realized with this method. It was most likely finished in January of 1964.

Image 1. The tape box for Aioon

In a letter from 22 December 1963 he explained how he had used a process of adding four tracks together in order to create up to 64 overlaps in a reduced number of steps, thereby reducing the effect of the tape noise to a minimum. These experiments allowed Raaijmakers to experience how a fragment of human voice would turn into almost an abstract static sound. He had used a short fragment of Herbert Eimert's voice saying 'Diese Teiltöne'.

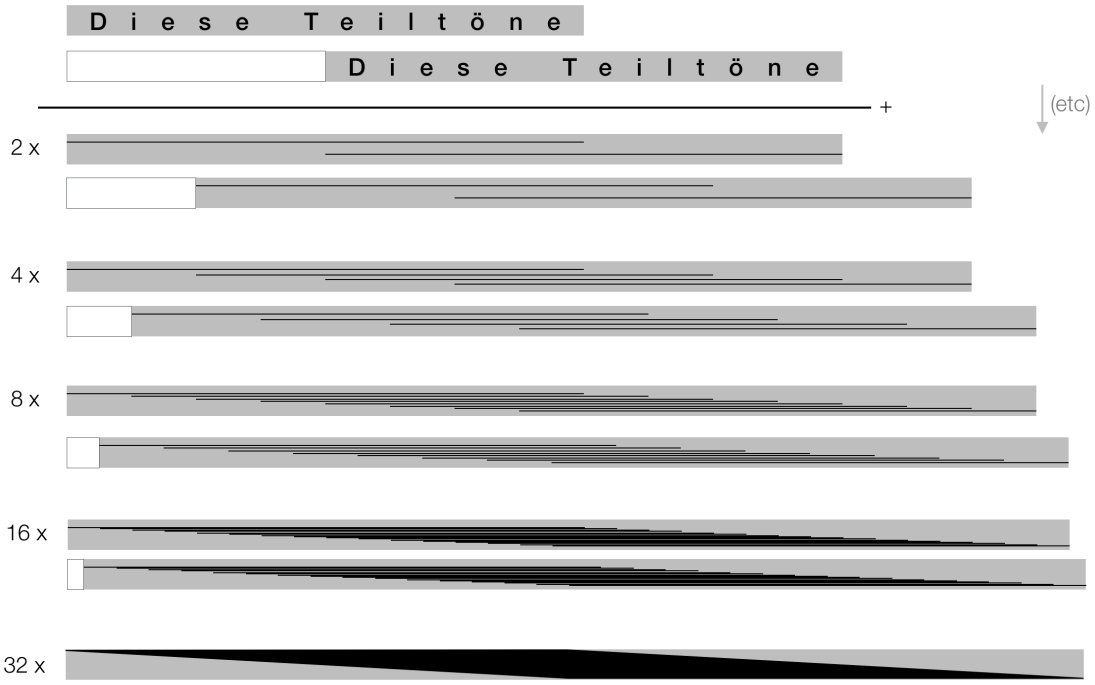


Image 2. 'Diese Teiltöne' process of construction

This result could be characterized as a sound exhibiting all the qualities of the human voice throughout the original fragment at each moment of the final result. Raaijmakers referred to the process of constructing densities in this way as auto-synchronization or auto-summation. This created a model of a sound complex of which the many layers could be compressed to a lesser or greater degree, depending on the desired outcome.

Such a process of compressing a sound on a horizontal timescale not only allowed Raaijmakers to experience these dense morphologies, it also helped him to theoretically describe a variety of states that would be the outcome of a compositional tool that controlled that compression through auto-synchronization. At the far and of the scale of compression he positioned 'total

horizontal morphity', a state in which a sound, through complete compression, exhibited all its momentary values in a single moment.

These experiments made him conclude that auto-synchronization was going to be an important procedure in constructing morphologies, at least one that could be conducted using a tape recorder. An additional feature of auto-synchronization was that for each step in doubling the density, a different time offset could be chosen. This was not possible in the setup where feedback was used; the time delay would be fixed to a single value as long as the process was running. It later appeared to be an important characteristic in the process leading to the *Canons*.

2.3 Induction as Method of Construction

The main issue that the work on the *Canons* tried to approach, is what sound actually is. The praxis of electronic composition in those days consisted of composing sounds in an electronic studio, using a (growing) variety of apparatus for synthesizing and transforming sounds, and recording those sounds on tape. The final product of such labour was a composition of sounds fixed onto a medium, the tape. The sounds as they were fixed onto the medium and the sound heard during an actual performance were one and the same. They were the same not only actually, but also conceptually.

In an attempt to move away from such ideas, Raaijmakers introduced a view on sound by making a distinction between sounds-towards-the-loudspeaker and sounds-from-the-loudspeaker. Although this appears to be a confusing and theoretical distinction, he appears to have made it in order to clearly point out where the attention of the composer should be directed: to the sounds-from-the-loudspeaker. In other terms, that which was heard during a performance should become the subject of composition. Composition certainly did not stop with fixing sounds onto a medium.

Additionally, when Raaijmakers introduced the concept of from-the-loudspeaker sounds, he was not just thinking of a pair of loudspeakers, or even maybe four or five. He envisioned a setup with many rings of loudspeakers that

would all contribute to a morphological experience of sound in the space where the audience was. Such an experience could even lead to different morphologies being heard at the same time, depending on one's position in that space.

The boundary between sounds-toward-the-loudspeaker and sounds-from-the-loudspeaker could only be transgressed/passed successfully once morphology was well understood. Raaijmakers expressed it as follows:

> *Composing morphologies will only connect logically to composing sound itself once morphology is fully understood.*[8]

The experiments he had been conducting based on auto-synchronization interestingly made clear the relationships between sounds-toward-the-loudspeaker and sounds-from-the-loudspeaker. Although the final result is created by overlaying many copies of the same sound with short offsets, it would be possible to think of a spatial setup that would lead to the same result. If the entry delays would be regarded as distances in time, by carefully spacing an array of loudspeaker and playing a sound to each of them simultaneously, the same result could be achieved. The distance to each loudspeaker would have to be approximately 10 meters.

It was through another experiment that he became aware of such relationships. He had taken the voice of a whining music-critic and created a 64-fold overlapping version. When this result was combined with the original fragment but on a lower volume level, it suddenly sounded as if the voice had been recorded in a cathedral.[9] In this way a relationship revealed itself between a method of sound production—auto-synchronization— and spatial characteristics.

Based on these insights, Raaijmakers introduced the term inductive composition. This was proposed as a method of composition in which primary original sounds played through loudspeakers would cause or induce sounds in the performance space. Such primary sounds would function as inductors. The result of this method of induction would be various so-called states of morphity. Auto-synchronization was explained to be a special case of induction.

As consequence of this thinking, a single primary sound would be able to induce at different moments a variety of sounding outcomes. With this step, the focus moved to the primary sound and from experiments it becomes clear that

Raaijmakers was trying out a variety of sounds in order to build an understanding of what the primary characteristics should be like in the context of inductive composition.

Apart from the experiments with voice, there are other examples where sounds from different origins were used. Some of them were instrumental sounds, sometimes layered or transformed. Other sounds had a synthetic origin. A consideration for these experiments seems to have been how a primary sound would behave in different states of morphity. From the examples, it could be concluded that what would work well were the dense morphologies, but in the examples with lower densities, the original sound would be very recognizable in an undesirable way.

Raaijmakers had introduced the concept of morphity-index, at least on a theoretical level, describing to what extent an original sound had morphologically transformed away from its inducing sound. The higher the index, the further away from the original. The challenge was to find the best candidate for an original sound or inductor which would allow such transformations in a convincing way for any morphity-index—low or high.

2.4 Double-pulse

In a letter to Spek dated 26 May 1964, Raaijmakers reported on a new discovery that he stumbled upon while working. This discovery dealt with the control of time on a micro-temporal scale. In the process of feedback using two tape recorders, the smallest time delay possible would be around 2 seconds, due to the physical distance of two adjacent tape recorders and maximum tape speed of 19 cm/s. The smallest distance required for creating the densities in the case of Eimert's voice speaking 'Diese Teiltöne' would be 1/16th of a second which would relate to approximately 12 mm of white tape. This procedure relied on exactly starting two recorders simultaneously. The precision of the procedure was not all exact, which can be heard in the example.

Creating precisely controlled smaller offsets was not possible with regular equipment.[10] But in a letter from 17 January 1964 to Raaijmakers, Spek had

shared the following idea:

> *What do you think of a flutter-head that serves to read full track, consisting however of two half-track parts of which one is moveable?*

For a two-track tape recorder, a playback head consists of two elements both scanning a section of the full tape width. If these two parts were separated and one would be made moveable, this would allow a signal recorded to both tracks to be reproduced with tiny offsets during playback.

Clearly, in order to realize this, an existing tape recorder would have to be modified. Apparently Raaijmakers had done that between January and May and he must have been testing this new flutter-head with a variety of materials. One of those materials was a simple impulse.

With any other sound the audible result would have been something like phasing, also known as flanging. A sound structure would overlap with itself with a tiny offset, adding to the sound a pitch-like impression. But a single pulse would have already finished by the time it reached the second playback head, and what remained was this pitch effect reduced to its core. It was as if in this way Raaijmakers had found a method to remove the unnecessary and excessive parts of any sound, revealing a reduction of sound that could not further be reduced: the double-pulse. With this double-pulse a number of problems were addressed.

As it was extremely short, the result of auto synchronization would remain very transparent. Other sound had the tendency to quickly become blurry or massive and make further morphological change impossible. Furthermore, the double-pulse worked very well for all densities on the scale from original to complete horizontal morphity. Where in the first step of auto synchronization any sound would simply sound like it was being repeated, as an echo, the double-pulse would focus on the rhythmical aspect of repetition.

At the same time a double-pulse was different from a single pulse to the extent that it allowed for making a variety of distinguishable materials, that could be juxtaposed in a composition.

And where in the beginning Raaijmakers was thinking of circular arrays of loudspeakers—something that would anyhow be unrealizable for economic reasons—the double-pulse as material worked well with a much smaller number of loudspeakers, even with one or two. The reason for this had to do with an

additional quality of the double-pulse, which is that it interacted very strongly with the acoustics of the room in which it was played.[11]

The double-pulse was an extremely important step in the research of Raaijmakers. He writes:

> *Also, with 8 different double-pulses as prime characters, I made various structures. You have to hear them!*[12]

Raaijmakers was here referring to material that later was used in *Canon-1*. In the last sentence, he clearly showed his enthusiasm about the material. Most likely the reason was that with this discovery, everything started to fall into place and he could take the next step, that of working out a compositional logic that would allow him to organize the material in time.

2.5 Compositions and Parameters

Having identified the double-pulse as the main material and the process of auto-synchronization as the method of creating various materials, Raaijmakers had to identify the parameters that he could organize in order to work towards different outcomes. When, in his letter to Spek, he spoke of eight prime characters—also called compositions or k.—he referred to eight different double-pulses, each having a distinct pitch quality. This pitch parameter could be said to be the main starting parameter. Regardless of any future treatment in terms of auto-synchronization, the outcome would always exhibit this pitch.

The eight pitch qualities were the result of positioning the flutter-head with eight different distance values. When a frequency is referred to as a certain number of cycles per second—261.63 Hz for the middle C on the piano—then the reciprocal of this value expresses the fraction of a second that a single cycle takes—3.82 ms in the case of 261.63 Hz. If the flutter-head would be moved away from the fixed one by the amount of 3.82 ms—0.73 mm with the tape traveling at 19 cm/sec—then the double-pulse would have a clear pitch characteristics of a C.

The precision of the mechanics was not such that these exact settings could be made, however, it was very straightforward to tune the system to a reference pitch from a tuning fork or piano.

Other parameters that Raaijmakers defined based on the diagram of the double-pulse were the width of each of the two pulses themselves—calling it timbre—the loudness of both pulses and the relation of loudness—form.

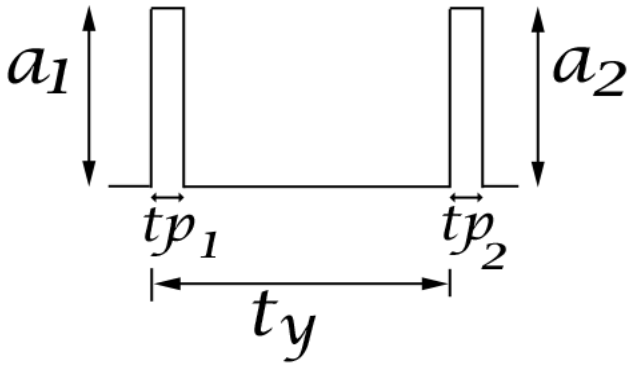


Image 3. Double-pulse

Apart from the parameters for the qualities of the double-pulse, additional parameters had to be defined for the process of auto-synchronization. The nature of this method had changed with the reduction of the material to the very short double-pulse. When auto-synchronization was performed on longer sounds, such as from the experiments using recorded voice, the procedure would at its first step already create an overlap. With double-pulse this was not the case.

As mentioned before, the rhythmical aspect started to become a more obvious quality. An initial material could be constructed of several individual double-pulses that were separated in time. If auto-synchronization would be applied and repeated often enough, the process could lead to continuous sounds. Raaijmakers found, while working, that there were clear relationships between the original structure, the number of steps of auto-synchronization and the final sounding result.

This relationship was expressed in two parameters, morphity-index and density-quotient, that he defined along the way. The first would refer to the instantaneous density being related to the number of steps of auto-synchronization, while the second explained the variation in density of a sound structure, being the result of the choices made while creating the original pulse

structure.

Compositionally speaking, these parameters, while technically the result of auto-synchronization, would result from an organizing concept that gave rise to values for the various parameters. Such a concept would also control the order and duration of longer sound structures in the final composition. In order to logically organize these concepts, Raaijmakers introduced a graphical method.

2.6 Graphical Notation

Even before the double-pulse entered the stage, Raaijmakers was experimenting with methods of graphically organizing the process of morphological state changes. He adopted an approach that made use of diagonal lines in a Cartesian system where the horizontal line referred to the progress of time, and the vertical line to the morphity-index. The diagonal line then could be seen as a trajectory on which the morphological state change of a certain character could be followed.

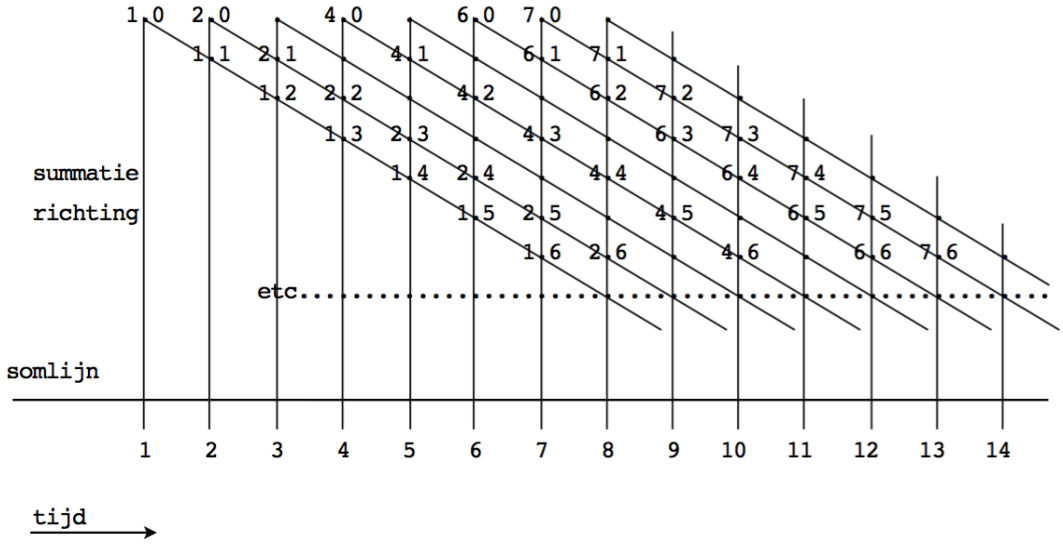


Image 4. Graphical Notation

This was a first attempt to build a logic of characters and their morphological states based on summation, introducing a procedure that could be notated

graphically. It is interesting to see that this notation method had a strong resemblance with the graphical representation of the first auto-synchronization experiments. That graph that Raaijmakers drew in one of his letters to Spek, shows with a diagonal line how time offsets create a structure.

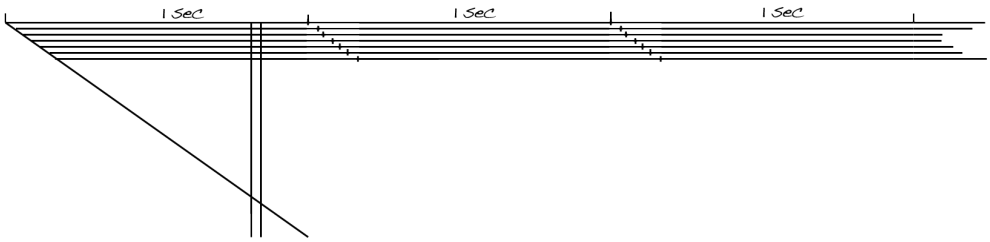


Image 5. 'Diese Teiltöne' representation

With the double-pulse and the introduction of iteration, the notion that density was increasing logarithmically led to a logic where summation was replaced by multiplication. The procedure for notation was adjusted to fit in a Cartesian system with logarithmic scaling.

It appears that what Raaijmakers had in mind concerning this score, was not merely to create a graphical representation of the music. Notation was going to be part of the procedure that would create the final composition. With the introduction of the graphical score, he also introduced a set of operations that would control state changes. These operations could be executed in the graphical environment on representations of compositions or basic sound characters.

3.

A Morphological Composition: Canon-1

Starting from the most basic material that he had discovered—the double-pulse—that through iteration and auto-synchronization could be transformed into dense morphological units, Raaijmakers had defined the appropriate material for a morphological composition. Moreover, with the help of graphical notation he had set up a system for controlling the overall structure of the composition, as well as methods that dictated the state of local microstructures within that overall structure.

With these steps, he had outlined the conditions for *Canon-1* to come into existence. What follows is a summarization of how Raaijmakers constructed it step by step, from the starting material, to the overall structure and to the detailed features.

3.1 Basic Material

The starting material of *Canon-1* consists of a series of eight pitches, that through the procedure of repetition with the flutter-head are translated into double-pulses spaced according to the period of these pitches. The series starts at G#1 and each consecutive pitch is at an interval of a fourth above.

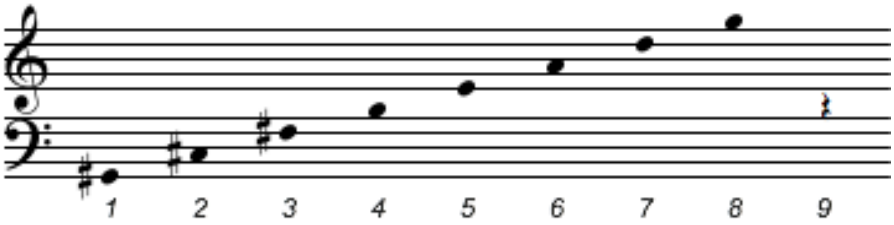


Image 1. Eight starting compositions

These eight double-pulses are called composition k.1, k.2 and so forth up to k.8. Together they form the primary k.series. All the sound material occurring in *Canon-1* is derived from these eight compositions.

While the distance t_y controls the distance between the individual pulses—and hence their pitch characteristics—for each of the 8 compositions, the space between each of the members is controlled by t_x. For *Canon-1* t_x is set to 1 second and is therefore much larger than t_y for each of the characters. Practically speaking the sum of t_x and t_y approaches one second for each of the compositions.

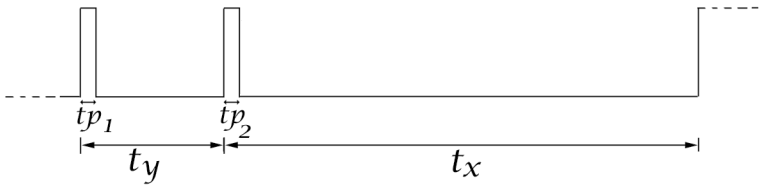


Image 2. Double-pulse

With the t_x of one second, the first eight seconds of *Canon-1* are occupied by these eight compositions in their original or first state of morphity. However, they are mute and not present in the final result. Although not audible themselves, defining these eight compositions and their spacing creates the beginning point of *Canon-1*

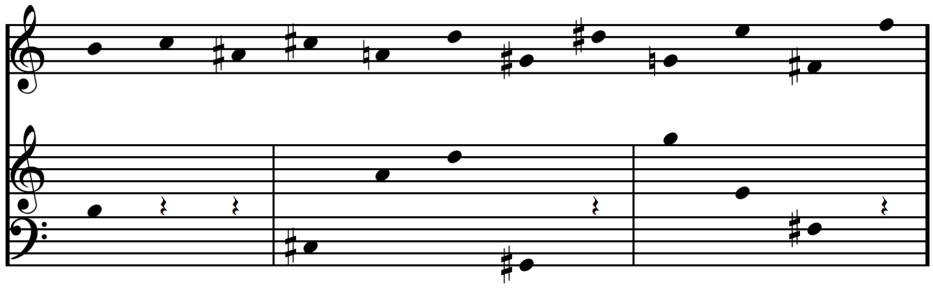
3.2 Inducing Generations

This original series of compositions is projected onto a field in various ways where they generate either sound material or synchronization points.

The first step is that three all-interval series are used to reorder the original series of pitches. They become the first generation of three induction series. The first two of these three induced series generate sounding material, whereby each member undergoes a morphological state change. This state change or s.number is calculated by dividing the time offset in seconds by the k.number.

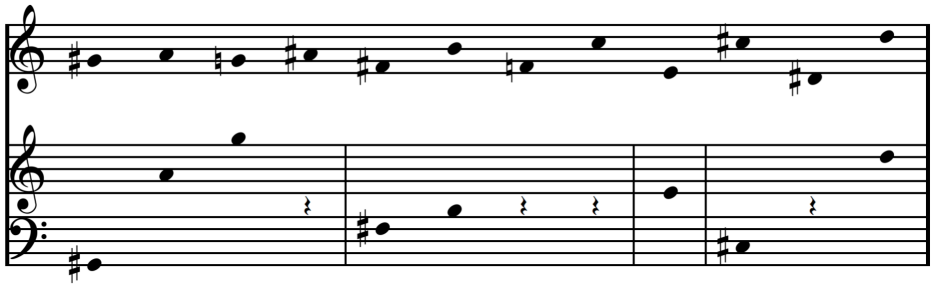
The first induction series (green) starts at four seconds—in this way k.4 of the primary k.series and k.4 of the first induction series are synchronized—and takes the t_x of the original series. The second induction series (red) starts at 10.5 seconds and the t_x of its members are half the original one—half a second. A possible reason for choosing these offset and spacing values, is that k1 and k8 of both series in this way are placed adjacent. Moreover, with the chosen settings for the third induction series, all k.5 of these three primary induction series are grouped together.

In these first two induction series, characters are formed by grouping members together. These characters are numbered, three for the first one and four for the second.



K.nummer	4	.	.	2	6	7	1	.	8	5	3	.
Somlijn	4	5	6	7	8	9	10	11	12	13	14	15
S.nummers	1	.	.	3.5	1.333	1.286	10	.	1.5	2.6	4.667	.
Karakter	1			2	2	2	2		3	3	3	

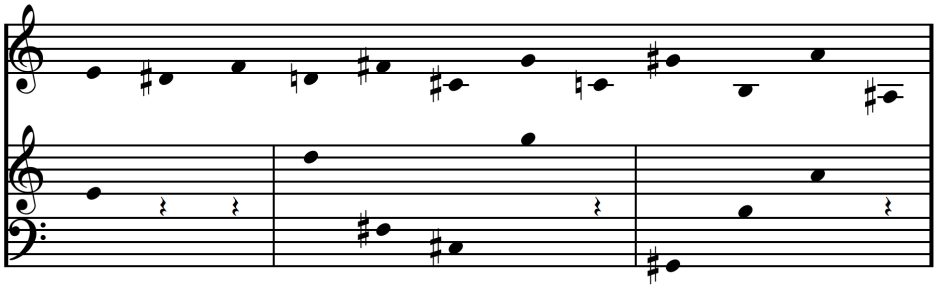
Image 3. First induction series (green)



K.nummer	1	6	8	.	3	4	.	.	5	2	.	7
Somlijn	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16
S.nummers	10.5	1.833	1.438	.	4.167	3.25	.	.	2.9	7.5	.	2.286
Karakter	1	1	1		2	2			3	4	4	4

Image 4. Second induction series (red)

The third induction series (purple) has a different function. Instead of generating sounding morphities, it structures the final composition by generating time offsets. These offsets become the synchronization point for other events. The method used for this is one based on accumulation, which implies that the structure is augmented as time continues—this feature gives *Canon-1* it's title (Super Augere).



K.nummer	5	.	.	7	3	2	8	.	1	4	6	.
KS	13.75	.	.	22	25.143	33.524	50.286	.	62.858	125.716	157.145	.
S.duur	2.75	.	.	3.143	8.381	16.762	6.286	.	62.858	31.429	26.191	.
aantal	3	.	.	1	1	1	2	.	1	1	2	.
veldgrootte	8.25	.	.	3.143	8.381	16.762	12.572	.	62.858	31.429	52.382	.
eind somgetal	22	.	.	25.143	33.524	50.286	62.858	.	125.716	157.145	209.527	.
eind K	16.5	.	.				56.572	.			183.336	.
Karakter	1			2	2	2	2		3	3	3	

Image 5. Third induction series (purple)

From this list of values, we can understand that the total duration was going

to be almost 210 seconds, or three and a half minutes. Raaijmakers indeed mentioned that duration in a letter dated 16 June 1964.

Next, these three series are plotted in a graph with logarithmic axes. The horizontal axis denotes both time and composition number, the vertical axis the state of morphity. The diagonal line follows the change of state of morphity for a single composition (k.).

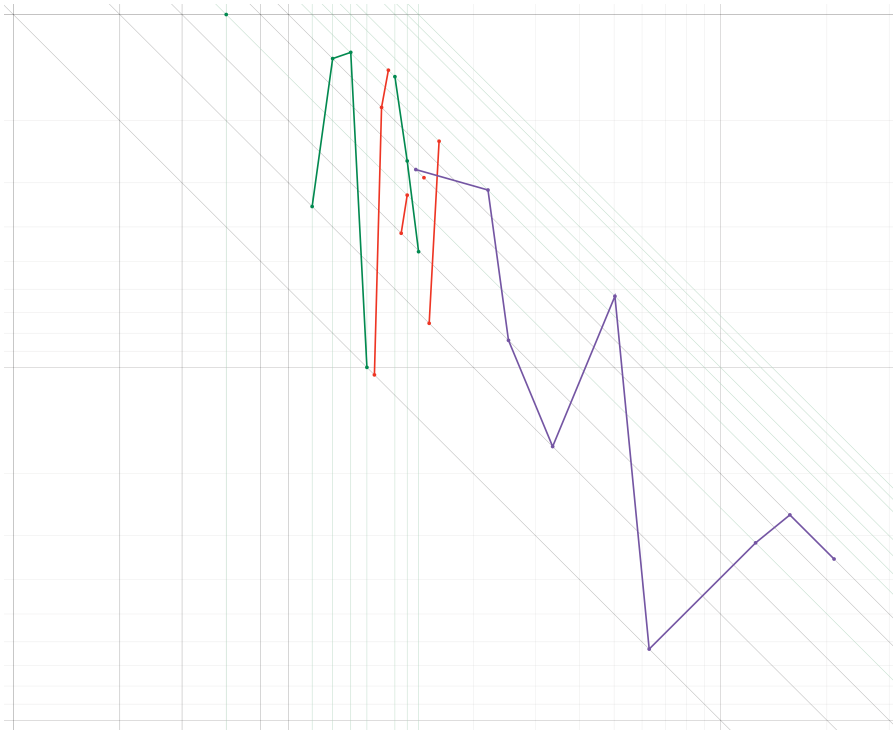


Image 6. First three induction series

Then a second generation of series is created. The first two take the 1st and 2nd induction series which are 'promoted' to two secondary series by projection on the line x=1, starting a new diagonal line—or path—for each of its members. In a sense these lines represents a next generation of compositions (k.). The third secondary series (brown) combines aspects of the first and the third induction series of the first generation. The resulting series both produces sounding morphities and is promoted to create new paths in a next generation.

1e sec. K.nummers	4	•	•	7	8	9	10	•	12	13	14	•
Idem in prim. K.nrs	4	•	•	2	6	7	1	•	8	5	3	•
De 3e permutatie van prim. K.nrs	5	•	•	7	3	2	8	•	1	4	6	•
Idem in 1e sec. K.nummers	13	•	•	9	14	7	12	•	10	4	8	•

K.nummer	13	.	.	9	14	7	12	.	10	4	8	.
KS	13.75	.	.	16.924	18.804	20.147	23.025	.	26.863	29.549	36.936	.
S.duur	1.058	.	.	1.88	1.343	2.878	1.919	.	2.686	7.387	4.617	.
aantal	3	.	.	1	1	1	2	.	1	1	2	.
veldgrootte	3.174	.	.	1.88	1.343	2.878	3.838	.	2.686	7.387	9.234	.
eind somgetal	16.924	.	.	18.804	20.147	23.025	26.863	.	29.549	36.936	46.17	.
eind K	14.808	.	.				24.944	.			41.553	.
Karakter	1			2	2	2	2		3	3	3	

Image 7. Third secondary series (brown)

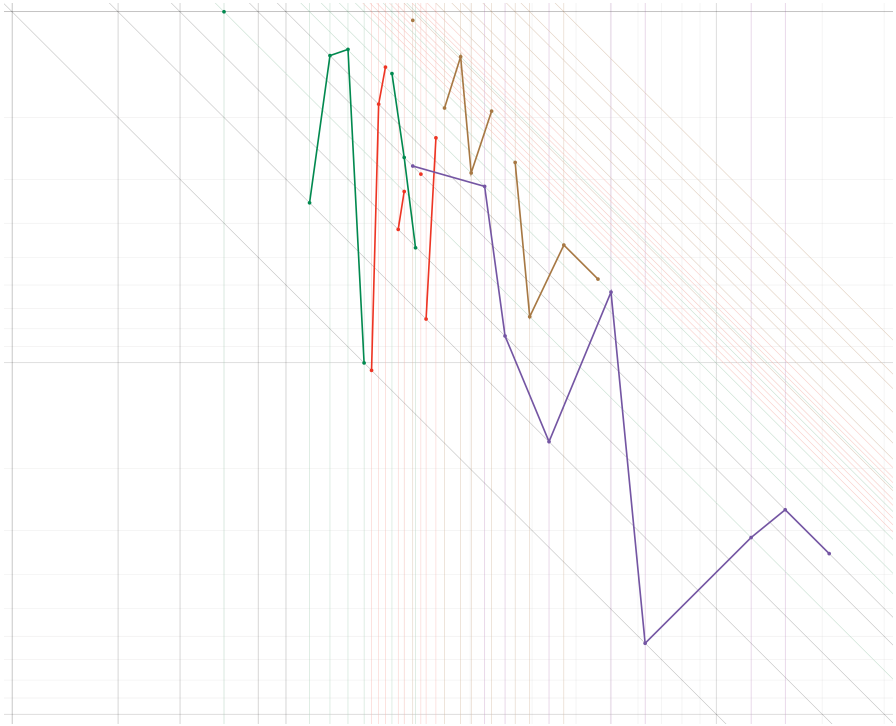
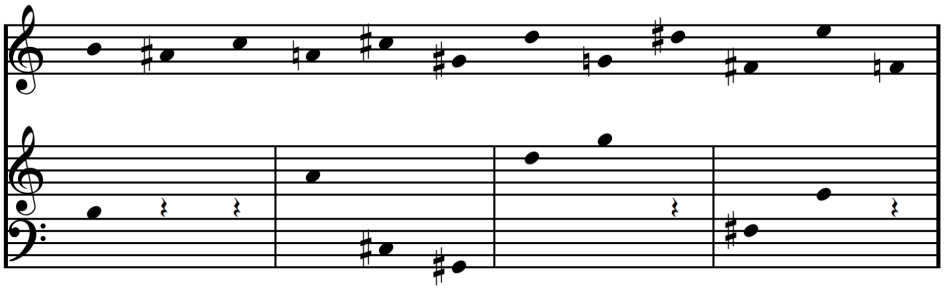


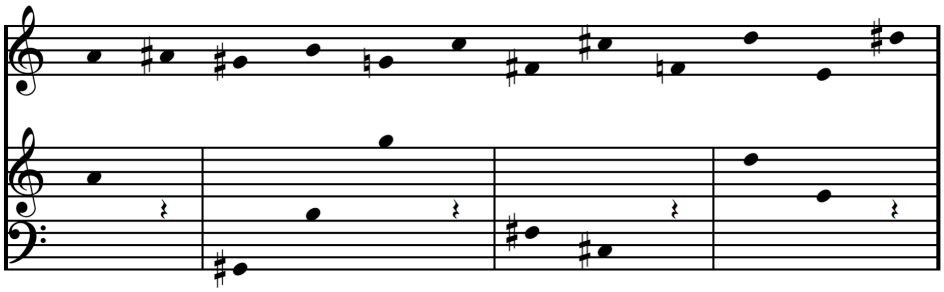
Image 8. First and second generation series

The purple series that augmented the structure has created a one minute distance between 62.828” and 125.716”. New material is generated to be exposed in this time. Two additional permutations construct the fourth (black) and fifth (blue) induction series, starting at 69.1 and 86.4 respectively.



K.nummer	4	.	.	6	2	1	7	8	.	3	5	.
KS	69.1	·	·	71.0	71.7	74.3	82.1	84.3	·	88.7	96.1	·
veldgrootte	1.9	·	·	0.7	2.6	7.8	2.2	4.4	·	7.4	11.8	·
Karakter	1	·	·	2	2	2	3	3	·	4	4	·

Image 9. Fourth induction series (black)



K.nummer	6	.	1	4	8	.	3	2	.	7	5	.
KS	86.428	·	86.857	86.857	86.857	·	90.500	90.500	·	99.428	99.428	·
S.duur	0.214	·	1.714	0.857	0.536	·	1.786	3.571	·	2.041	3.265	·
aantal	2	·	1	1	2	·	1	2	·	1	2	·
KS Eind	86.643	·	88.571	87.714	87.393	·	92.286	94.071	·	101.469	102.694	·
Karakter	1	·	2	2	2	·	3	3	·	4	4	·

Image 10. Fifth induction series (blue)

Finally, one new point is created in the structure of the *Canon*. For this procedure k.5 plays an important role. The primary k.series is scaled up to the full duration of 209.6 seconds, after which the fifth element (orange) is looked up in terms of starting point. This occurs at 104.8 seconds.

A generation tree clarifies the relationships between the original material and the three generations of induced material.

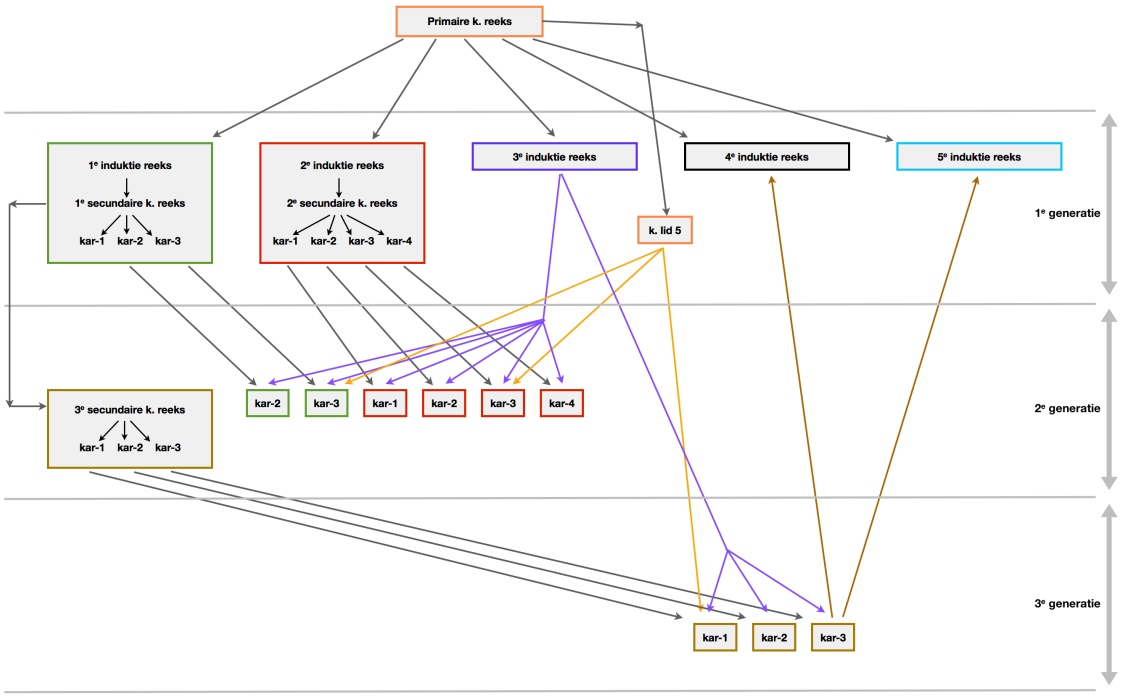


Image 11. Generation tree

3.3 Constructing the Field

With the first and second generation of series, both the basic material and the backbone for the final composition are planned. The next step consists of filling in this structure with material. The characters 2 and 3 of the first secondary (green) and the characters 1, 2 and 4 of the second secondary series (red) induce a 2nd generation of states, whereas the characters 2 and 3 of the 3rd secondary series (brown) induce a 3rd generation of states.

A logic is created according to which time values—both starting point and duration—can be calculated. At the core of this principle lies the relationship of composition number and state of morphity.

The third induction series (purple) organizes how the induced 2nd and 3rd generations are placed in time. Also, the way these characters are synchronized is determined by it. Of this series, the first two time offsets (13.75” and 22”) are not used.

offset	purple	character	name	k's	sync k
25.143	3	green 3	I-b	8 - 5 - 3	8/5/3
25.143	3	red 2	II-b	3 - 4	3
33.524	2	green 2	I-c	2 - 6 - 7 - 1	2
33.524	2	red 4	II-c	2 - 7	2
50.268	8	green 3	I-d	8 - 5 - 3	8
50.268	8	red 1	II-d	1 - 6 - 8	1/6/8
50.268	8	brown 2	III-b	7 - 3 - 2 - 8	8
62.858	1	green 2	I-e	2 - 6 - 7 - 1	2/6/7/1
62.858	1	red 1	II-e	1 - 6 - 8	1
62.858	1	brown 3	III-c	1 - 4 - 6	1
125.716	4	red 2	II-g	3 - 4	4
125.716	4	brown 3	III-e	1 - 4 - 6	4/6
157.145	6	green 2	I-g	2 - 6 - 7 - 1	6
157.145	6	red 1	II-h	1 - 6 - 8	6
157.145	6	brown 3	III-f	1 - 4 - 6	1/4/6

Image 12. 2nd and 3rd generation characters

Additionally, at the time offset generated by k.5 the characters of the green, red and brown series containing k.5 are positioned. They are synchronized on basis of that fifth element.

In this way step by step a field is constructed in which characters, created from groups of compositions, are placed in a plane. Based on this, the final score can be completed.

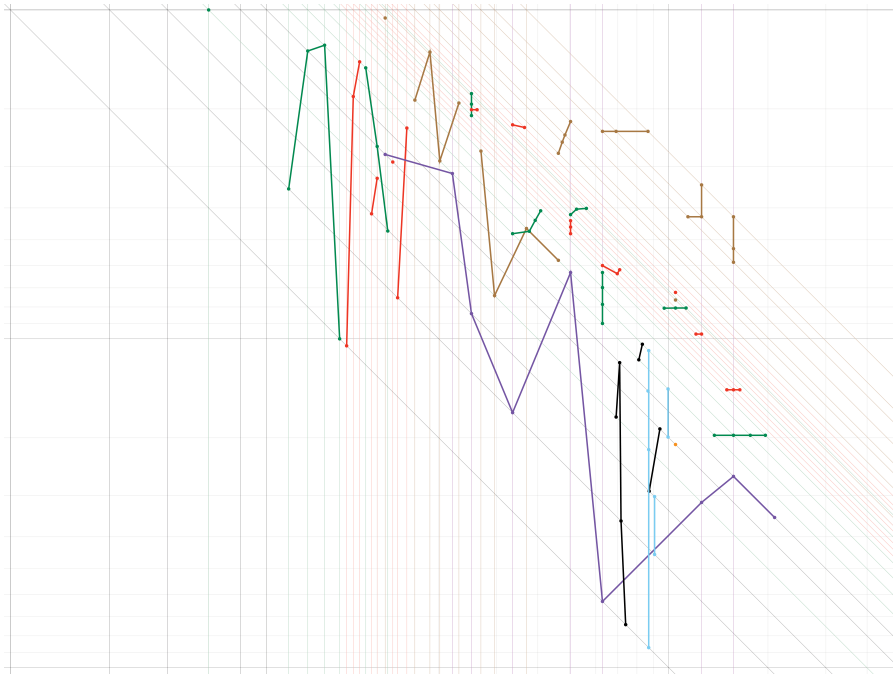


Image 13. Complete score

3.4 Generating States

With all characters in place, the next step deals with the local characteristics of each of the compositions. As for instance the first induction series (green) shows, based on the placement of each of the compositions, the state of morphity is different. For instance, k.2 of this series starting at 7 seconds has a state of morphity of 3.5.

This state of morphity strongly relates to procedure of iteration and auto-synchronization. The further this process is taken, the more continuous the resulting sound can become. This implies that the values for state of morphity need to be interpreted in relation to that process in order to give meaning to a value like 3.5. However, based on the choice of characteristics for setting up this process, the final result can be of a great variety. In a way, a single parameter does not capture that variety.

In order to get grip on this issue, Raaijmakers introduces another parameter that deals with the density of the sound characteristics and he names it the

density-quotient. With this second parameter, a sound can have different aspects measured along two axes. A high state of morphity combined with a low density-quotient could mean that a densely overlapped sound is broken up so that the morphity is revealed in short bursts.

Rather than creating the material for compositions in a certain state of morphity with a certain density-quotient, he selected them from previously made state-tapes. These tapes contain a large collection of morphological changes of the eight original compositions based on different variables for the process of auto-synchronization.

At the beginning of this process of selecting material, Raaijmakers made a decision concerning duration. The duration for each of the compositions is the result of various methods of calculus and the third induction series (purple) generating the backbone of the final composition has its endpoint at 209.5 seconds, which would roughly translate to 3’30”. At the tape speed at which he is working, one second would relate to 19 cm of tape. But at this point he decided to translate one second to 30 cm, thereby scaling all time values with a factor of roughly 1.58, leading to a final duration of 331 seconds, being 5’31”.

A reason for this choice might have been that with the original speed the tempo in the beginning would have been very high. Maybe during construction this led to problems that were solved by scaling everything up.

3.5 Final Distribution

The final stage in the process of composing *Canon-1* is bringing all the material together. Practically speaking this meant mixing and splicing together the pieces of selected material, and offsetting them using white tape. As an intermediate step, at some point Raaijmakers had three complete mono tracks, one with all green characters with the black inserted, one with all red and blue inserted, and finally one with all brown characters.

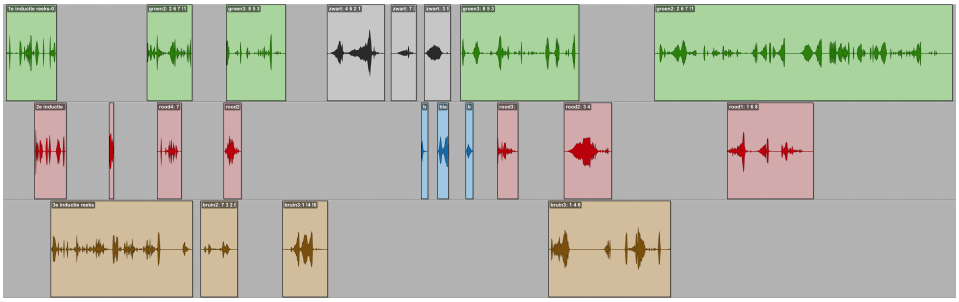


Image 14. Overview characters per track

The three final tapes are mixed together using a scheme the explains how each of the characters is copied to either the first or the second track of the final result.[13]

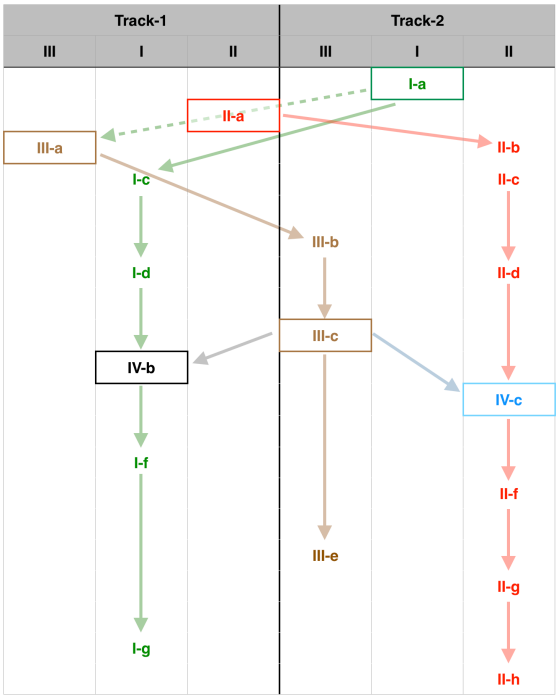


Image 15. Distribution table

On basis of an analysis of this scheme, as well as the three tapes, it becomes clear that Raaijmakers decided not to include all the designed characters. There could be a number of reasons that contributed to making this decision. Most likely by including all characters, the density would become such that the overall clarity would suffer. At this stage Raaijmakers had dropped the idea of using many loudspeakers and was aiming for a two track final result. Maybe if he would have been able to use more tracks—for instance four, playing over four

loudspeakers—that would have given enough spatial playing field to include all characters.

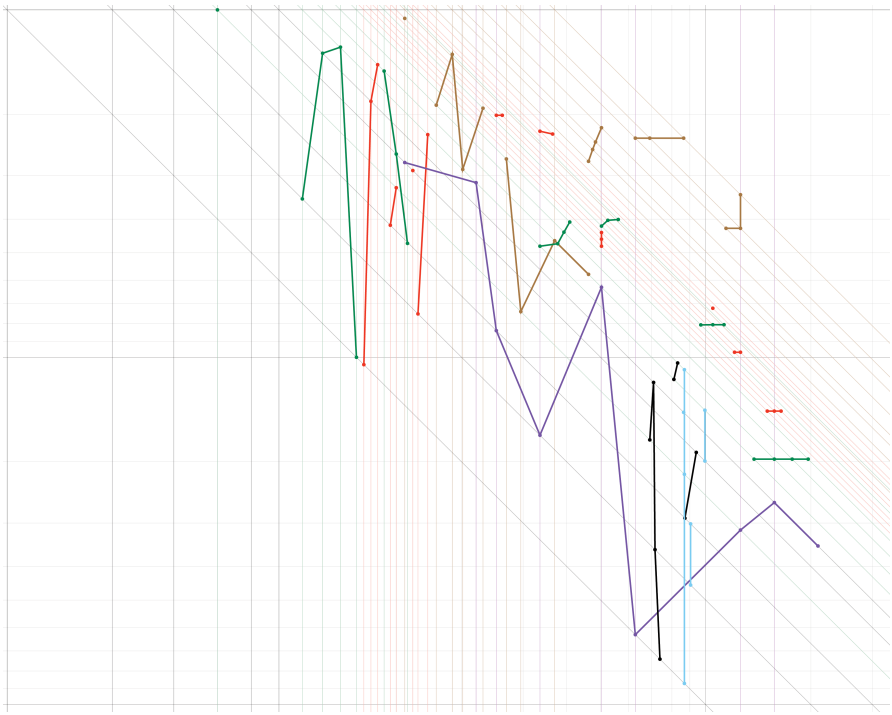


Image 16. *Canon-1* the final composition

4.

A Reflection

The work that resulted in the *Canons* served as a research for Raaijmakers in order to find proper methods and clear descriptions for electro-acoustic composition. Later in his life, Raaijmakers has reflected on this research on several occasions. For instance, in *Cahier «M»* he thoroughly describes his ideas concerning the morphology of sound. By that time, he had been able to take some distance from what he did in the period 1963-1965. Moreover, he had opened new—and probably clearer—perspectives on the matter.

This chapter reflects on the ideas as he introduced them, returning to the time frame in which he actually worked on the *Canons*. The reason for this is to reconstruct, based on what he wrote at the time, the path that Raaijmakers took. Doing this allows for making connections to various subjects, probably including those that he didn't see. Finally, this chapter evaluates the methods used that led to *Canon-1*.

4.1 New Paradigms

The most important yet hermetic concept that Raaijmakers introduced is what he referred to with the term morphity (Dutch: morfiteit). The term does not exist in the English language. The Dutch word that it substitutes is non-existent as well. When he introduced it, he wrote that it represented a desperate move[14] (to express his thoughts). In this context, it is relevant to understand that

morphing is relatively new concept, related to digital technology—e.g. the morphing of one image into another. In order to understand better Raaijmakers' ideas, the scope of this term requires some attention.

The root of morphity can be found in the Greek word morphé. This could be translated to form or shape; however, it is important to point out that this word creates a relationship between the essential—inner—substance and the outward expression. This relationship could be a description in general terms—clouds and the water droplets of which they consist—but the addition of the suffix -ity makes it point to a specific instance. At that point it becomes interesting how, for the specific instance, the forces that create shape out of substance are at work.

Defining these three components—substance, shape and forces—clarify the conditions under which morphological change can become subject of composition. It is not so much about the notion that something has a changing shape, but how the change of shape comes about that comes to the foreground.

Raaijmakers wrote:

> *If I would try to define morphity, I would call it a momentary aggregate state of sound.*[15]

This definition introduces the term aggregate, which implies that many particles or fragments together form such a morphity. Since morphity deals with sound, particles or fragments could be understood to be sound paths.

> *A sound does not travel one path, but millions. Think of a clock in a tall tower and then of all the houses and fields around it. Even between the sound source and the ear, a thousand paths are imaginable. That which enters our ear in composed form we call "sound."*[16]

According to this example, sounds that enter the ear can be regarded as a summation of many paths that a single original sound has travelled before reaching it, each path reporting how it has travelled. As a sounding object radiates sound waves spherically, those waves encounter numerous objects from which they bounce off, potentially creating a great variation in sound paths.

This variation implies that the same sound having travelled different paths might lead to different perceived sounds in different places. Raaijmakers ideas

indeed were based on the assumption that it should be possible to hear in the same moment different sounds in various places of the hall where a composition was performed.

However, Raaijmakers was not at all interested in the acoustical phenomena that his model referred to, but tried to find ways to make those processes the subject of morphological composition.

> *The subject of morphity is the change that sound undergoes in space. The science of these changes is called acoustics, and has nothing to do with music. However, these changes first have to be elevated to a musical level and connected to essential musical quantities, before morphity itself can become a subject of composition.*[17]

Finding those essential musical quantities was a crucial undertaking and in the view of Raaijmakers it should lead away from thinking in terms of traditional parameters such as pitch, intensity, timbre and duration. He hoped to find them in the mechanics for state changes of morphities themselves.

Summarizing, the sounds in a morphological composition could be described as a multitude of simultaneous processes that in a related way interact on an original sound, thereby continuously bringing the morphological characteristics of that sound into a different state, generating varying shapes as a total of those processes. Not the construction of sound, but the interaction with it would become central. Thereby it should be taken into account that multiple—or great many—loudspeakers would have to be used in order to realize multiple simultaneous perspectives.

From the start, it was clear to Raaijmakers that, with the available tools in the electronic studio, this could never be fully realized. Methods were needed which would allow one to work on the smallest possible scale of the movement of sound. Somewhere he mentioned a time scale of one ten thousandth of a second.[18] In relation to this he described a primitive method incorporating digital computation that would be able to give access to this smallest time scale.

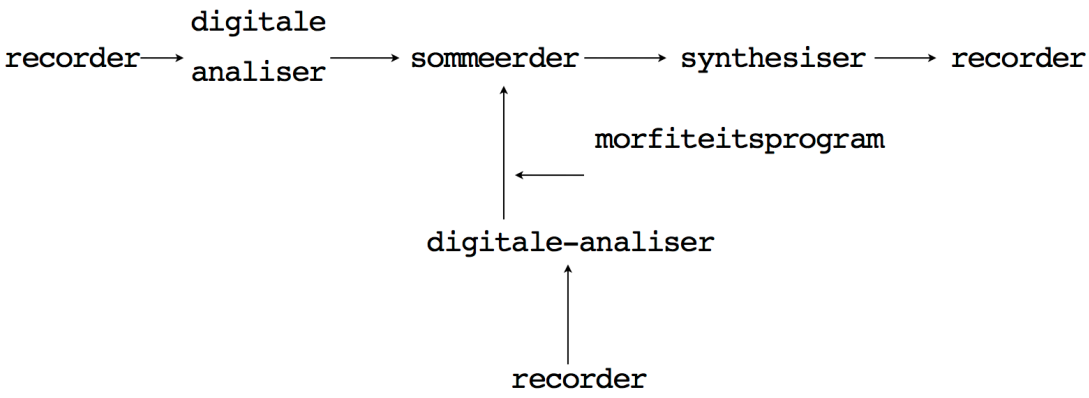


Image 1. Schematic view morphological composition device

4.2 Attempting Generalization

In describing a method for morphological composition, it is clear that Raaijmakers attempted to create a general description that goes beyond a personal set of choices made for a single composition. The attempt to generalize could be considered from a number of viewpoints.

First of all, such generalization had not been attempted before. There were methods available for composers that wished to work in an electronic studio. An example of such a method is the Bilthoven Course[19] material written by G.M. Koenig, where a step by step introduction to devices and methods reveals an approach to electro-acoustic composition. But is seems that Raaijmakers wanted to describe a systematic approach that went beyond the description of available devices and their methods, including approaches to working with apparatus that had not yet been invented.

It seems that an important reason for such an attempt was to spark debate about the development of the field of electro-acoustic composition. In order to allow such debate to happen, Raaijmakers tried to introduce a vocabulary that could be shared among his peers. Since the field was so new, the vocabulary he put forward was built on non-existing terminology. Morphity is a clear example of such terminology.

During the process Raaijmakers was often encouraged by Jaap Spek to move forward. In his letters, he calls Raaijmakers ideas lucid, going further than anyone and making the work done in Cologne look old-fashioned.

4.3 The Title Canon

It is not clear at which point and for which reasons Raaijmakers decided to adopt the term canon to name his first composition. The earliest mention in his own notes is on 18 April 1964. This was in the context of constructing a *Canon* that was never realized and most likely before the double-pulse was introduced. The first time he mentioned it in his correspondence to Jaap Spek is in a letter dated August 2, 1964. There he mentioned it in reference to *Canon-1*, which was by then already finished, but he gave no explanation for the reasons of choosing this title.

Analysis of *Canon-1* shows that canonic techniques do not at all play a role on the level of composition comparable to the contrapuntal operation from which the terms stems. Structurally speaking there is no overlapping repetition of material that create a sense of counterpoint.

Yet, the experiments by the end of 1963 in which he had used voice and other sounds to create densities were based on canonic techniques, as the same material would repeat at equal distances creating overlapping structures. Rather than structural—or contrapuntal—the result of these overlaps was regarded by Raaijmakers in terms of their timbral characteristics. It could be said that the canon technique was at work on a micro-temporal scale contributing to a morphological structuring of sound.

Later, when the material was reduced to pulses, it could be said that the double-pulse was created through a canonic operation—one pulse being repeated once with a short offset. However, strictly speaking this was not a canon, as the first pulse had finished before the next started.[20]

When Raaijmakers started building densities from these double-pulses, although it was done with the same technique of repetition of the late 1963 attempts, the result would not lead to a material in which exact repeats were

perceptible. Rather, the repeats were varied in terms of offset so that, more than anything, the final result could be regarded as stochastically varying densities.[21] The operation could be called a canon, the result was certainly not that.

Another aspect of the term canon is that it comes from the Greek word for 'rule'. Indeed, the musical term canon is a contrapuntal rule, but rule could be extended to mean more generally a compositional rule. When he expressed what a morphological composition environment should look like, he introduced the term morphity-program. Although Raaijmakers never explained what this exactly should look like, this could be described, from today's perspective where the use of computers for composition has become common, as a unit that would be capable of evaluating instructions that were defined by the composer. Such a unit would have made it possible to test a variety of rules or formalizations other than traditional contrapuntal ones.

4.4 Action Music

The actual sonic material of *Canon-1* was the result of combining the discovered double-pulse with the method of building morphities, creating dense overlaps. With eight differently pitched double-pulses Raaijmakers constructed a great variety of morphological states. It allowed him to experience the variation in terms of the characteristics of such states. The work that resulted from this procedure was captured on three so called state-tapes.

He worked on the first of these state-tapes in the period May 10th to 16th, the second from May 17th to 30th, and the third from June 1st to 5th. Together these three tapes comprise over fifteen minutes of sound material—measured without silences. From among these materials the final sounds for *Canon-1* were selected.[22]

The process of constructing *Canon-1* most likely took place between June 27th and July 8th. In the three weeks between this final stage and the last of the state-tapes, a score was made and tables were produced on basis of which the selection of material took place.

On the 27th of June Raaijmakers copied the most important values to a

working sheet and started working on a table that controlled how material was distributed over two tracks. It is reasonable to imagine that this initiated the work of slicing the material together. Most likely this work was finished on the 8th of July.

This means that all the work from the first double-pulse to the final composition took place in little less than two months. The actual studio work was done within forty days. Taking into account the number of steps required to build up the basic material and the fact that he shared the studio[23] with Jan Boerman, it could be said that Raaijmakers produced *Canon-1* and the state-tapes on which it was based in a relatively short amount of time.

There are several reasons that Raaijmakers could produce this work in such a short time. First of all, he understood very well the equipment in the studio and his vast experience must have allowed him to work quickly.[24] At the same time the nature of the material was such that it did not have to undergo additional transformations after it had been constructed. Furthermore, Raaijmakers reversed the order of making a score and producing the material. It could be said that the state-tapes informed him about the organization of the final composition.

This approach—the material guiding the composition process—was one that played an important role in his earlier work Pianoforte. This work came about by making recordings of 'attacking' the interior of a piano with a variety of objects, making the microphone the instrument. Without having a prior idea about the final work, the composition dynamically grew dynamically beneath his hands from an instantaneous decision making guided by the material itself. Raaijmakers would compare this to action painting, calling it 'action music'.

In the case of *Canon-1* a score was made, based on an abstraction of the material that he was working on. But the concrete sound material that was already there must have definitely given it direction. Where the score dictated differentiations in terms of morphological state, instead of creating those anew for the final composition, he selected them from among the materials on the state-tapes.

4.5 Executing Code

On so many occasion in his letters to Spek, Raaijmakers lamented that he did not have the proper devices to do what he wanted to do, and that new apparatus had to be developed in order to make that happen. Raaijmakers lived in a period where digital technology was step by step introduced in the world of electronics. From nearby, during his work at Philips, he had witnessed the advent of it.

In his ideas that he formed concerning the *Canons*, there are clear traces of digital technology. The clearest example is his drawing of what a device for morphological composition should look like. It is striking to see that a part of this device was indicated as a morphity program. Without having any experience programming computers—which almost no one had—it was clear to him that some code was required that would execute instructions.[25]

He wrote:

> *Electronic music is a craft that requires writing code on tape and not a painting.*

The context in which he wrote these words was a critique towards Stockhausen's skillful use of color in creating electronic sounds. However, there is something about the idea of writing code on tape in relation to the *Canon-1*. The basic material of it was a pulse, which in a sense can be regarded as a brief binary state change. From off, to on, and back to off. A double pulse could be considered as the simple instruction to repeat this binary state change after a short delay.

Every double-pulse that occurred in *Canon-1* then could be the result of an instruction that generated it. That instruction could be a pulse in itself. Seen from this perspective, the entire *Canon-1* could have the outcome of a program that would control the instantiation of double-pulses in time. All the sound material could have been produced like this, instead of with tape-recorders.

Important is the notion that such ideas had a strong influence on his working process as a composer. Even though the densities of doube-pulses he created were all made with tape-recorders, he could produce them relatively quickly and

hence was immediately able to evaluate the outcome in terms of compositional use. This was a very different approach to composition as opposed to one where sounds were designed or imagined after which they would be constructed in the studio.

Another aspect that is worth mentioning is the way in which Raaijmakers dealt with variation in the construction of densities of double-pulses. By 'randomizing' offsets for every step of duplication he discovered that the distribution of double-pulses would have an interesting stochastic character. Since it was himself who cut the tape, it was not truly random, but the outcome was very valuable as it showed something important about how to think in terms of automated processes.

4.6 Evaluation of Methods

With the construction of *Canon-1* Raaijmakers had proven how his morphological concepts could indeed lead to a method of composition in which procedures for organizing a greater structure and generating sound were rooted in the same original principle.

Jaap Spek wrote about it:

> *As a study this piece is more than a success: from the simplest starting point, you reached a complete congruence of idea and result. As sounding work too little imaginative of course, therefor just for a select audience.*[26]

His qualification of the sounding end result might point to the fact that his ears heard something he had never heard before and did not know how to listen to it.[27] In the same letter he advices Raaijmakers to once again put his theory on paper and solve the countless sloppy and diffuse aspects.

Apparently Spek had it found difficult to follow from those letters was exactly he was doing. This is understandable. Often Raaijmakers would introduce terminology in one letter and never return to it, or in the next letter change its meaning. Words were invented without properly describing their scope. And his letters continuously mixed definition and opinion. This all would not be

problematic in the context of developing a very personal view that would lead to a personalized method for composing one ore a number of works. But Raaijmakers clearly had in mind to spark a discussion on electronic composition with his colleagues in the field—and preferably with Stockhausen. In that sense, there was a problem.

Another issue was the actual method that led to *Canon-1*. By the time Raaijmakers had experienced morphities in the form of extremely dense sounds, he started to define mathematical relationships that would logically lead to all kinds of materials. At the beginning, that mathematics was too simple to express the kind of complexity one might imagine would be the result of morphological composition, as it was based on adding and subtracting.

Later this changed to multiplication and division, when he started to work on logarithmic paper. But the procedures that he had thought of by then, based on diagonal lines, was maintained. However, he didn't realize that a straight line on logarithmic paper would be a curved line in a linearly organized graph. Moreover, Raaijmakers saw that the math seemed to confirm his ideas, but apparently, he missed that the math would always lead to the 'correct' answer because of some circular logic going on.

Some of the calculations seem completely arbitrary and are difficult to grasp in terms of the intended relationships. Again, all this would not be an issue, would he not have presented it as a general methodology that could be picked up by anyone. Other calculations, those for state of morphity, were accurate to three values after the decimal point, but nowhere was explained how to interpret these values. By the end, when *Canon-1* was put together, a density-quotient was introduced that was equally accurately calculated. Based on these precise values, he finally selected material from the previously made state-tapes. This was the way in which they were freely and roughly interpreted.

Notwithstanding all these issues, *Canon-1* is a unique work, even from today's perspective. With it, Raaijmakers took a radical step, both in terms of the listening experience, and, related to that, finding a new musical material that could truly be shaped according morphological principles.

5.

Canons and Kontakte

When reading the correspondence with Jaap Spek, it is striking to see how often Stockhausen is mentioned in letters from Raaijmakers. He must have been of special importance to him.

In November 1957 Raaijmakers had the chance to meet Stockhausen when he assisted him during a performance of *Gesang Der Jünglinge*. For this performance, that took place in a theatre in Eindhoven, Raaijmakers had made a connection to a set of loudspeakers mounted in the ceiling, part of a reverberation system developed by Philips. During the performance, the ceiling started resonating as Stockhausen brought up the levels much too far. Not only that mistake, but also the music that had been chosen to be played during the intermission—two works of the popular electronic music by Kid Baltan[28]—had annoyed Stockhausen. It had been an unlucky start.

Raaijmakers was very well aware of Stockhausen's work. Later, he would make a very precise study of his articles.[29] Moreover, he also analyzed Stockhausen's music. An extraordinary opportunity to understand his work even better occurred when Jaap Spek brought a tape with sound examples from the production of *Kontakte*[30] during a visit in September 1963, that illustrated Stockhausen's working method step-by-step[31]. Raaijmakers copied this tape and must have analyzed it meticulously.

Such study and analysis made him say about Stockhausen:

> *Nothing arbitrary, everything connects with everything. […] Every breath, every step of his immediately has a meaning. His entire life is one continuous musical act. There is no one, not even remotely that creates such an energy*

in every area of music: […][32]

On the one hand Raaijmakers appeared to have a deep adoration for his work. But on the other hand, in the letters to Spek he took a very critical or provocative stance towards his ideas. He seemed to suggest that although Stockhausen had made a valuable start in outlining the central concerns of electronic music composition, the ideas would have to be taken much further in order to really reveal their potential.

Probably Raaijmakers was hoping to discuss such matters with him directly, and that his correspondence with Spek, who was so close to the source, would contribute to creating such an occasion.[33] And Spek might have alluded to such an opportunity, which becomes clear with what he wrote to Raaijmakers:

> *[…] it is not that I have been isolating you from Karlheinz Stockhausen for such a long time simply because I think incubation may be healthier to you, but on the contrary, in order to strengthen your self-confidence […]. Regardless, […] my concern is to prohibit his stealing.*[34]

This chapter deals with the critical remarks Raaijmakers made in his writings, addressing Stockhausen. It must be noted that many of his considerations dealt with here, were made before the actual work on *Canon-1*. Many of these considerations, however valuable, were not realized—or could not be realized—by it.

5.1 Defining the Parameters

In 1962 Stockhausen wrote in the article *'The Concept of Unity in Electronic Music'*:

> *In the preparatory work for my composition* Kontakte*, I found, for the first time, ways to bring all properties under a single control. I deduced that all differences of acoustic perception can be traced to differences in the temporal structure of sound waves. These temporal relations enable us to distinguish the many different manifestations of pitch, timbre, simultaneity,*

> *sound-mixture, and noise: their speed of oscillation, their particular intervals —either equal and regular or more or less irregular—their density, and the frequency with which pulsations reach the ear.*

The properties referred to here were timbre, pitch, intensity and duration. This can be interpreted to mean that individual parameters as they traditionally occur in notated music, are not as such discernible in the acoustical waves that reach our ears.

Concerning these traditional parameters, Raaijmakers observed when discussing music made with computers:

> *This reasoning stems from physics books: a pitch has so many cycles per second, a violin tone for instance consists of a variety of tones simultaneously (often very complex). In order to make music with computers one should first make these tones.*[35]

With this observation Raaijmakers took the critical stance that by synthesizing known properties with new tools, the old paradigms would enter the equation unnoticeably and have a determining impact on the music made such tools. The properties mentioned were those discovered by analysis. The danger was that it would only lead to a situation of new machines producing old music. Raaijmakers proposed to leave analysis behind and find new paradigms in relation to the new tools that the electronic era had introduced, in order to develop a fresh artistic stance towards such tools.

Even though Stockhausen had taken a step in the right direction, according to Raaijmakers, his conclusions did not reach far enough. Even though he had found a way to bring all properties under a single control, the resulting music was still considered in terms of traditional properties. When listening to *Kontakte*, Raaijmakers heard what he described thing-sounds: sounds that appeared to have a mechanical origin. Especially the use of reverberation contributed negatively to such an impression, as the sounds were given an acoustical depth suggesting that the things that produced the sounds were actually in the same space as the listener.

In addition to describing the problematic nature of the traditional parameters, Raaijmakers acknowledged that new devices would have to be developed. These could replace the devices in studios that were reminiscent of earlier

traditions and would allow the creation of new approaches. In an essay from 1965 giving an overview of the developments taking place in electronic composition, Koenig would comment on the way studio were equipped with these words:

> *You see how strong is the aftermath of instrumental pattern, even in the most modern studios.*[36]

An important feature of Raaijmakers' ideas of morphity was that it allowed to describe all sounding material in a composition in terms of parameters that were not building on a logic that was so well-known from instrumental composition. Equally important is that it led to an approach of describing such parameter in terms of global constellations.

Composers using serial approaches to organize parameters, found it increasingly difficult to control the outcome by observing serial rules. Iannis Xenakis explained concerning this issue:

> *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, colors and so on. […] 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, probabilities.*[37]

The *Canons* were the result of a fresh approach to listening, and they realized such stochastic approaches.

5.2 Concepts of Space

Apart from the use of reverberation in order to create a sense of spatialized sound, the introduction of multitrack recorders allowed experimentation with the spatial distribution of loudspeakers. It was a new field to be explored in terms of

its musical use. It was much easier to distribute loudspeakers in space than musicians. As a result, composers would work with sounds coming from various angles, or with moving sounds.

For the work *Kontakte* Stockhausen had developed an approach to moving sound using a rotating loudspeaker. Four microphones recorded the rotation and the resulting recordings would be played over four loudspeakers. The result would give an impression of a sound moving around the audience.

Raaijmakers strongly opposed such ideas.

> *Direction, directional hearing, moving sounds are local and physiological quantities and not musically quantifiable. That sound coming from loudspeakers can move is applied parasitism on a sensual habituation that has nothing to do with music.*[38]

Clearly Raaijmakers rejected the view of space as a 3-dimensional construction in which sounds would move, as it was based on the notion that our ears are very well equipped to perceive directionality of a source. And in no way, was that notion connected to a musical idea.

His proposal was instead to develop concepts of morphity in order to develop musical ideas on how sounds may undergo changes in a space.

> *The science of these changes is called acoustics and has nothing to do with music. These changes first have to be elevated to a musical level and connected to essential musical quantities, before morphity itself can become a subject of composition. That Stockhausen neglected this is my greatest criticism towards his Musik-im-Raum concept.*[39]

Concretely when thinking in terms of the morphity of sounds, even though it could be explained in terms of acoustical effects, Raaijmakers' view was that composing morphity or spatiality went much further than just positioning sounds in a space. Space would have to play a role at the very root of the compositional process.

5.3 Composition and Form

With the composition *Kontakte*, Stockhausen had expressed his view on organization of compositional form by introducing the term Momentform. Rather than thinking of a continuous development, Momentform approached composition as consisting of sequences of self-contained sections which did not rely on order in relation to previous or following sections to allow creation of structure.

Raaijmakers suggested for his ideas of morphity a view on structure that was inspired by Stockhausen's ideas of Momentform, but which he took a step further. Where Stockhausen had defined Moment, Teilmoment and Momentgruppe as three units describing aspects of Momentform, Raaijmakers suggested five form units:

- Composition (related to Moment);
- Composition-character[40] (related to Teilmoment);
- Composition-point (segment of a composition);
- Composition-group (related to Momentgruppe); and
- Resultant-composition (the final form as it sounds during a performance)

With this grouping, Raaijmakers focussed on the relationship between each of the units. In addition, he remarked that in this context the term composition should be seen as a very mobile expression.

A composition could be any sound structure that, according to a logic of morphity, would be able to induce new sounds or new compositions. Since the induction of new sounds would be the result of the primary compositions—or the starting material—, the rules according to which induction would take place and the space in which the performance would take place, the final outcome or resultant-composition would by no means be predefined.

An important feature of Raaijmakers ideas was that it allowed to think of structure from the largest scale, the resultant composition, all the way down to the micro-temporal scale. In his view these extremes had to be connected in order to truly be able to talk of sound in terms of its structural aspect.

> *Sound is structure. Stockhausen claims so too, however, each sound from* Kontakte *is 90% periodical and derived from sped up 'formant rhythms'. […]*

> *St.-sounds show structure, but they aren't structure. In fact, they remain skillfully fabricated materials, drenched in dye, of unmatched ingenuity.*[41]

Stockhausen had set forth complex ideas of structural form aspects in relation to sound production. Raaijmakers wondered why, if that were the case, the majority of those sounds had a periodical character. He concluded that the claims made by Stockhausen were not at all realized.

> *Striking as well is to see Stockhausen's latent conception of continuity and discontinuity demonstrated by the tune in the middle of* Kontakte*: the entire tune is periodical from beginning to end, taking color like a rainbow! Nota bene, is that structure?*[42]

Practically speaking, Raaijmakers took a critical stance to how the electronic sounds were realized in *Kontakte*, however convincing and well-made they were. The problem, according to him, laid in the fact that a primitive sound—an impulse—would transform towards structure through applying a complex sequence of transformations, thereby step by step adding to the structural aspects of the sound. In the concept of morphity, any sound would occur by grace of another sound, with which it had a morphological relationship.

5.4 Tape as a Timeline

In addition to the previously described thing-sounds—sounds that appear to have a mechanical origin—Raaijmakers perceived in listening to *Kontakte* a quasi-instrumental logic in how sounds appeared together in the composition.

> *Magnificent! The miniature instruments of Stockhausen produce minuscule peeps in the left corner and right after a thunder strikes totally somewhere else.*[43]

And although Stockhausen had introduced Momentform as a means to avoid stereotypical ideas of climax, Raaijmakers found that apparently, the concept

had not stopped him from relying on such ideas. The problem was that it implied causal relationships between sounds both in terms of spatial and timbral aspects. Too easily they would hint at a sense of an aural reality that relied on psycho-acoustics. Such choices could de simply be the result of pre-existing ideas about those relationships, as they would normally be used in instrumental music.

This aspect was also addressed by G.M. Koenig when he wrote:

> *The production technique corresponds to this: elementary sound-material is produced and possibly altered by later transformation. A certain length of tape is cut out of the result and stuck to other little pieces of tape of the same sort. It could be said that a previously existing time-score is "scored" for sounds.*[44]

If a complex form was used that would reveal itself both on the level of structural aspects as well as sound characteristics, then one could rely on the qualities of those sounds themselves to create dramatic interactions.

5.5 Studio and Apparatus

Some of Raaijmakers' criticism described above, had to do with the way electronic studios were equipped. The equipment would mostly consist of devices that were originally intended for acoustical measurements. They had been created to understand acoustical phenomena better and to explore the human hearing. This situation inherently confirmed that analysis would be the proper starting point for composition.

> *The technology that will have to become the foundation of sound transformation and composition from the perspectives I have revealed, goes far beyond the initial and casual attempts by Stockhausen. The shifting complexities and a piling up of complexity that adequately relates to sound won't be realized with some tape recorders, feedback circuits, scissors and ruler.*[45]

Against the trend of building a greater variety and more advanced devices for sound generation and transformation, Raaijmakers proposes to build completely new ones that could deal with sound as a morphity.

> *I have made an appointment in early August with a Philips sound engineer (a perception specialist) to develop a fundamentally correct modulator circuit. […] I think it is impossible to process sound at manual speeds (knobs). Sound must be processed using sound itself. Modulators are necessary for this.*[46]

The diagram printed earlier showing what such a modulator could look like introduced such principles. Sound, according to Raaijmakers, should be processed or altered on a micro-temporal scale using qualities derived from sound itself. Only then could a truly morphological composition be realized.

6.

Epilogue

After finishing *Canon-1*, over the course of the following one-and-a-half years, Raaijmakers made three other *Canons*— with the subtitles *Super Imprimere, Super Addere, Super Sub-Trahere*. With these works, he attempted to further develop his ideas concerning morphological composition. But the work ground to a halt and was never really finished.[47]

Although he had been very serious about this undertaking, the work was not received with great enthusiasm, quite the contrary. Where he had hoped to spark a discussion, what he got instead was disdain. Even the correspondence with Jaap Spek lost its friendly tone and eventually derailed.

In 1967 Raaijmakers made a final *Canon-5 (Super Dis-Moi)* with which he wanted to close this chapter. At some occasion, he has called it the cork with which to seal the bottle with the *Canons* so they would never come out again. This final *Canon* was created with a crackling record, because someone had said that that was what the *Canons* sounded like, after all. The whole experience had truly disappointed Raaijmakers and made him enter the field of music-theatre[48]—and leave that of electro-acoustic composition.

Regrettably the exchange of ideas with Stockhausen never took place. But then again, in the summer of 1964, Raaijmakers wrote Spek:

That these noise-canons[49] *were produced at about the same time as the impressively detailed moon photos, is a thought that doesn't leave me. There is a connection here beyond coincidence: if all art until today possesses a colorfulness like our Earth—and it possesses that because it is a part of it—than, in terms of color, the music of the future must be able to be grey like the moon and other celestial bodies and made of the same single substance, in the way Earthly art consists of Earthly substances. The dust structure of the surface of the moon and the noise structure of the* Canons *are related in a special way. To observe this gives me more joy than a fine compliment from St.*[50]

7.

Conclusion

This research has contributed to a clear insight in how Raaijmakers has set up a logic around ideas of morphology, that allowed him to systematically work toward the realization of *Canon-1*. In his own research, he was able to approach sound as a phenomenon from a fresh angle by renewing and analyzing his own listening. Based on that experience he started to define the aspects of sound that according to him would be most suitable to be raised to a compositional level. Initial experiments in the studio allowed him to further work out this logic, and make a connection between the phenomenological and the practical. It has also become clear that he could do this because of his vast experience in the electronic studio.

Contrary to what has regularly been claimed, *Canon-1* was realized in a relatively short time. Although theoretical preparations had taken more than half a year, the actual work from beginning to end happened in a time span of less than two months. Partially this had to do with his being experienced but, more importantly, it was the result of a different attitude towards creating and selecting material for composition. This attitude was strongly linked to ideas that he formed concerning stochastic composition, which, in an electronic or digital situation, relate to very quickly being able to generate and evaluate sound material in terms of the desired characteristics.

Despite this successful intermediate result, closer analysis revealed many

issues with the method that Raaijmakers had developed. Although he had hoped to be able to thoroughly discuss his method with his peers, such discussions never happened and in a somewhat isolated situation Raaijmakers got stuck because of a range of issues. Partially they had to do with lack of clarity, partially with the lack of proper equipment that allowed him to perform the kind of operations he had in mind.

Concerning that aspect of equipment, it is very interesting to see how Raaijmakers had a deep understanding of technology that would allow him to take a next step, but that simply did not exist. Looking back, he was working with concepts that would become concrete only in the next few decades—evaluating code, stochastic synthesis, non-standard synthesis, to name a few.

Finally, I hope that this research adds to clarifying ideas that Raaijmakers throughout his life has returned to, of which the descriptions have at moments comes across to be so hermetically: morphological composition.

8.

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[1] Nine conversations between June and November 2010.

[2] Personal communication, 19 June 2010.

[3] An exception is the work he did together with Ton Bruynèl in Bruynèl's private studio.

[4] Jaap Spek (1929–2003) had worked in a studio at Delft University of Technology from 1958 until 1960. Correspondence covers the period from August 1961 until May 1966.

[5] The first task that he was assigned to was making the realization score of *Kontakte*.

[6] Morphity is not a proper English word, nor is the Dutch original 'morfiteit' proper Dutch. The reason to use this English term is to stay close to the ideas that Raaijmakers was developing.

[7] Letter to Jaap Spek, dated 30 September 1963.

[8] Letter to Jaap Spek, 6 January 1964.

[9] In a personal communication on 12 June 2010 he mentioned that this gave him confirmation to be on the right track.

[10] The equipment for the reverberation unit developed at Philips, the EL6910, would have been able to do that.

[11] Personal communication, 19 June 2010.

[12] Letter to Jaap Spek, 26 May 1964.

[13] Analysis of the 1982 LP version, on which the later CD version is based, shows that a new mix has been made where the first two green characters are on the right channel and the others on the left, the first three red characters are on the left and the others on the right, and all the brown characters are on the right channel. The black and blue characters are—equally—on the left and right respectively.

[14] Dutch: noodsprongwoord.

[15] Letter to Jaap Spek, 14 September 1963.

[16] Letter to Miep Oddens, 15 March 1964.

[17] Letter to Jaap Spek, 6 January 1964.

[18] This represents approximately four samples at 44.1 kHz sample rate.

[19] This course was first given in 1964/65 in Bilthoven, organized by Gaudeamus. This material can be found in 'Ästhetische Praxis', Band5, Supplement II.

[20] This is not entirely true because of the sweep that replaces the double-pulse.

[21] In a personal communication Raaijmakers expressed to be interested in such stochastic approaches.

[22] In a note with the state tapes Raaijmakers wrote: "Tape I-II-III have laid at the foundation of Canon-2".

[23] In a Letter to Miep Oddens he wrote: From last night (JvK: Saturday May 23rd, 1964), I am able to work through without interruption until Wednesday night. That is

four whole days. (…) Jan will continue Wednesday night. He will keep working Thursday and Friday.

[24] A short documentary broadcasted on 17 January 1959 shows Raaijmakers in the Philips Laboratory while working on the music of Tom Dissevelt. (zoeken.beeldengeluid.nl, Document ID 44672).

[25] In his notes he even hints as to what such code might look like. Striking is the resemblance with modern languages like SuperCollider or JAVA.

[26] Letter to Dick Raaijmakers, dated 17 July 1964.

[27] Concerning his willingness to accept the somewhat monotonous sound quality of the Canons, Raaijmakers wrote in *Cahier M*: "To this end, one must sacrifice a certain necessary amount of that beauty and coloristic richness which is inherent to living sound, a loss of richness which is however amply compensated by the benefit of a composable morphological system of sound. When the present author actually put such a system into practice in 1964-65, such a benefit in those computerless times was not to be despised."

[28] Raaijmakers had produced this music under this pseudonym—Natlab Di(c)k in reverse—work of which with hindsight he was not very proud.

[29] Among his materials for the Canons is a summarization of Stockhausen's article "Wie die Zeit vergeht".

[30] As Stockhausen's assistant, Spek was working on the realization score of Kontakte.

[31] On the Threshold of Beauty, Kees Tazelaar, p. 237.

[32] Letter to Miep Oddens, 11 December 1963.

[33] In a letter dated 8 January 1964 he writes to Spek: 'It would be great to once come to Cologne.'

[34] Letter of 4 November 1964.

[35] Letter to Jaap Spek, 2 August 1964.

[36] The Second Phase of Electronic Music, G.M. Koenig, 1965.

[37] *Conversations with Iannis Xenakis*, p.54.

[38] Letter to Jaap Spek, 22 December 1963.

[39] Letter to Jaap Spek, 6 January 1964.

[40] This should not be confused with the term character as Raaijmakers used when constructing Canon-1, which referred to a group of compositions.

[41] Letter to Jaap Spek, 2 August 1964.

[42] Letter to Jaap Spek, 2 August 1964.

[43] Letter to Jaap Spek, 14 September 1963.

[44] The Second Phase of Electronic Music, G.M. Koenig, 1965.

[45] Letter to Jaap Spek, 6 January 1964.

[46] Letter to Miep Oddens, 18 July 1963.

[47] Personal communication, 12 June 2010.

[48] Personal communication, 12 June 2010.

[49] He is referring here to Canon-2, which basically is the first Canon, ring-modulated with noise. He had made two versions.

[50] Letter to Jaap Spek, 2 August 1964.