

Mapping the Beginnings of Computer-generated Art in the Netherlands

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Abstract:

This paper presents a mapping of the field (participants, production, presentations, institutions and networks) within interdisciplinary research that encompasses fine arts, music, graphic design, typography and architecture as well as interdisciplinary projects and multimedia art.

Apart from a few exceptional works made prior to 1969, computer-generated art in the Netherlands started relatively late, and had its full swing in 1970 and 1971.

Several networkswere active promoting computer-generated art: the working group for computers and verbal, visual and sonal research (1969 -1973), CASH - Computer Arts Society Holland (1970 - 1972, a spin-off of CAS in London), the Foundation Experiments in Art and Technology (1971 - 1976), the Werkgroep Architectuur Komputer (1970), the Institute for Sonology (since 1967), and STEIM (Studio for Electro-Instrumental Music, since 1969). Two PhD theses in art history about computer-art were defended in 1970 and 1971. Most participants in the above-mentioned networks will in the following decades become a new establishment of Dutch culture, as directors of several major museums and members of different decision-making boards. The Museum Boymans-Van Beuningen in Rotterdam had ‘art and technology’ as the topic of its annual program in 1971. Since 1966 the Dutch National Bank issued series of banknotes that used computer-generated images, designed by Ootje Oxenaar. Oxenaar also designed the world’s first post stamps with computer-generated images, that were issued by PTT in 1970.

Most of the protagonists had a leftist political orientation. The opera *Reconstruction* (1969), collectively written by five composers and partly composed by computer, was dedicated to Che Guevara. In the work *nixmur* (1969) by Remko Scha, a computer program endlessly prints out the text ‘Nixon moordenaar’. The sound installation *Quadraat Stelling I* (1971) by Victor Wentink, consisting of an interactive man-machine network, was inspired by the idea of socializing technology after Marx and Benjamin, and criticized the idea of computerizing the world and the power of the mainframe computers. It demonstrated a horizontal interactive participatory technology enabling all combinations of communication and feedbacks, preceding internet based social networks from beginning of 21st Century.

Apart of the art practices of Peter Struycken, Victor Wentink and Remko Scha, there is no continuation of the first generation of digital art in the fine arts today in the Netherlands. Only computer-generated music has seen a continuation of its production, institutions and education, under the umbrella of electronic music, which spans the decades and is still active today. This kind of situation is typical for the field of digital art around the world.



Punch card, Computing Centre of the National Universiteit Groningen



Prince Bernhard opened the new complex of Electrologica NV in Rijswijk in 1964

Introduction

Unlike other aspects of the fine arts, computer-generated art in the Netherlands has not yet received systematic treatment. This research is the first attempt to define the arrival of computer-generated art in the Netherlands in its historic context. The research was conducted in a period of half a year in 2010 - 2011 by a single researcher. As there was no single essay or other kind of document available on the subject, the research started from scratch, collecting information and linking the findings, thus creating a map of the field in a bottom-up fashion. Many protagonists and practitioners of early computer-generated art are not reachable or not alive, and many networks and institutions have closed down; therefore it was not possible to obtain, confirm or extend all relevant information within the frame of this (first draft) research. Bearing this in mind, the author is aware of possible shortcomings and structured the research documents in a dynamic manner, thereby respecting the need to fill in the gaps and double-check the information. The author will therefore welcome everyone's collaboration in the form of comments and suggestions.

During the transition from the industrial age to the information society - since the mid-20th century - a segment of the arts has also been concerned with information, especially with digitally generated and mediated information. Computers arrived in visual art in the early 1960's, first in Western Germany and the USA. After a short period of inauguration in mainstream art discourses and institutions in the late 1960's and the very beginning of the 1970's, computer-generated art disappears from the world's art scene in the mid-1970's, as a consequence of anti-technological sentiment and of new discourses in contemporary art. Since the 1960's, computer-generated art has moved in waves in and out of the domain of interest of mainstream contemporary art. Several decades later, computer-generated art is viewed within the context of media art and media culture: an open area of practice and critical theory that operates on the fine line between fine arts, science, social and political activism, and technology.

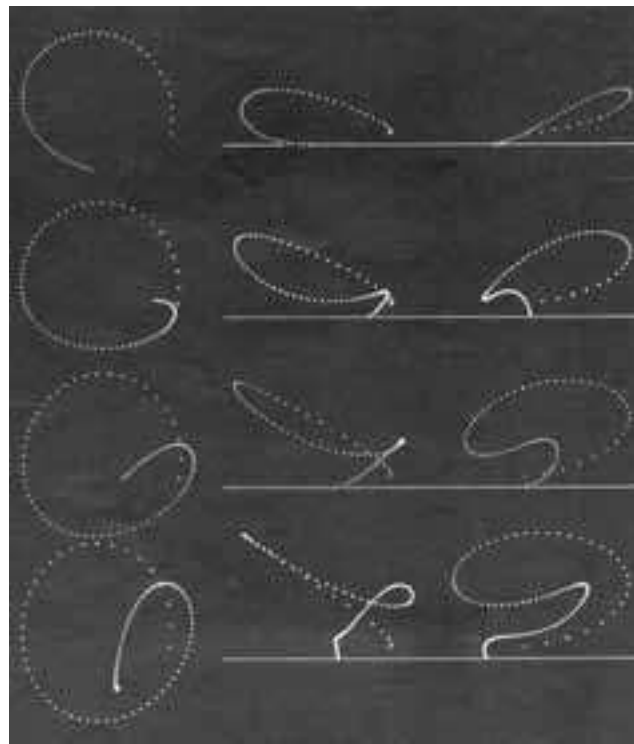
This research spans only the first phase of computer-generated art, from its very beginnings up to the arrival of personal computers; it thus covers the creative use of mainframes and mini-computers and the very first use of PCs, all before 1980.

The research includes a mapping of the field: participants (artists and scientists that produced it, art historians and other supporters), institutions, networks. Besides this text (that is still in progress), we have started creating a chronology and a bibliography. Our approach to the observed artworks takes into consideration the entire production and distribution process ranging from an initial concept to its execution (output, artwork), embracing both creative and technological aspects of the work as of equal interest. The technological process is considered of the same importance as its output, because of the specific circumstances of using new technology. The unique situation of specially created software for each artwork and the use of certain programming languages as well available hardware was therefore taken into consideration (insofar as such information was available). Considering the specific situation of computer-generated art and our limited access to the equipment of this historical period, art concepts that were not realized as well as hand-made works that were directly inspired by computers and digital aesthetics have also been included in this overview.

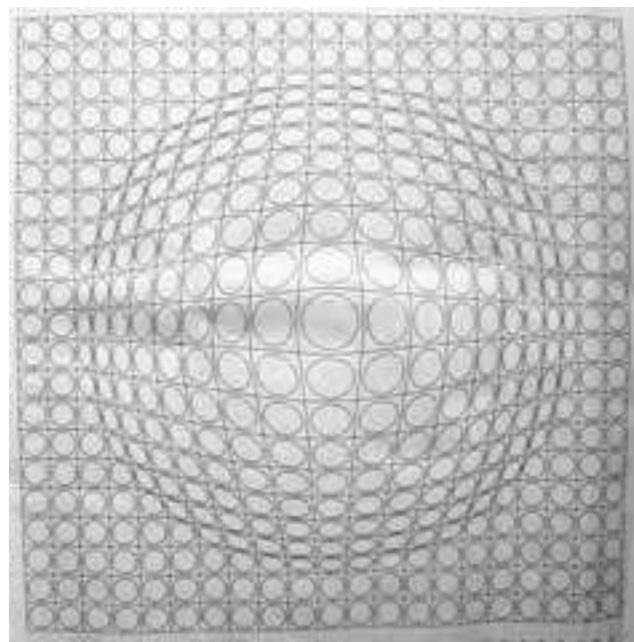
Our research started with a focus on the visual arts but it quickly turned out to be necessary to include other fields of creativity as well. Such a shift was motivated by the interdisciplinary approach of the arts of the 1960's and 1970's, and the fact that many participants created in different fields at the same time, or made collective and multimedia works; also, artworks created in one discipline were often created by people coming from different disciplines and/or from science.



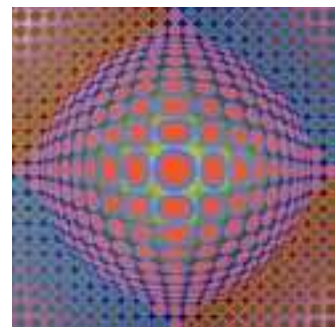
anonymous: *Trijntje*, reprinted in demonstrations of the TR4, RC Groningen



Felix Hess: mathematical model for the returning motion of the boomerang, ca. 1968, Program co-written in Algol by author and Lambrecht Cook. Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.



Felix Hess: digital re-enactment of the artwork by **Victor Vasarely** *Vega 200* (1968, below). Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.



Straight and Shifted Art Disciplines, Multimedia and Interdisciplinarity

Most of the world's computer-generated art pioneers were scientists (as **Herbert W. Franke**, **Frieder Nake**, **Georg Nees**, **Michael Noll**) and some were trained artists (as **Kurd Alsleben** and **Otto Beckman**), while very few had both kind of education (as **Charles Csuri**). The new arrivals enriched or confused the protagonists of the art world at the time, as it still sometimes does today.

Such a trend we can see within the Dutch pioneers as well: trained scientists that made computer-generated art are biologist **Herman de Vries** and the three members of the **Compos 68** group, i.e., the biology students **Arthur Veen** and **Jeroen Clausman** and the art history student **Jan Baptist Bedaux**. Computer scientists **Leo Geurts** and **Lambert Meertens** often collaborated in projects in both art and science. They both worked primarily as computer scientists but during several years devoted a lot of effort to create computer-generated graphics and music -- on their own as well as in collaboration with other composers (**Louis Andriessen**). Their interest in the creative use of computers leads them to establish **CASH**, the **Computer Arts Society Holland**.

Trained visual artists are **Peter Struycken** and **Pieter Laurens Mol** who stick to their original disciplines of Concrete Art and Conceptual Art respectively, and **R. D. E. (Ootje) Oxenaar**, who primarily worked in the field of graphic design and secondarily in the fine arts. **Victor Wentink** had an education in both fine arts and music, which will show in full potential in his multimedia works.

An exemplary case of the interdisciplinary approach in both education and practice is **Remko Scha**. In the 1960's he studied Physical Engineering, and also participated actively in music and the fine arts, sometimes merging them in an "open aesthetics" approach that was influenced by Fluxus. Later he combined research in Logical Semantics and Computational Linguistics with a consistent practice of Generative Art¹.

Extended Science, Digital Folklore, Amateur Art and Computer-Art as a Hobby

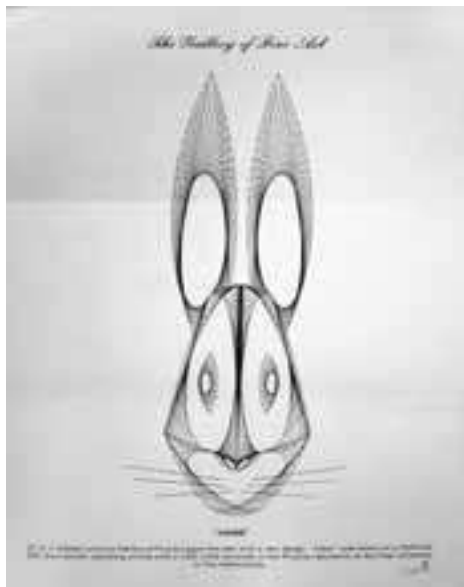
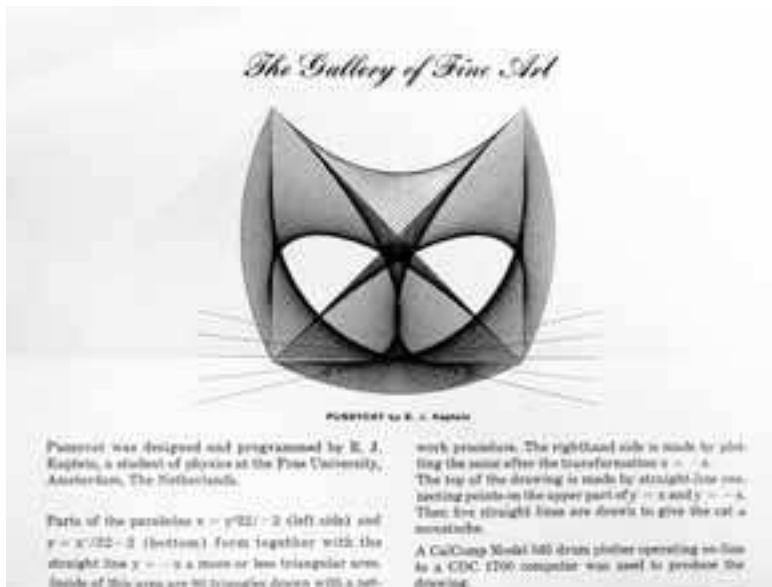
Early computer-generated art was mostly practiced by scientists who had hands-on access to (then) exclusive technology. Some of them dedicated their career to the creative use of technology in art; examples are the prominent computer-artists **Frieder Nake** and **Georg Nees** from Germany. On the other hand, some scientists just played with machines as a hobby, creating jokes or amateur art or solving self-imposed programming or creative problems in their free time.

Electronical engineer **Willem Nijenhuis**, working at the **Philips Natuurkundig Laboratorium (Natlab)** (Philips' Research Laboratories) in Eindhoven, carried out a series of computer sound experiments ***Calculation Sounds of PASCAL*** (1962)². **PASCAL** is a name of the computer he employed, and stands for "*Philips Akeling Snelle CALculator*" - *Philips' very fast calculator*. The signals emanated from the voltage of the CPU during the execution of various programs, for instance the computation of the sequence of prime numbers. The sounds were issued on a 45 rpm vinyl record enclosed with an issue of the *Philips Technical Review*³ which discussed the recorded algorithms from a scientific as well as from a musical point of view. The first three pieces - ***Fourier Analysis***, ***Smoothing*** and ***Calibration*** - are presented as parts of a series entitled **Cloverleaf Cyclotron**; they are followed by individual 'tracks': ***Cutting Losses of Corrugated Cardboard***, ***Potential***

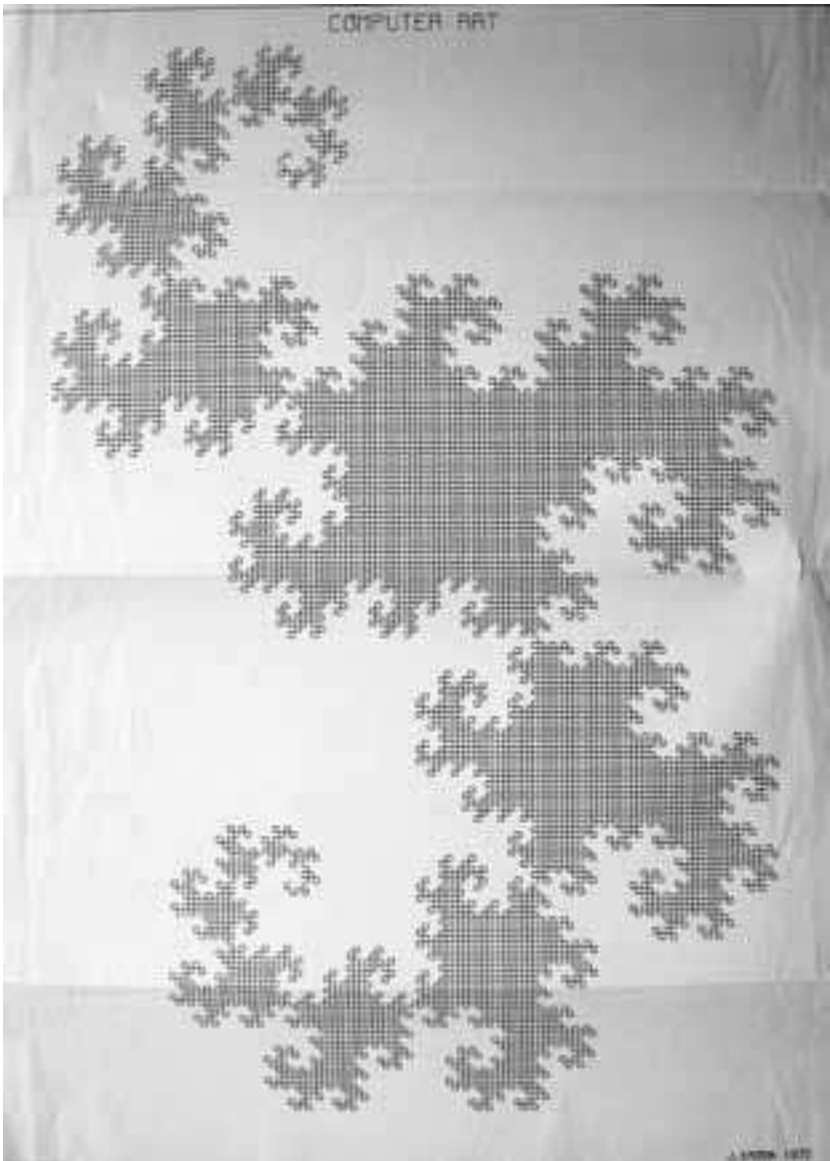
¹ Het Apollohuis (1980 – 1983) was an alternative space for music and visual art in Eindhoven, the Netherlands, initiated by Remko Scha and Paul Panhuysen in 1980. As well Scha working in education within Humanities at the University of Amsterdam.

² *Rekengeluiiden van de PASCAL*

³ *Philips Technisch Tijdschrift* (Philips Technical Review), 1962, no. 4/5.



E. J. Kaptein: *Pussycat* (1972) and *Hare* (1973), both made with CalComp 565 drum plotter operating on-line with CDC-1700 computer in the Physics Laboratory at the Vrije Universiteit in Amsterdam.



John Krook, *Computer Art*, 1972, Telefunken TR4 computer and Benson-Lehner plotter at Rekencentrum of the Rijksuniversiteit Groningen

*fields and Electron Orbits, Jigsaw Puzzle, Prime Numbers, Mozart Minuet and Stochastic Melody*⁴. The last two compositions use conventional musical structures, but all other pieces are unintentional side-effects of scientifically useful calculations; they consist of extreme atonal electronic sounds such as beeps, cracks etc, that are reminiscent of recent experiments in underground hard-core electronic music. These experiments also preceded the translations from one code, language or medium into another, that have become popular in the conceptually oriented branch of contemporary digital art.

The *Digital Plotting Newsletter* issued by the leading manufacturer of graphic hardware *Calcomp* (California Computing) included on its last page a 'Fine Arts' section, where several Dutch computer graphics pieces were published. In the **Van der Waals Laboratorium** of the **University of Amsterdam** the physicists **Cornelis Andries ten Seldam** and **Dick Oepts** both made in 1969 autonomous computer graphics, using the CDC 1700 (Control Data computer) and the Calcomp 565 Digital Incremental drum plotter. **Dick Oepts** explains his motives for such an exercise: "I've always been fascinated by the pattern in the disk of composite flowers, and found it an interesting challenge to generate this with the computer. The purpose was not so much to produce an artful picture, but to do it with a small or elegant program."⁵ Nuclear physicist **E. J. Kaptein** published two graphics in the same publication: *Pussycat* (1972) and *Hare* (1973), both drawn in the **Physics Laboratory** at the **Vrije Universiteit** in Amsterdam.⁶

From 1967 until 1975, physicist **Felix Hess** (b. 1941) worked on a mathematical model for the returning motion of the boomerang. A program which included a visualization component was co-written in Algol by **Felix Hess** and **Lambrecht Cook**. Graphics were made with a Telefunken TR4 computer and a Benson-Lehner plotter at the **Rekencentrum of the Rijksuniversiteit Groningen**. First findings accompanied by computer-graphics were published in the article *The Aerodynamics of Boomerangs* in the *Scientific American* in 1968. More calculations were carried out later with a CRAY J932 computer, that was 120 times faster. The research led to the PhD thesis *Boomerangs, Aerodynamics and motion*, with illustrations that could be observed with a three-dimensional stereo viewer. In 1971, during his thesis research, **Hess** also made a series of free works, programming a digital re-enactment of *Vega 200* (1968) by **Victor Vasarely**. These works were digitally programmed variations of vector files, where the image was reduced to the black outlines of the geometric shape. Later on, in the 1980's, **Felix Hess** started to work as an artist with sound installations and semi-autonomous sound machines, shifting his profession entirely from science to art.

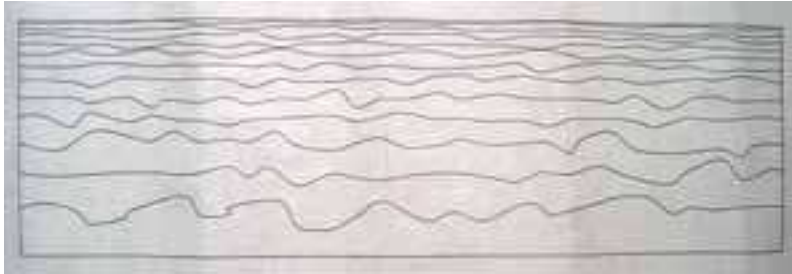
Also in the **Rekencentrum of the Rijksuniversiteit Groningen** the scientists **Johan Krook** and **Jan Kraak** made computer graphics. A series of graphics by **Jan Kraak** from 1970 shows horizontal lines with random deviations. The ALGOL-60 program used an interpolation routine based upon the Akima algorithm, and a subroutine called '*bibber*' (jitter in Dutch), in order to form unequal - jitter line. Points lying on equal distances on a straight line were given random deviations perpendicular to that line. The shifted points were then connected by the *Akima* interpolation routine, to form a more or less jittering line.⁷ Around 1970, **Jan Kraak** made work based on **A. Michael Noll's** *Computer Composition With Lines - Mondrian Experiment*. In 1965, A. Michael Noll, one of the most well-known pioneers of computer-graphics, made two xerographic reproductions: one showing *Composition With Lines* (1917) by **Piet Mondrian**, and the other showing a picture that was generated by a digital computer⁸ using pseudorandom numbers with statistics approximating the Mondrian painting. He conducted a small-scale experiment searching for opinions as to which image is preferred by

4 Klaverbladcyclotron: Fourieranalyse, Gladstrijken, Calibratie; Snijverliezen van golfkarton, Potentiaalvelden en elektronenbanen, Legpuzzel, Priemgetallen, Mozart Menuet, Stochastische melodie 5 e-m to DF, Jan 19 2011. Graphics were published in September / October and November / December issue of CalComp Newsletter, 1969.

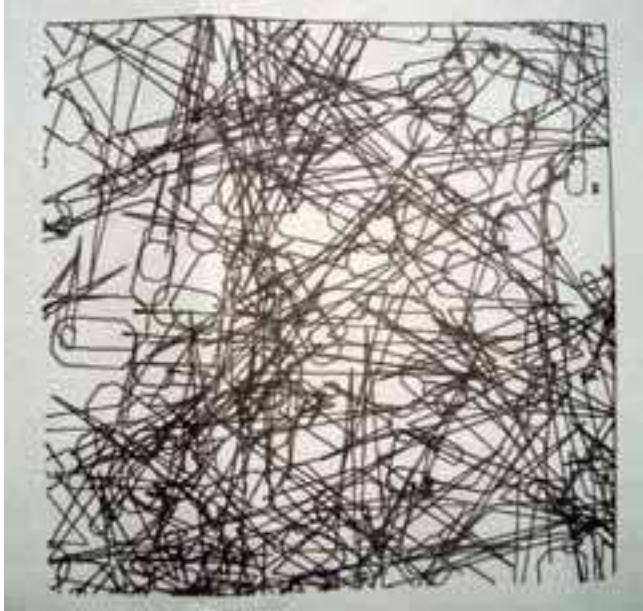
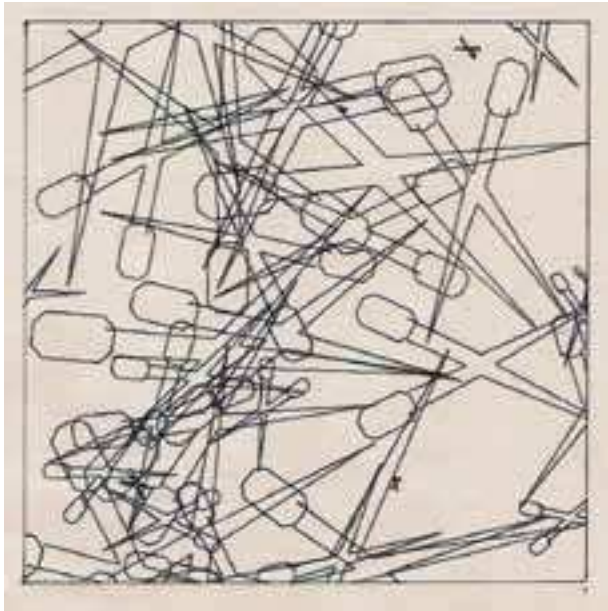
6 using CalComp 565 drum plotter operating on-line with CDC-1700 computer.

7 Graphics were made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

8 IBM-7094, Stromberg-Carlson S-C 4020 microfilm recorder, programmed in FORTRAN, produced in Bell Telephone Laboratories, New Jersey

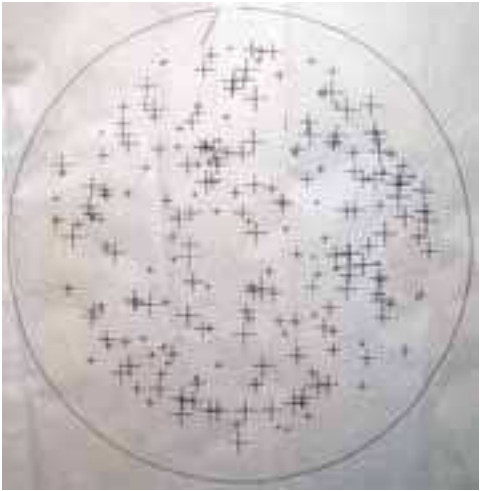


Jan Kraak, Untitled, from *Bibber* series, 1970, Telefunken TR4 computer and Benson-Lehner plotter at Rekencentrum of the Rijksuniversiteit Groningen, Program written in ALGOL-60 language.



Jan Kraak, Untitled, from *Random scharen* series, 1971, Telefunken TR4 computer and Benson-Lehner plotter at Rekencentrum of the Rijksuniversiteit Groningen, Program written in ALGOL-60 language.

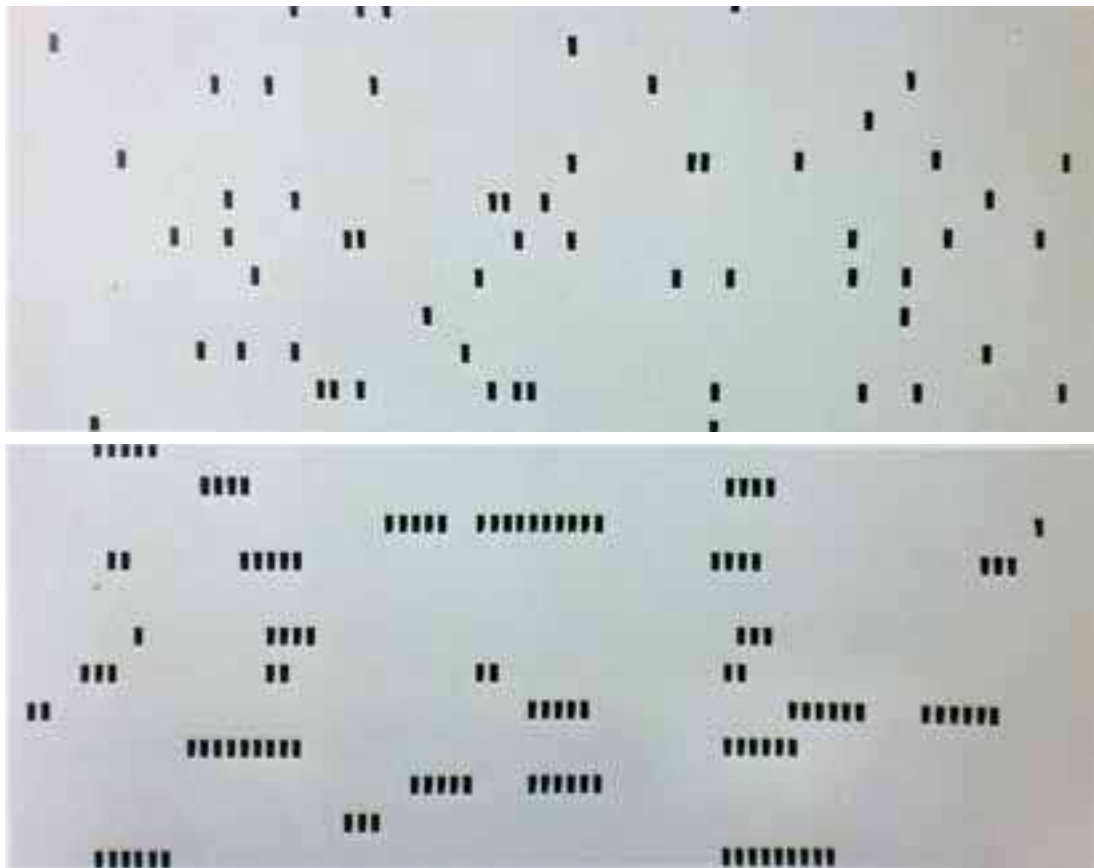
Jan Kraak, Untitled (after *Computer Composition With Lines - Mondrian Experiment* by A. Michael Noll, 1965), 1971. Telefunken TR4 computer and Benson-Lehner plotter at Rekencentrum of the Rijksuniversiteit Groningen, Program written in ALGOL-60 language.



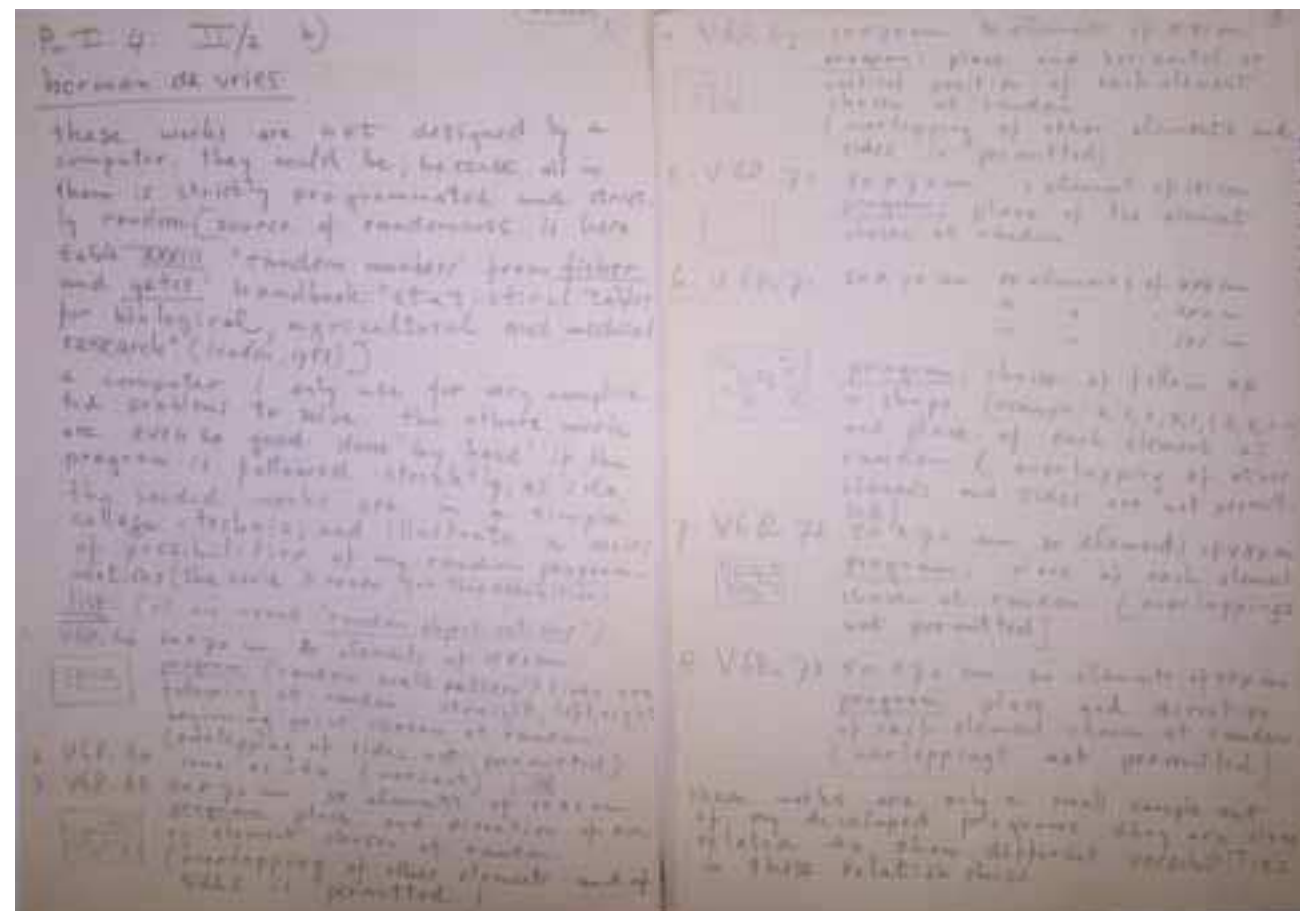
humans.⁹ After seeing this work 1970 in a journal¹⁰ **Jan Kraak** also tried to emulate Mondrian's *Composition with lines*. His conclusion was that "Mondrian's 'algorithm' was more complicated then the algorithm I (and Noll) used".¹¹ In 1970 **Kraak** wrote an ALGOL-60 program to draw a ***pattern for a ladies dress*** (*dames grond patroon*) based upon 9 measures of the female body, as a free work. It is based on a real instruction for a tailor about how to draw a pattern based upon some measures of the human body. The pattern could have been employed for actual use, but wasn't. The plot consists of straight and curved lines.¹² Part of the drawing is a scissor (Dutch: *schaar*) that is used in series of prints *Random scharen* (1971). Figures of a pair of scissors are positioned on random positions, with a random size and with a random angle, clipped within a square boundary. This work was inspired by the computer-graphic *Random War* (1967) by the American artist **Charles Csuri**. One particular print from this series is the result of a software error (one of the two programs was probably not closed correctly): a plot of **Jan Kraak** (*Random schaar*) combined with a plot of **Felix Hess** (digital re-enactment of the *Vega 200* by **Victor Vasarely**).¹³

During his study at the Arnhem Academy of Arts, **Casper C. Bosveld** (b. 1941, also known on the Internet as **Pointer** or **DutchPointer**) worked for the Koninklijke Nederlandse Heidemaatschappij where he developed a perspective presentation computer drawing-program (with hidden line removal), from 1965 to 1967.¹⁴ Afterwards, **Bosveld** start teaching fine art at the Augustinus College in Groningen, and continues experiments on vector graphics. In Groningen he worked on computers at the University's Mathematics Center, mostly with the Astronomy researchers, using the *GIPSY*-program for advanced image processing. Until 1972, **Casper C. Bosveld** carried out experiments with computer art graphics, and worked on public art commissions (with no computing involved). In 1972, **Bosveld** finished his experimental phase, and starts to conceive his computer graphics as artworks. Since 1976 **Casper C. Bosveld** has programmed hundreds of computer-generated graphics using a *Tektronix 4051* computer and a *Tektronix 4662* Interactive Digital Plotter; he made many sales to German collectors. In the early eighties, **Bosveld** received a subsidy of 100,000 guilders from the Raad voor de Kunst for the project ***Vector*** (the largest sum of subsidy for an experimental project until that date). He taught media art at the *Academy of Fine Arts Vredeman de Vries*, at Leeuwarden. After a commitment to commercial software business and a break form artistic practices over several years, he started to make computer graphics again in 1987, as two-dimensional colorful virtual reliefs.¹⁵

9 When xerographic reproductions of both pictures were shown to 100 subjects - people working in Bell Lab, New Jersey - the computer-generated picture was preferred by 59 of them. Only 28 subjects identified the Mondrian painting. Apparently, many of the observers associated randomness with human creativity and where therefore led astray in making the picture identification.
10 Reichardt, Jasia (ed.), *Cybernetic Serendipity, the computer and the arts*, Studio International Special Issue, No. 905, November 1968, London
11 Kraak wrote a program in ALGOL-60 that draw a + symbol with random size and random X and Y position. In the upper side appears a programming error. Work is made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen. e-mail correspondence with author, 2010.
12 To draw the curved lines, an interpolation routine based upon the Akima algorithm was used (as used in 'bibber', 1970).
13 printed 1st February 1971, print 117-1. Works were made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.
14 programmed in Assembler and ALGOL. Univac computer and Calcomp plotter (A 0 format, a flatbed with one pen). The program was loaded in the computer by a paper-tape reader. The data came stored on punch cards. The final program was examined and approved 1967 by the Institute of Electric and Electronic Engineering (IEEE).
15 He wrote a new parser to translate mathematic formulas in images to be processed in newly developed rendering environments like POV-Ray (that offers a programming environment in which one have to write original applications). See artist' website: <http://www.confrontaal.org/>



Herman de Vries, *random objectivations*, 1965. Computer punch cards. Made at the Institute for Research of Bird migration.



Herman de Vries, additional information about the *random objectivations* series submitted to *tendencies 4* exhibition, July 1968. Archive MSU Zagreb

Space of determinism and randomness / Computer-generated art as part and continuation of Concrete art

Neo-Constructivism, Concrete Art, (Lumino-) Kinetic Art and other 'systematic', 'algorithmic' and 'rational' styles of the 1950's and 1960's have natural affinity with the tendency towards merging art and science and technology. In the Netherlands, they had a strong local reference to the tradition of neoplasticism (**De Stijl**), Constructivism and Bauhaus, and were well-accepted and promoted within the mainstream contemporary art world.

Several artists that made algorithmic and programmed art by analogue means start to use computers, mostly as a tool for carrying out more complex algorithms. In Netherlands that was the case with the artistic practices of **Herman de Vries** and **Peter Struycken**, as well as the Czech artist **Zdenek Sykora** who presents both analogue and digitally generated works in the Netherlands regularly since the 1960's.

Herman de Vries (b.1931) is an academically trained biologist, who after a short period of working in his primary profession, shifts his activities exclusively to art and becomes one of the most well-known Dutch artists. Since the 1950's, **De Vries** was deeply involved in the idea of merging art and science. In 1962, he starts to work with randomly organized visual structures. His interest in the new possibilities opened by computers led him to create one of the first computer-generated visual artworks in the Netherlands. In 1965 he made two artworks from the *random objectivations* series on computer punch cards. The punch machines were programmed and used to make random punches in the computer punch cards, creating random visual fields.¹⁶ These works were made during lunch breaks, when Herman worked at the Institute for Research of Bird Migration.

The continuation of art practices achieved in Concrete art that transgressed to visual research by computers was inaugurated and contextualized by the Galleries of Contemporary Art in Zagreb. This Gallery started the series of *New Tendencies* exhibitions in 1961, that by the mid-1960's becomes a synonym for the international movement of Concrete art and other visual research-oriented art that preferred a rational and systematic approach to individual intuition and myth.¹⁷ Series of symposia and exhibitions under the title *tendencies 4*, held in Zagreb during 1968 and 1969, included programs under title *computers and visual research*. Herman de Vries had previously taken part in two New Tendencies exhibitions, and he replied to the call for works for the *computers and visual research* exhibition in 1968, submitting some works from the 1968 *random objectivations* series.¹⁸ In an accompanying letter he explained:

"These works are not designed by a computer. They could be, because all in them is strictly programmed and strictly random. [The source of randomness here is Table XXXIII 'random numbers' from Fisher and Yates' handbook 'Statistical tables for biological, agricultural and medical research' (London, 1953).] A computer I only use for very complicated problems to solve. The others work are even so good done 'by hand' if the program is followed strictly, as I do. Sent works are in a simple collage - technique, and illustrate a series of possibilities of my random programmations. (the series is made for this exhibition)."¹⁹

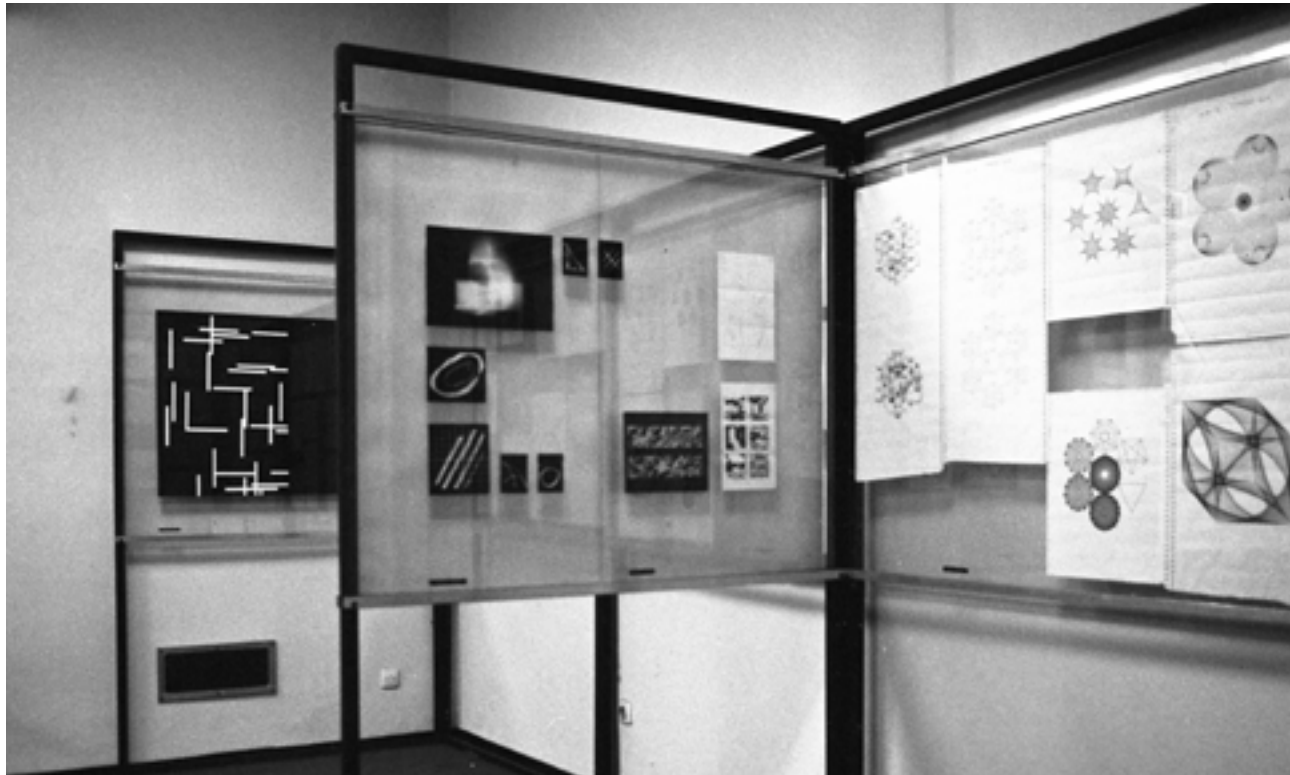
Artworks *V68-67* and *V68-70* were exhibited at the *computers and visual research* exhibition in 1968, as part of *tendencies 4*. Because of the strict criteria for the follow-up 1969 exhibition of the same name, where flow-charts and computer programs were requested next to artworks, **De Vries'** work (as well

¹⁶ 'at that time I thought I should use anything to make art'. (telephone conversation, 2010). Exhibited at the solo show in Groningen museum, 1980, reproduction in the catalogue, p. 86.

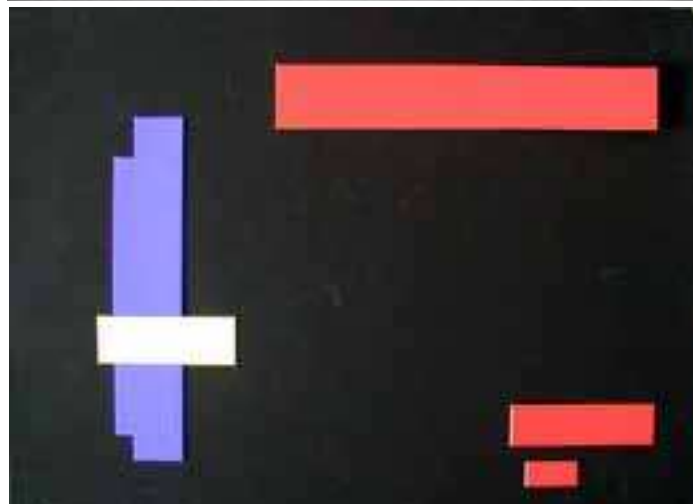
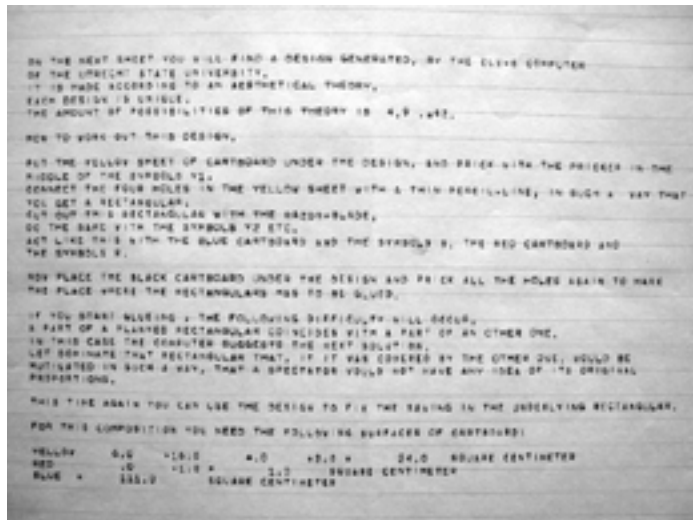
¹⁷ First exhibition New Tendencies was in 1961, followed by NT 2 in 1963, and NT 3 in 1965 in Zagreb as well in Venice 1963-64, Paris and Leverkusen, both 1964. De Vries participated at four exhibitions: Leverkusen, NT 3 and t4, both 1968 and 1969.

¹⁸ in total he exhibited eleven works at both Tendencies 4 exhibitions in Zagreb 1968-1969: V67 - 93; V68 - 64; V68 - 65; V68 - 66; V68 - 67; V68 - 69; V68 - 70; V68 - 70; V68 - 71; V69 - 72; V69 - 73.

¹⁹ July 1968. Archives Museum of Contemporary Art, Zagreb.



random objectivations V68-67 and V68-70 by Herman de Vries (left) exhibited at the *computers and visual research* exhibition at the KIC, Zagreb, August 1968, part of *tendencies 4*. Archive MSU Zagreb



Compos 68, *Hobby Box*, 1969. variable multiple, Designe programmed at Electrologica X8 computer a the Utrecht University

works made by analogue computing, by computer art pioneer **Kurt Alsleben**, for example) were included in another part of the *tendencies 4* exhibition program that presented “analogue” works: *recent examples of visual research*.

Finally, in 1973 **Herman de Vries** did actually use computer to calculate the chance-fields, in the series of works collected in the art-book *chance-fields, an essay on the topology of randomness*.²⁰ **Michael Herbert** in Frankfurt made calculations of the chance-ranges by computer. However, he did not program the calculation of the final data needed to produce the artworks, so the last part of the calculation was done by hand.²¹

De Vries’ overall affinity to computers become visible in the October 1972 issue of the artist-magazine *integration*, that he both edited and published. It includes texts on computer-generated art by **Frieder Nake** (DE), **Michael Noll** (USA) and **Zdenek Sykora** (CHR).

De Vries’ works made by analogue techniques were exhibited in a two-man exhibition alongside computer-graphics by **Frieder Nake** (DE) in Swart gallery in Amsterdam 1970,²² and presented in numerous exhibitions and publications in the Netherlands and abroad.

The group **Compos 68** was founded by **Jan Baptist Bedaux** (1947), **Jeroen Clausman** (1947) and **Arthur Veen** (1949) in September 1968 in Utrecht, where all three members studied. Then a student of art history, **Jan Baptist Bedaux** brings the idea of combining the aesthetics of modernist paintings (as **Mondrian** and **Klee**) and the computer simulation of growing trees. **Arthur Veen** was an assistant of professor **A. Lindenmayer** who taught Philosophy of Biology at the Biology department of Utrecht University; **Veen** was programming in ALGOL in his biology research. *Series 1* and *Series 2* (both 1968, hand-colored computer-prints made by an Electrologica X8 plotter) were produced by the EL - X8 Philips computer at the department of mathematics of Utrecht University. The program was written in ALGOL. **Bedaux**, **Clausman** and **Veen** created a system that could assign numerical values to the elements ‘color’ and ‘form’ in order to obtain numbers for mathematically formulated aesthetic theories. The variable multiple *Hobby Box* (1969) consists of a package with four colored cardboards, a pin, a variable pattern with stylus (created by the Electrologica X8 plotter) and an instruction manual, both printed as computer sheets.²³ The *variable pattern* is a computer print that shows an outline of a composition that is to be copied (by pin) to each color cardboard, and such cut rectangles finally assembled at the black cardboard according to a unique computer-programmed composition. This is an early example of participative computer-generated work, with new notions of ‘manual’ and ‘user’ in the context of computer-generated art (similar to do-it-yourself art multiples in Fluxus art).

In its short existence as a group (1968 - 1969), **Compos 68** succeeds in exhibiting its work in several important international exhibitions of computer-generated art, such as *tendencies 4* in Zagreb and *Kunst und Computer* in Vienna.²⁴ They received an award for ‘*Hobby Box*’ at the ‘*tendencies 4 - computers and visual research*’ exhibition in Zagreb in 1969, an exhibition that propagated the idea of visual research with computers as a continuation of the tradition of Concrete Art

20 *herman de vries : chance-fields, an essay on the topology of randomness / chance-felder, ein essay über die topologie des zufalls.*, edition.e, 1973.

21 e-mail to Darko Fritz, 10 November 2010.

22 5 - 26 april 1970 - exhibition of computer-graphics by Frieder Nake and *random objectivations* by Herman de Vries, Galerie Swart, Amsterdam

23 design generated by the ELX-8 cpmputer of Utrecht State University. Multiple consits of the package with four colored cardboards, pin, variable pattern with stylus (Electrologica X8 plotter) and instruction manual (computer sheet). Computer prints produced 10 and 11 March 1969. Program: 1 page comp. print, 10 pages output results.

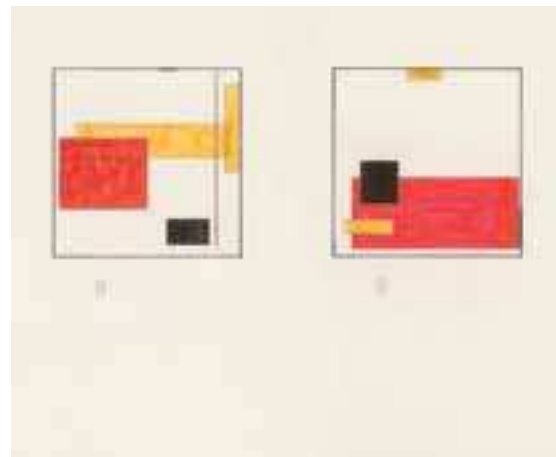
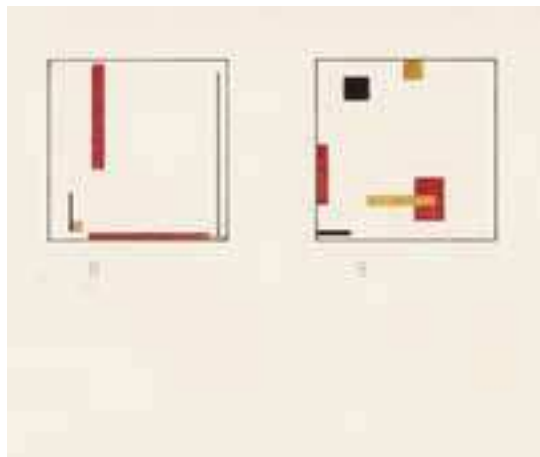
24 Compos 68 presents ‘*Series 1*’, ‘*Series 2*’, ‘*Hobby Box*’ and ‘*Example of the development of a program to generate lines*’ at the ‘*tendencies 4 - computers and visual research*’ exhibition in Zagreb, 5th May - 30th June 1969. ‘*Hobby Box*’ is exhibited as well at the *Kunst und Computer* exhibition, Datenzentrum der Zentralsparkasse, Vienna, 27 november - 19 december 1969 (with Fanke, Stiegler, Beckmann/Grassi, Alsleben/Pasow, Adrian and Nake).



Series I and Series II (1968, right, up) and *Example of the development of a program to generate lines* (1969, right, lower) by Compos 68 (left) exhibited at the *computers and visual research* exhibition at the Gallery of Contemporary Art, Zagreb, May 1969,



Compos 68, *Series I* and *Series II*, both 1968. Computer-generated design, hand-colored ink, felt-tip pen, paper, Electrologica X8, plotter. Produced at Utrecht University. ZKM Collection. photo © ZKM | Karlsruhe.
Below: details *Series I* and *Series II*



(and similar art styles falling under the umbrella title *New Tendencies*, named after the series of exhibitions with that name since 1961). **Compos 68** elaborated theoretically on its work in several articles.²⁵

Peter Struycken (b.1939) had established a career in Concrete Art with geometric abstract paintings in which form and color underwent systematic changes, before he started to use computers in his art. In 1968 he attended courses on electronic music (by **G.M. Koenig**) and on the programming language ALGOL at the **Instituut voor Sonologie - Rijksuniversiteit Utrecht**, leading to his first computer-drawings in 1969. He was helped in writing the computer program for these drawings by the physicist **Constant A.G.M. (Stan) Tempelaars** (1938 - 2010), and by **Greta Vermeulen**. A series of eight paintings, **Computerstructuren** (1969 - 1970), was made by hand according to computer-generated visual compositions.²⁶ Black and white images used the square as basic element, with increased emphasis on the conditions that the elements had to fulfill (structural rules), and their effect on the visual outcome. Transitions were made from simple to complex, from regular to random visual structures. The series of paintings was chosen as the final selection from a much larger sequence of images, all of which are different versions of one another. The computer enabled **Struycken** to investigate the role of chance in the creative process, whilst also retaining some measure of control. **Struycken** welcomed the ability of the computer to calculate endless visual alternatives for the arrangement of a series of different colored squares across the picture plane.

The computer program used in the **Computerstructuren** was used again for an architectural art commission: the sandblasted glass partition walls on the executive floor of the KLM office in Amsterdam.²⁷ Two semi-transparent sandblasted patterns overlap with a small distance, thus creating the third image. Successfully translating data to solid materials **Struycken** created fourteen computer-generated permanent public art works until 1980, and more since.

The use of a random program is employed in **Vier toevalstekeningen voor Lien en Ad, 29.10.72** (1972, *Four Random Drawings for Lien and Ad*) that are **Struycken's** first entirely computer produced and executed works, in the form of plotted prints.

In 1972 - 1974 **Struycken** develops and uses the PLONS computer program to manipulate colors. The analysis of formal characteristics of color will be the inspiration for a great number of his later works. For **CLUSTER** (1971 - 1975), a series of 16 paintings, he developed a program with **Stan Tempelaars** that placed 24 different colored elements in a rectangular plane.

Since his encounter with computer, he almost exclusively shifted his working methods to computer-generated works and pioneered the use of computers in Netherlands in almost every aspect of visual arts: paintings, graphics, audio-visual light-objects, film, video and sculptures applied in public art. Struycken's continuation to work with computer-generated images from 1969 until today (2011) is unique in the field of visual arts in Netherlands.²⁸

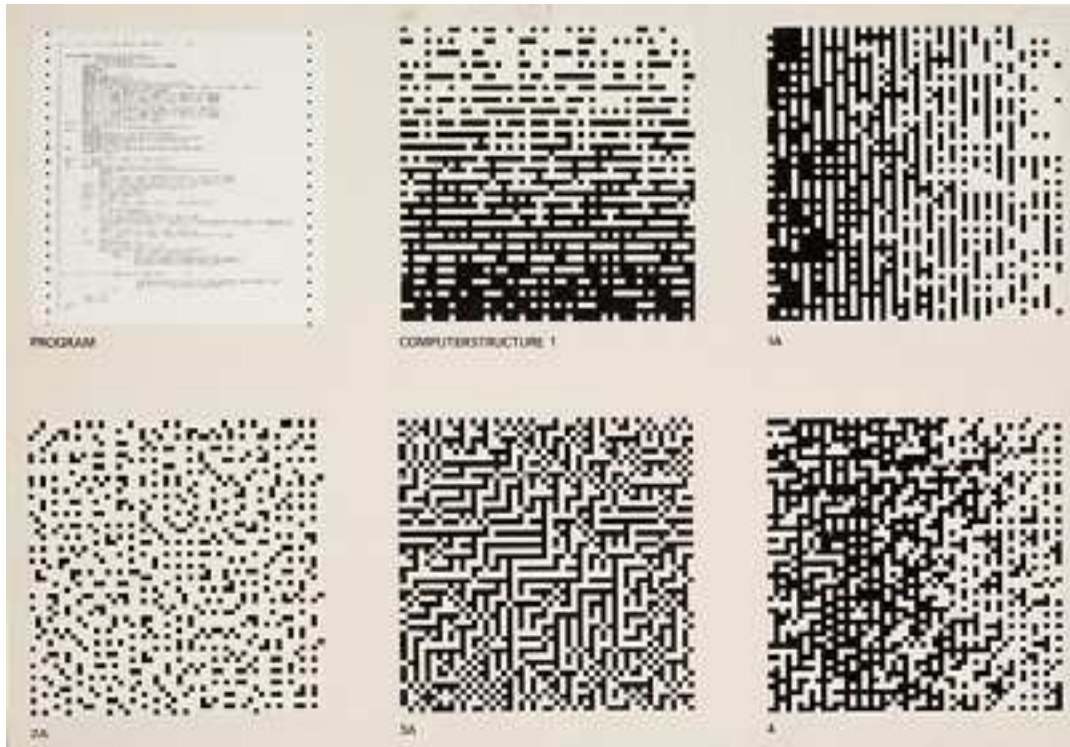
His first film **Beeldprogramma I** (1970) is made as a stop-animation of drawings

²⁵ All three members participated at the symposium 'computers and visual research' (part of 'tendencies 4' program) in Zagreb, 5th - 6th May 1969. Text of the presentation published as 'Definitions ...' in: *bit international* 7, Boris Kelemen and Radoslav Putar (eds.), Galerije grada Zagreba, 1971, pp. 143 - 148. *Computer-output als esthetisch object* by Jan Baptist Bedaux, 1970, 8 pages, 10 b/w 35 mm slides, paper read at the Aesthetics course at the Art history and archeology department, Catholic University of Leuven CUL, March 1970. Unpublished. See 'Arthur Veen, 'Compos 68', in: Peter Struycken (ed.), *Vormgeving en exacte disciplines* / *Design and the exact disciplines*, Bureau Vormingwerk van de Rijksuniversiteit Utrecht, 1971,

²⁶ *Computerstructuur 1A, Computerstructuur 1B, Computerstructuur 4, Computerstructuur 4a-69* (under title *Computerstructuur IV A* in the collection Stedelijk Museum Amsterdam). Each ink on perspex, 150 x 150 cm. 8 - 21 January 1970 he exhibited this series at solo exhibition *Komputerstructuren*, Verfindustrie Jac. Eyck nv, Heerlen. / cat.

²⁷ architect: Rein Fleddeurs

²⁸ Work of Struycken is well researched and documented. See Blotkamp, Carel; Dekkers, Daniel (and others), P.Struycken, NAI Publishers, Rotterdam 2007, and here Bibliography.

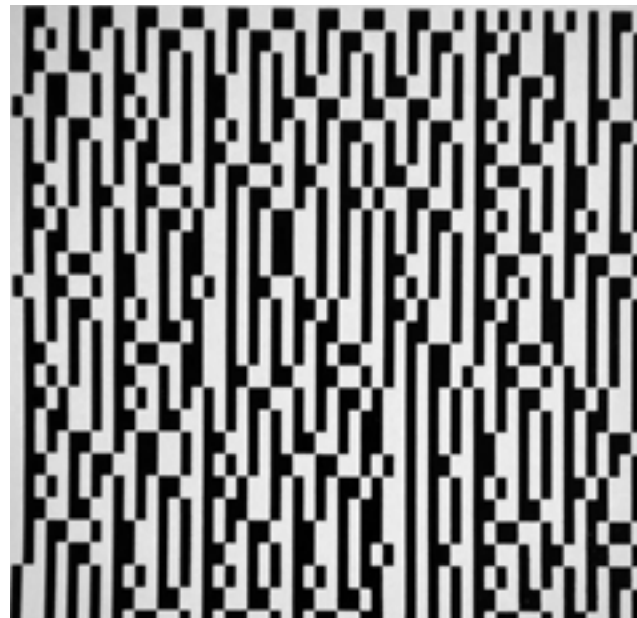


Peter Struycken *Computerstrukturen*
1969 -1970, program and *Computerstrukturen 1, 1A, 2A, 3A* and *4*.

Program written in ALGOL by Struycken, Constant A.G.M. (Stan) Tempelaars and Greta Vermuelen at the Instituut voor Sonologie. Series of hand made paintings hand following computer-generated visual compositions.



Peter Struycken, *Computer Structure 3A*, 1970 - 1971.
The choice principle for the distribution is ALEADUB.



Peter Struycken, *Computer Structure 7A*, 1970 - 1971.
The choice principle for the distribution is RATIODUB.

made after computer-programmed visual compositions.²⁹ In 1973 - 1974 he develops the computer program ASTRA, that will find its output result in a film; in 1976 he made his first real-time computer animated images recorded on video (***Waves, Disp, Vloei, Square, Grid 3, Lijn 1***) and finally in 1981 he made the 'stand alone' image generator '*SHFT*'. It showed images, being calculated one by one on a display. The images never repeat in space or time and are generated by a fully deterministic program (without using randomness).

Beeld en geluid programma 1, 1970 - (*Image and Sound programme 1, 1970*) is an audio-visual object, a light box showing 180 combinations of 24 basic black and white patterns, with sound synchronized in real-time.³⁰ The computer program was designed with **Stan Tempelaars**.

Advanced research on the relationship between structure and randomness was carried out by computer scientists **Lambert Meertens** and **Leo Geurts** in their series of works ***Kristalstrukturen***, (Crystal Structures, 1970) that follows the logic of cellular automata in the growth of crystals. They employed a family of algorithms which all use majority voting. Some of them use larger neighborhoods than the immediately adjacent cells. The update regime is incremental: cells are updated one by one. A selection of images was printed and exhibited internationally.³¹

Computer-generated art was presented within the frame of the Concrete Art on numerous occasions all over the Netherlands: in the Amsterdam galleries **Swart (Leo Geurts / Lambert Meertens and Peter Struycken)** and **Multi Art Points** and the **Stedelijk Museum**, as well as in **Kunstcentrum Badhuis** in Gorinchem (**De Vries** and **Sykora**), **Galerie de Mangelgang** in Groningen and **Museum Boymans-Van Beuningen** in Rotterdam. Several group exhibitions made different curatorial contributions to the subject. In 1972 the group exhibition "*Programmi Sistemati: Dekkers, Hilgemann, Schoonhoven, Struycken, De Vries*" took place in Galleria Milan in Milan; "*Peter Struycken, Ad Dekkers, Jan Schoonhoven, Carel Visser*" in Lens Fine Art in Antwerp and *Struktuur - een thema, een methode* presented the *Centrum voor Cubische Constructies*, Dekkers, Van den Ende, Von Graevenitz, Hilgemann, Roskam, Van Rossum and **De Vries** next to computer-generated works by **Geurts / Meertens** and **Struycken** in De Lakenhal, Leiden. *Varianten* - an exhibition of Dutch Constructivists, organized by Nederlandse Kunststichting in De Aart in Hilversum in 1973, included work by **Peter Struycken**.

The topic of preprogrammed or completely determined works versus randomness or chance (Dutch: *toeval*) is well-known in the discourse of Concrete Art, and well applicable to computer-generated art. In 1976 the traveling exhibition of Concrete Art ***Toeval Kunst*** included computer-generated works by **Struycken**.³²

Another exhibition with a similar name, ***Toeval***, was initially conceived as an exhibition of computer-art by **Frans Haks** (1938 - 2006) but later extended to the general subject of chance in art.³³ The exhibition was prepared in the course of two years by a core group of five members (**G. M. van Aspen, Frans Haks, W. Nijdam, F. C. Weiland, Stan Tempelaars**) that invited more than twenty collaborators who selected the program. Finally, it took place in March 1972 in

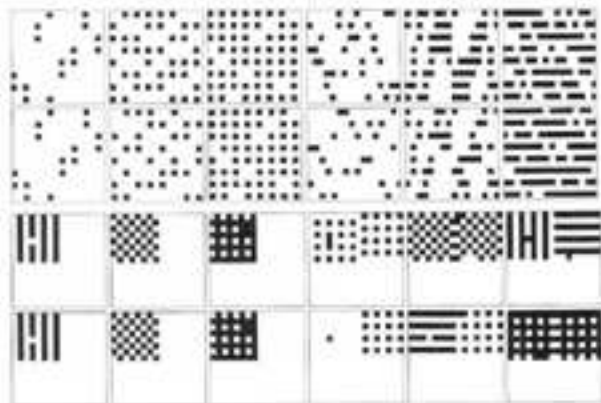
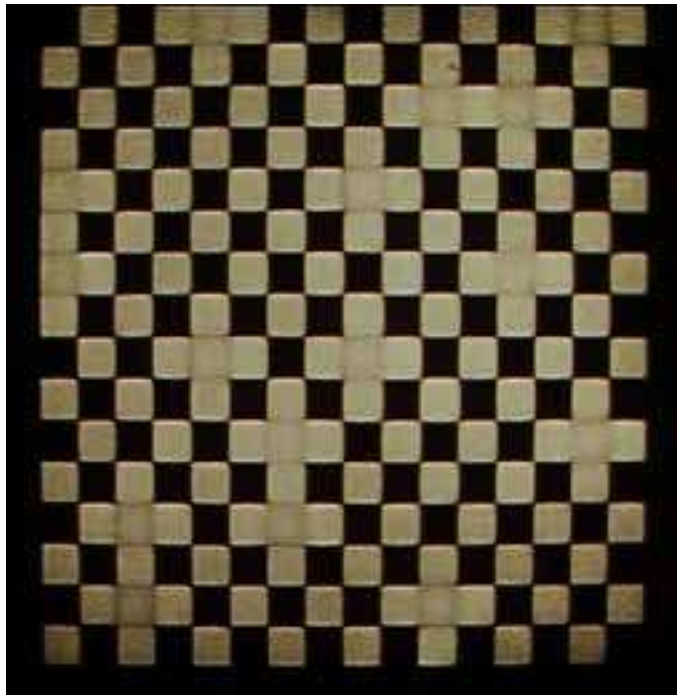
29 Premiered in 'Openbaar Kunstbezit', TV program directed by Frans Haks.

30 290 x 290 x 18 cm (col. SM). Work was shown first time at the exhibition *Geluid <=> Kijken (Sound <=> Sight)*, drie audio-visuele projecten: Ton Bruynèl, Dick Raaijmakers, Peter Struycken, Stedelijk Museum, Amsterdam, 5 March - 2 May 1970, curated by Jan Martinet in collaboratin with Frits Weiland.

31 In 1970 *Kristalstrukturen 1- 4* (under the titles Computer Structure, Crystallization 050270/1; Computer Structure, Crystallization 090270/3; Computer Structure, Crystallization 240270/14; Computer Structure, Crystallization 060670/2) participated in the 8th Annual Computer Art Contest, organized by the journal Computers and Automation, where they got an "honorable mention" and were published in the August 1970 issue and were exhibited at the Third Annual ACM Computer Arts Festival (Association for Computing Machinery) that took place at Rhienelander Gallery, New York, 1st - 3rd September 1970 (Honorary Mention prize). In 1972 Galerie Swart exhibited this series in Amaterdam (12 maart - 1 april), and published a portfolio of four silkscreen prints.

32 Netherlands Ministry for Cultural Affairs, Recreation and Social Welfare / Nederlandse Kunststichting, 1976, cat.

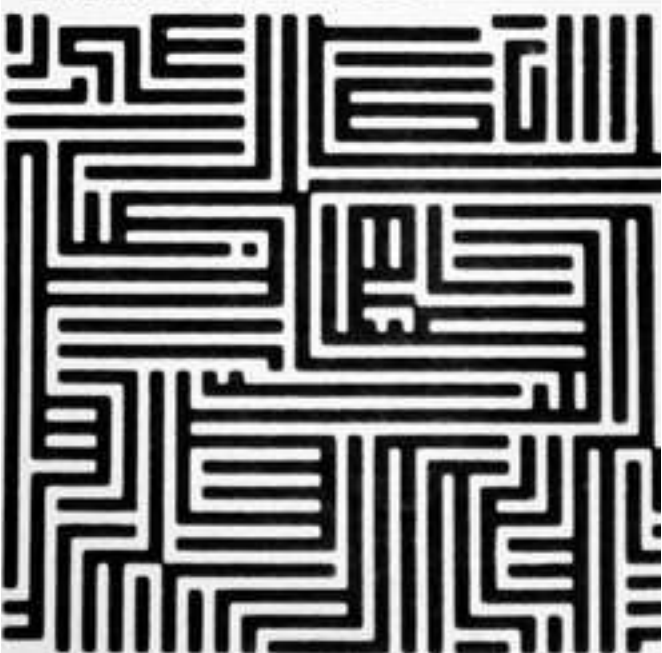
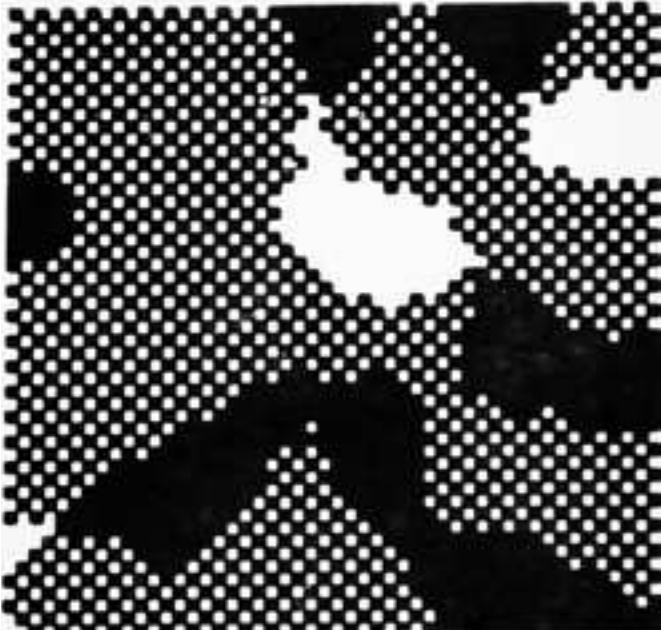
33 13 - 17 March 1972 - Toeval, group exhibition curated by Frans Haks. Studium Generale, Rijksuniversiteit Utrecht / cat.



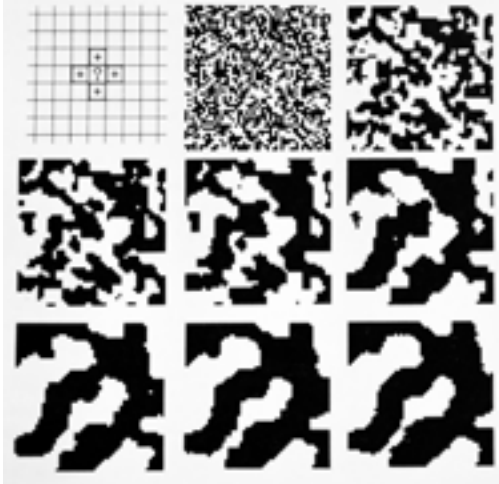
Peter Struycken, *Beld en geluid programma 1*, 1970 (*Image and Sound programme 1*, 1970), 1970. audio-visual object. Light box showing 180 combinations of 24 basic black and white patterns, with sound synchronized in real-time. Computer program is designed by Peter Struycken and Stan Tempelaars



Peter Struycken, *Noise-reduction wall and garden*, 1980 -1984, public art, PTT dispatch hub, Utrecht. Two programs were used in design: DOTS and SHIFT, both written by artist.



Lambert Meertens and Leo Geurts, from the series *Kristalstructuren*, (Crystal Structures), 1970.
Below: process of crystallization in eight steps, designed by authors with ALGOL 60 language and Electrologica X8 computer at the Mathematic Canter in Amsterdam.





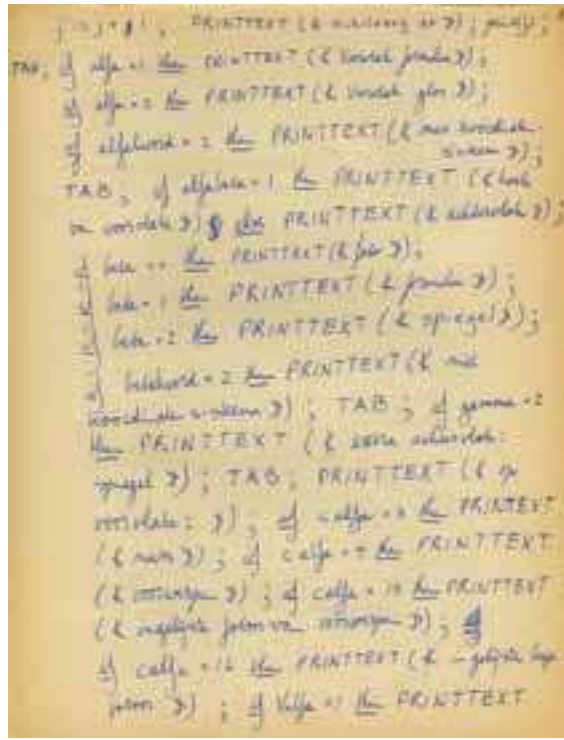
above left: Remko Scha, concept design from the series *Touwverbanden (Rope Connections)*, 1966 - 1967

above right: Remko Scha, *Touwverbanden (Rope Connections)*, Installation view, Stedelijk Museum, Amsterdam, November 1967



left: Remko Scha, *Untitled (Algol Program)*, 1968, from the series *Touwverbanden (Rope Connections)* series, concept design.

below: Remko Scha, *Untitled (Algol Program)*, 1968, from the series *Touwverbanden (Rope Connections)* series, computer program in ALGOL



Utrecht and presented a new and truly interdisciplinary approach. The project included a wide range of subjects: fine arts, biology, literature, music, psychology, mathematics and physics. An exhibition, slide show, film and music program as well participatory actions were presented. The fine arts section presented different art discourses ranging from the historical avant-garde of the 1920's to Concrete Art and Conceptual Art. In an extensive publication that accompanied the exhibition an essay *Kunst en computer* by **Hoos Blotkamp** provides a context and readings of the *Kristalstructuren* by **Leo Geurts / Lambert Meertens** and computer-generated works by **Peter Struycken** and **Zdenek Sykora**.

Computer-generated art as part of Fluxus and Conceptual Art

A different approach to structured determinism and randomness we can find in artworks by **Remko Scha** (b. 1945). Being active in both the music scene as well as the visual arts, his work bridges the traditions of Fluxus and Conceptual art. **Markov muziek - Opus 27** (1966)³⁴ is an algorithmic music work conceived for the computer. Transition tables define Markov random processes. The piece consists of seven parts with different transition tables: 1: Deterministic scale, 2: *Random White Note Music*, 3: Scale with randomly broadened steps, 4: Monotone version, 5: Interpolation between Monotone and *Random White Note Music*, 6: Random Walk, 7: Random random.³⁵

Untitled Algol Program (1968, working title) is a program generating textual descriptions of ca. 600.000 assemblages, made of different objects in different configurations. The output assemblages may be built, but the program generating their descriptions may also be presented in operation, by installing a computer with a printer in the gallery. **Untitled Algol Program** follows Scha's series of installations *Touwverbanden (Rope Connections)*, since 1966) where different groups of objects were connected by ropes, displaying their mutual relations and thus materializing a *relational aesthetic*. In the assemblages described by the output texts of **Untitled Algol Program**, objects, photographs, philosophy books, and/or empty spaces (holes) are positioned in a grid, on two surface layers above each other. The surfaces may be realized in different materials (formica, glass, mirror). Objects/books/spaces may or may not be numbered or connected with ropes. The total number of configurations allowed within the constraints of the program is ca. 600.000. The program that calculates and generates the texts describing these configurations was written in Algol 60 by the author.³⁶

nixmur (automatisering) (1969) is another Algol 60 program, conceived for an installation consisting of a computer and a printer.³⁷ The program is a 'loop'; the computer that runs the program, endlessly puts out the text '*nixon moordenaar*'³⁸ to the printer, that use long sheets of paper (as was standard at the time). As this popular anti Vietnam War slogan was officially banned in Netherlands and therefore protesters were shouting it rather than writing it on their banners, the machine here took 'responsibility' for the action. Despite the fact that **Scha** was one of few artists who actually knew computer programming at the time, he did not have an access to the hardware to execute this piece. In an artist's statement accompanying the original manuscript of the program, he wrote: "*The principle that determines all modern art, which is the identity of form and content, has been completely abandoned here. Starting point for this work was the idea of making the tension between form and content as large as possible*".

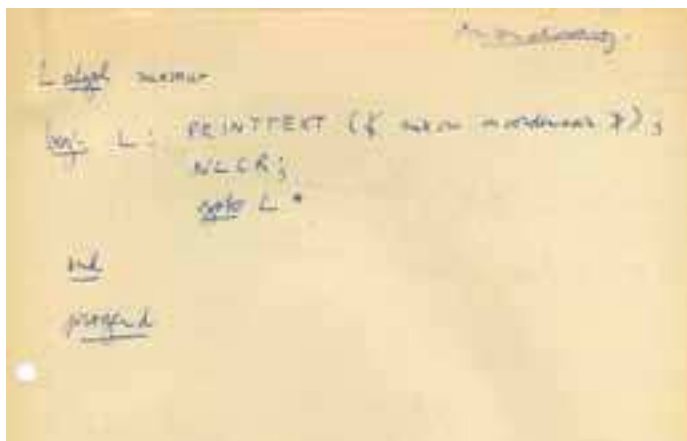
34 not performed (2011)

35 9 pages, handwritten, Remko Scha archive

36 Installation is not realized (2010). Documentation: Examples of intended output (6 pages, handwritten) and related computer program (10 pages, handwritten), 1968. Remko Scha archive.

37 concept and program in ALGOL from 1969, not realized (2011). Remko Scha archive.

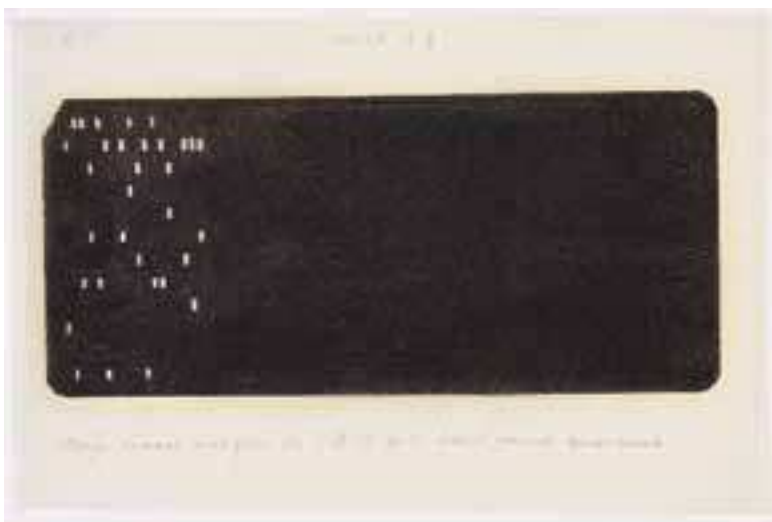
38 that-time wellknown anti Vietnam War slogan, that was officially banned in Netherlands



Remko Scha, *nixmur (automatisering)*, 1969, computer program in ALGOL



Remko Scha, *Muzak for Wijnand*, 1980, interactive generative sound object. Produced at Philips NatLab, Eindhoven. Program written in assembly code *TWIN ASSEMBLER VER 2650*. Hardware (controller, chip): 2650 Microprocessor by Signetics (CA, USA) and Programmable Sound Generator AY-3-8910 (by Genral Instruments co.), all build in the Philips radio model B3X02A-1960-L.



Pieter Laurens Mol, *My Name according to the IBM-29 Card Punch Machine*, 1969, cardboard print in oil paint on tissue paper, direct impression from punch card, made by IBM computer, Volmac company, Utrecht. Edition of 4 copies, not signed, numbered: 1/4 - 4/4 and 1 copy "épreuve d'artiste" on light green paper, not signed, numbered: E.A.



Pieter Laurens Mol, *Machine Poem Piece*, 1968, Computer print, made by IBM computer at the Volmac company, Utrecht. Edition of 8 copies, signed and numbered: 1/8 - 8/8 and 1 copy "épreuve d'artiste", signed and numbered: E.A.

After ten years of absence from the art scene, devoted to research on computational linguistics, **Scha** made in 1980 an interactive generative art object, ***Muzak for Wijnand***. The object consists of the outside of a readymade radio-receiver, whose inside hardware was substantially changed. An electronic chip was built in that was programmed by the author to generate minimal music sequences forever, interrupted at random moments by bursts of random noise and distortions. The listener could change the speed of music, by using the radio's buttons whose function had been changed. Since the early eighties **Scha** has again become active in generative and multimedia art, employing his interests and knowledge of artificial intelligence, computing, music, social activism and ever-changing visual contemporary art.

Conceptual artist **Pieter Laurens Mol** (b. 1946) made three computer-generated works in 1968 and 1969, as he had access to IBM computers and programmers that helped him in the software company Volmac.³⁹ ***Machine Poem Piece*** (1968) is a computer print in an edition of 8 copies. *Machine Poem Piece* makes it possible to read sentences in all directions. ***Mijn Naam volgens de IBM-29 Card Punch Machine*** (*My Name according to the IBM-29 Card Punch Machine*) (1969) is a cardboard print in oil paint on tissue paper - direct impression from punch card, made in an edition of 4. ***moment 1*** (working title, 1969) is a process-based conceptual artwork that made use of computer technology alongside other means of communication. The artwork took the form of personal gesture from the artist to art collectors **Martin** and **Mia Visser**. The text of the artwork read (in Dutch):

/ MENTAL VIBRATION OF PIETER LAURENS MOL / 7 JANUARY 1969 / 7.29 PM
/ AMSTERDAM
/ SOLD TO MARTIN AND MIA VISSER / MARCH 1969 / BERGEYK /
/ OBJECT / VACUUM /
/ TITLE / MY THOUGHTS /
/ PRICE / THE GREATER PART OF YOUR IMAGINATION ^{A0}

Additional explanatory text (in German) was displayed next to the work sent by post. The text explains three parts of the process: the idea about the work (January 1969), the production of the work (March 18th 1969, "I produce a program on the IBM card punch machine 29 ...") and finally sending the work by post (April 2nd 1969).⁴¹ This tautological piece presented the very process of making and selling as an artwork. The idea of participation and process are conceived within the discourse of conceptual art of the time; this also applies to the personal gesture viewed as an artwork.

³⁹ Artist's brother Jan co-founded the company with Joop van Oostrum.

⁴⁰ translation by artist

⁴¹ Work was shown at the exhibition 'Pläne und Projekte als Kunst' (Plans and projects as art), Kunsthalle Bern from November 8 - December 7, 1969.



Robert Deodaat Emile (Ootje) Oxenaar, 5 Gulden banknotes, 1966 and 1973 (redesign), Nederlandsche Bank. Partly computer-generated design at Technical University in Eindhoven with the help of the program controlled drawing system CORAGRAPH.

Inauguration of Computer-generated art and design into the mainstream visual culture in the Netherlands

Unlike in the rest of the world where such processes took decades, early computer graphics were inaugurated in the main Dutch governmental institutions that deal with visual culture and its representation: the design of money and post stamps.

Artist and graphic designer **Robert Deodaat Emile (Ootje) Oxenaar** (b. 1929) developed a series of seven banknotes from 1966 to 1985 for the Nederlandsche Bank that were (almost all) in circulation until the currency changed to the Euro in 2003.⁴² He improved banknote design in many ways in general, but keeping our focus on the subject here, it is interesting that all designs used computer-generated basic patterns prepared at the Technological University in Eindhoven with the help of the program controlled drawing system CORAGRAPH. Looking back to the use of computers in the 1960's, he says: "The funny thing is that this very old fashioned firm of Enschede [the printing house, DF] was the first in the world to use computer-aided machines for its banknotes in this way".⁴³

As in the case of the banknotes, the Netherlands is the very first country that issued computer-designed post stamps in 1970, also designed by **Oxenaar**. The *Summer postage stamps 1970*, a series of five computer-designed post stamps and five related posters, are made in collaboration with the group Numerical Control of the department Business Science of the Technological University Eindhoven, and issued by PTT. The design had been developed some years before, and was realized in collaboration with the Business Department led by Prof. **C. de Boer** and in collaboration with **Th. W. M. Lambs** and **J. van de Forest**. The 15c+10 stamp was derived from a design by the **Centrum voor Cubische Constructies**, announcing their participation at the 35th Venice Biennale same summer. **Max Kisman** reflects on the design: "The experiment to produce computerized graphics is entirely driven by the need for visual complexity of adding security to value papers. Structures that are too complicated to be executed by human hands. The creators have nevertheless succeeded to reduce that complexity into an accessible image (of computer application) and an attractive design."⁴⁴ As part of the promotion of the new post stamp series, PTT issued five computer-graphic images by **Oxenaar** that are related to the ones employed in the stamp designs, printed in offset in a presumably big edition. In an explanatory letter by the PTT, this abstract computer-designed graphics is called 'wall decoration'.

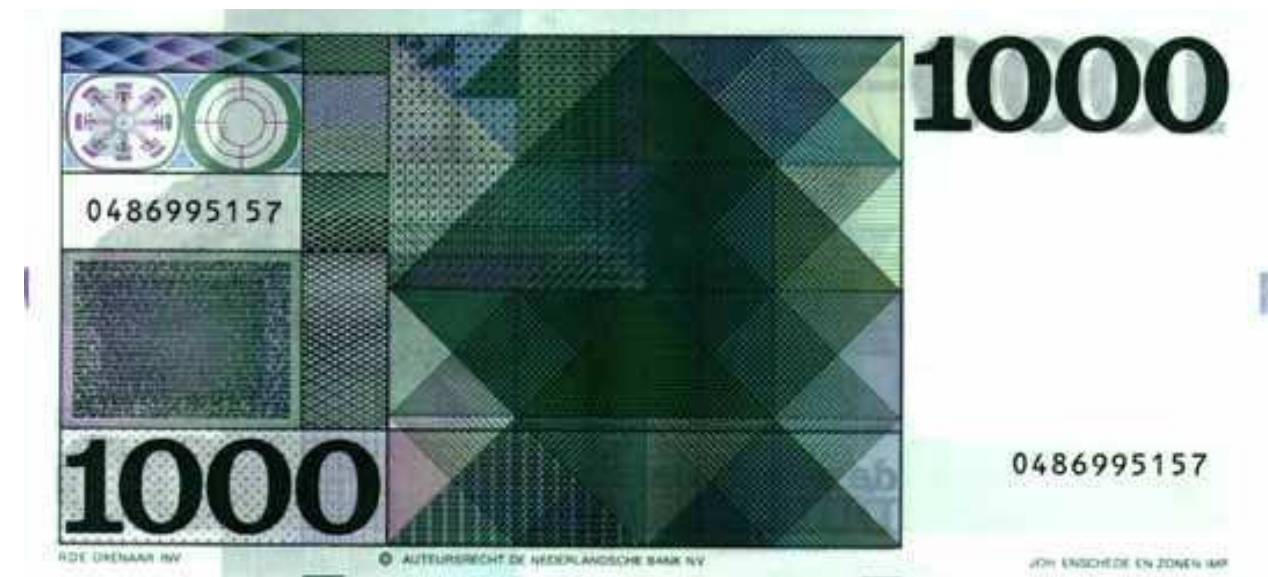
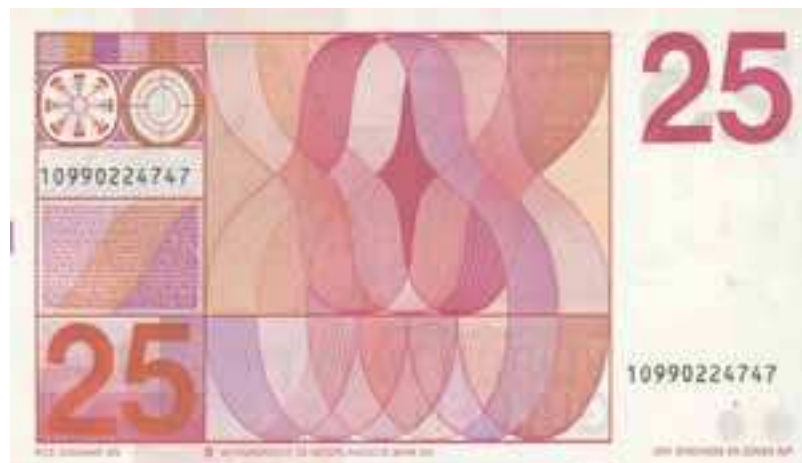
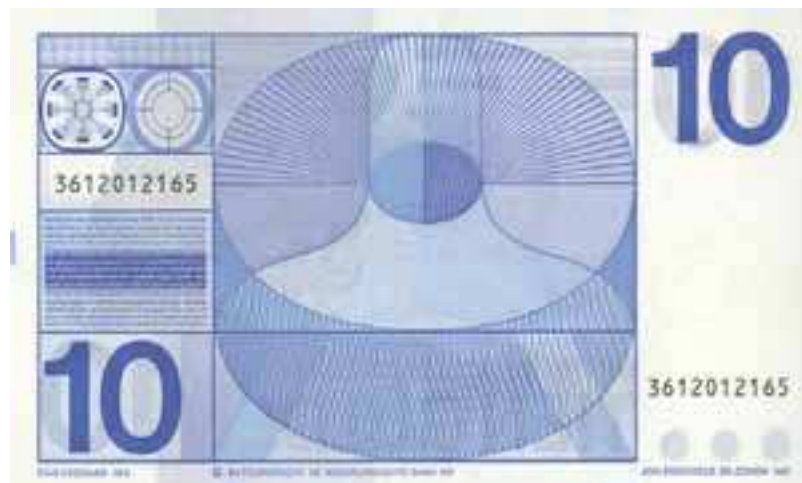
On occasion of coronation of **Beatrix** in 1980 PTT commissioned a new permanent queen stamp that was designed by **Peter Struycken**. The dot pattern was based on a digitized photograph that was made at the Pattern Recognition department at Delft University of Technology. The 128 x 128 grid was 'shaken up' using a random program. These stamps, in many mono or two-color variations, even made the transition to the Euro, thus being the longest-circulating stamp design in the history of the Dutch Post. **Struycken** also made several portraits of the queen for public buildings such as the Netherlands Court of Audit in The Hague (1996 - 1997). Those works are his only figurative works. Queen **Beatrix** made **Struycken** a Knight in the Order of Orange-Nassau in 1984.

Peter Struycken, who realized fourteen high-budget computer-generated permanent public art works until 1980, and even more since, mastered the inauguration of computer-generated art in the field of public art. **Struycken** designed the cladding of two areas, floor, ceiling walls and sitting elements in light-reflecting metal for World's Fair in Osaka 1970, while **Wim Crouwel** designed the graphic material.

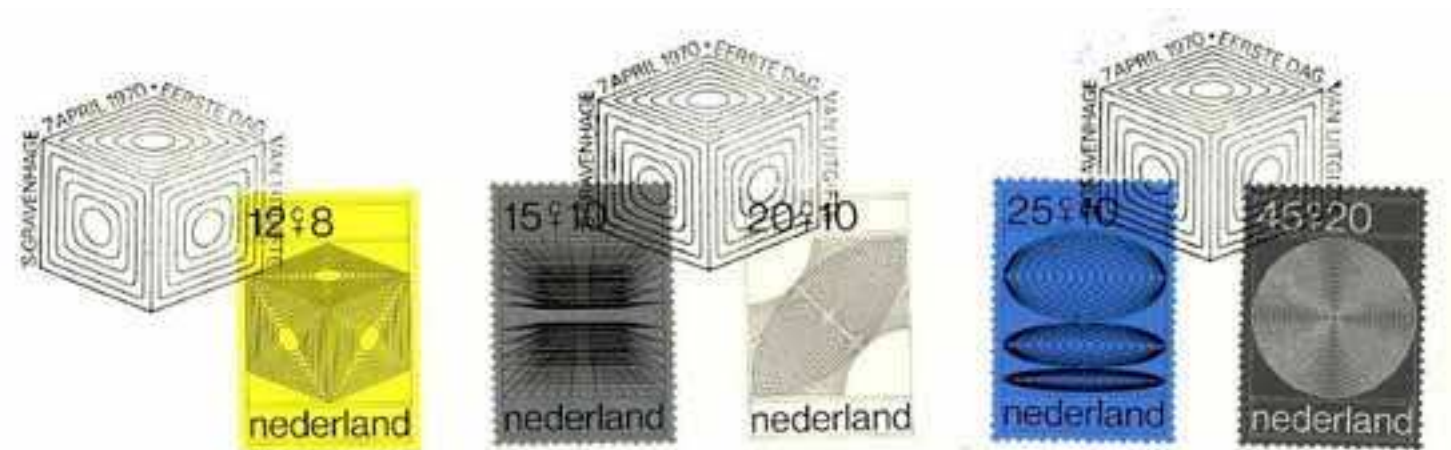
⁴² 5, 10, 25, 50, 100, 250, 1000 Guldens, and redesigns of his own design of 5 and 100 Guldens. Further reading: Jaap Bolten, *Het Nederlandse bankbiljet 1814-2002 : vormgeving en ontwikkeling*, Het Nederlandsche Bank, Primavera Press, Leiden, 1999

⁴³ Lecture by Ootje Oxenaar, *Proceedings of a congress held in Amsterdam in 1987*. Unpublished.

⁴⁴ Max Kisman, *Bits to Pieces*, 2010



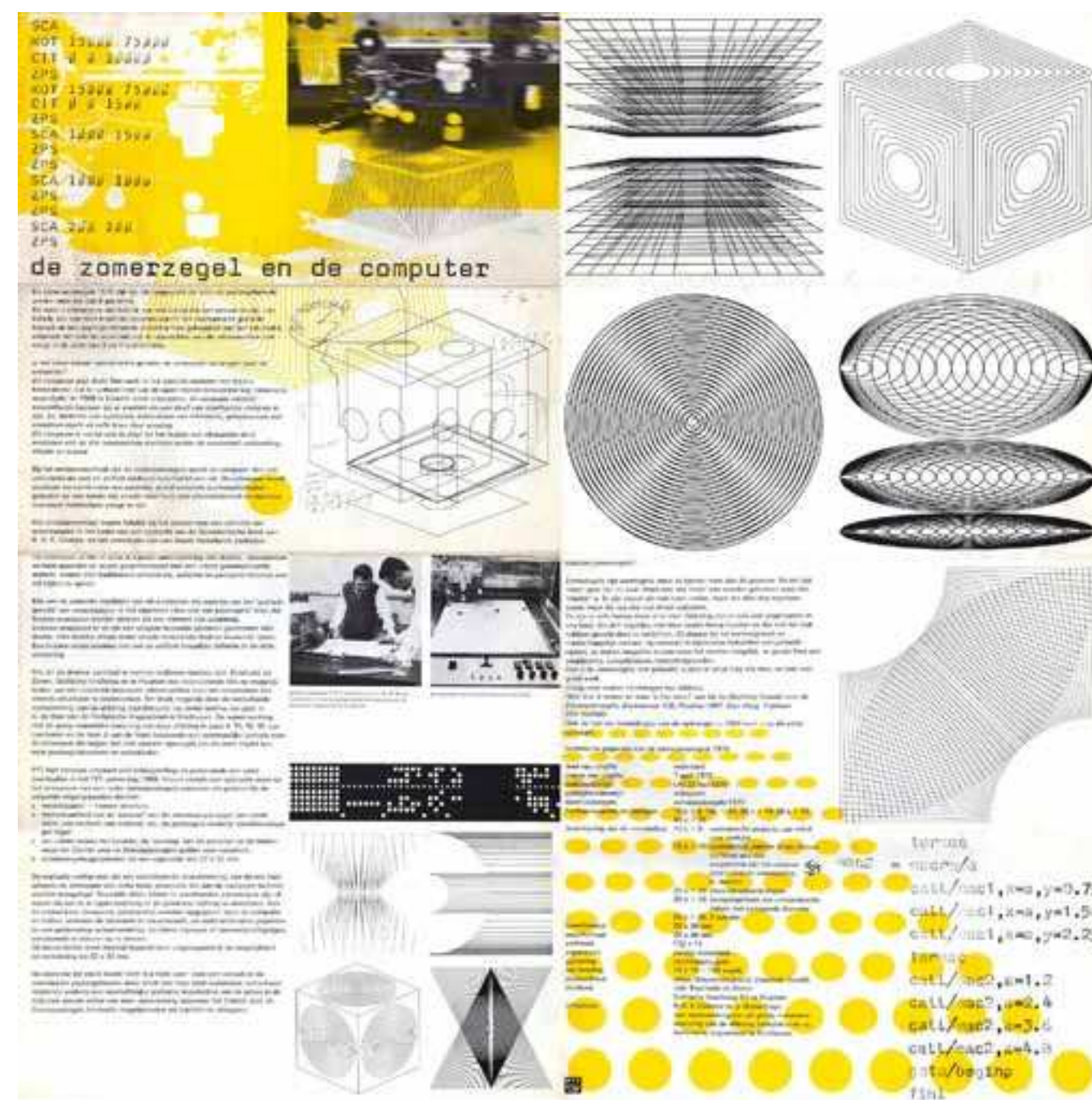
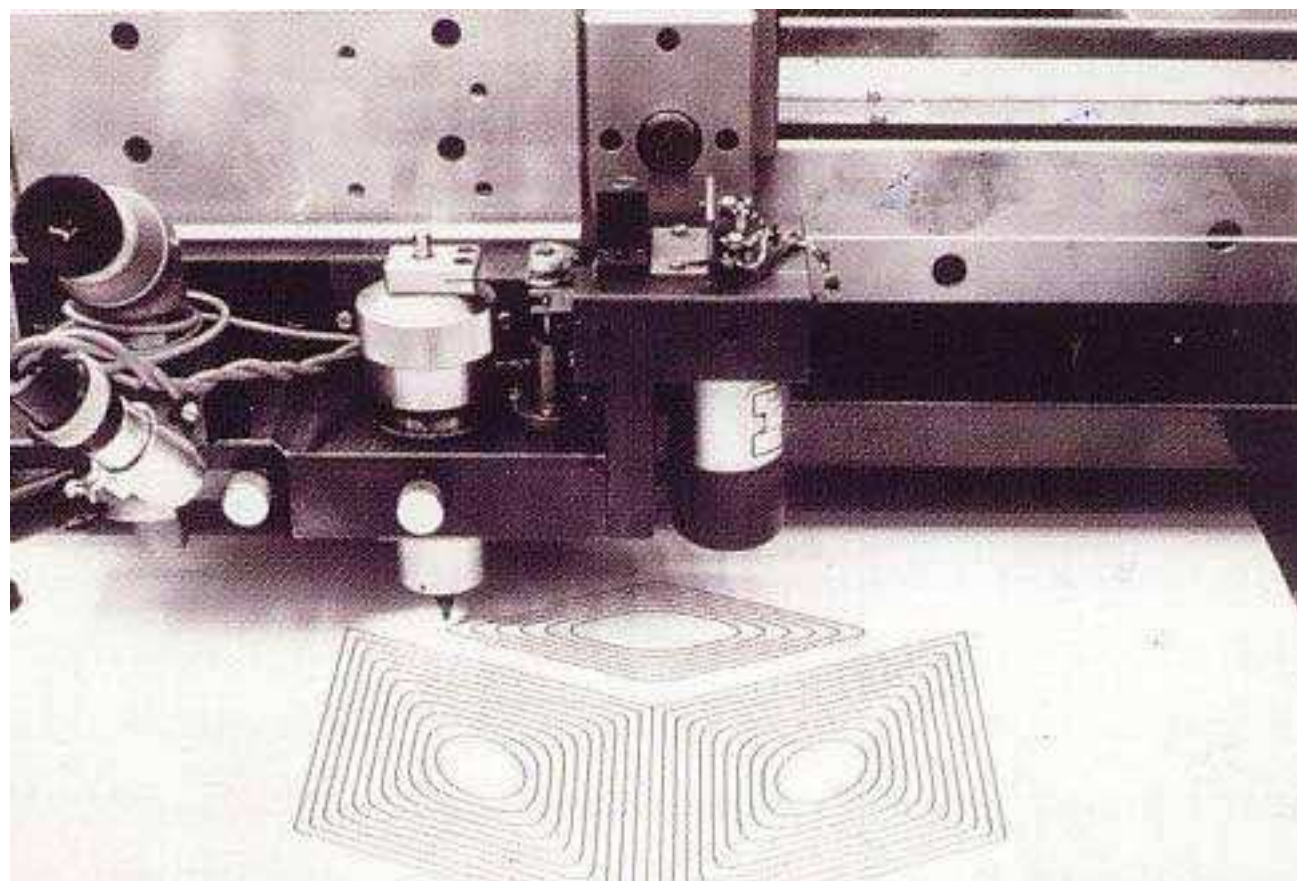
Robert Deodaat Emile (Ootje) Oxenaar, banknotes: 10 Gulden, 1969, 25 Gulden, 1973, 100 Gulden, 1970 and 1000 Gulden, 1972, Netherlands Bank. Partly computer-generated design at Technical University in Eindhoven with the help of the program controlled drawing system CORAGRAPH.

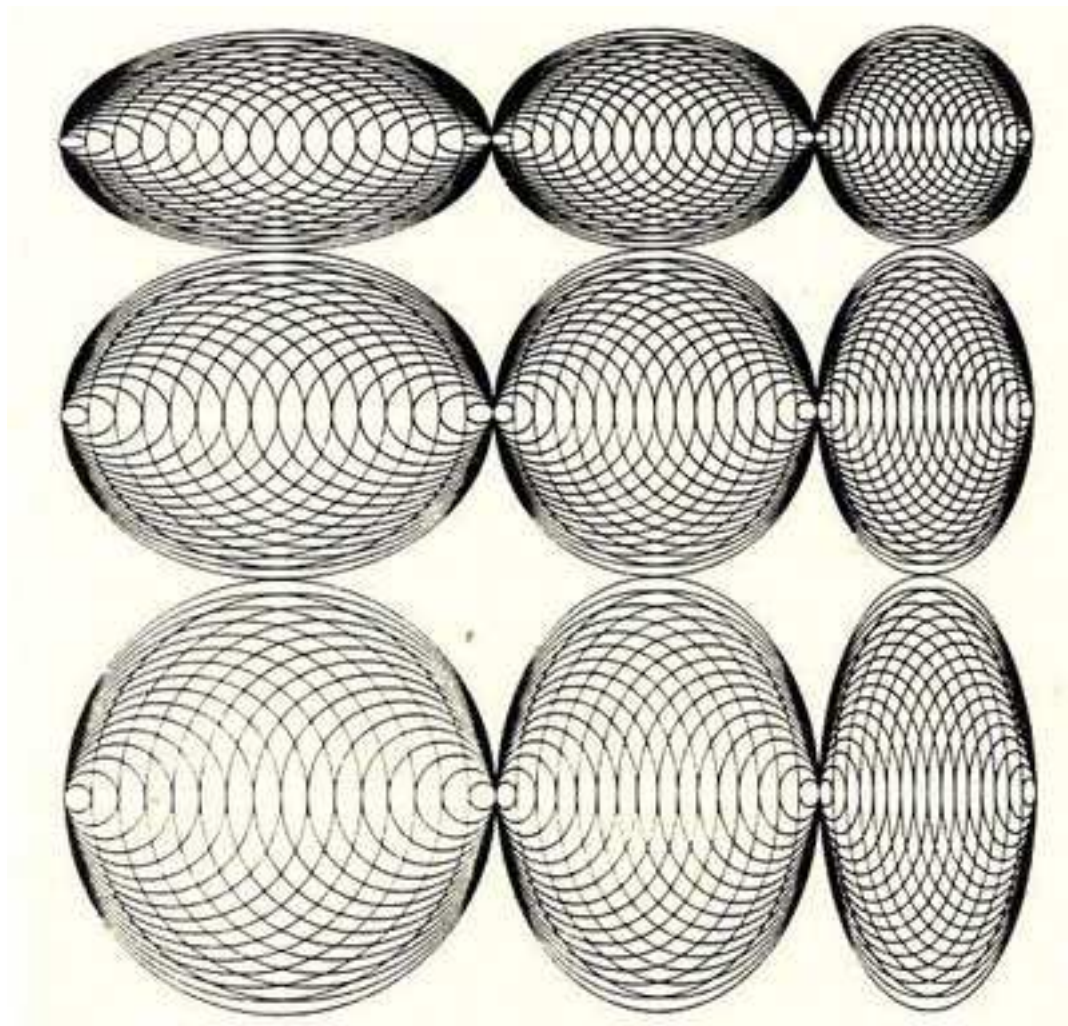


Robert Deodaat Emile (Ootje) Oxenaar: *Summer postage stamps 1970*, series of five computer-designed post stamps. Made in collaboration with the group numerical control of the department business science of the Technical University Eindhoven, and issued by PTT Netherlands.

Below: computer printing of stamp design

Next page: poster and flyer advertizing the *Summer postage stamps 1970*





Robert Deodaa Emile (Ootje) Oxenaar, *Untitled*, computer graphic printed as poster, promoting *Summer postage stamps 1970*. Made in collaboration with the group numerical control of the department business science of the Technical University Eindhoven, and issued by PTT Netherland



Peter Struycken, *Queen stamps for the PTT (Series 1)*, 1980, issued by PTT Netherland. Made in collaboration with pattern recognition department at Delft University of Technology, using *DIP 1* technology developed by Lyckle Aardema.

Film director, screenwriter, inventor and entrepreneur **Samuel Meyering** (1944 – 2006) made a permanent public art installation with a computer-generated chaotic line at eighteen elevator lobbies of the Ministry of the Interior and Kingdom Relations⁴⁵ in Hague in 1978. **Meyering** also worked with computer-generated sculpture, animations, interactive video games and demos, using the Apple II personal computer. In 1980 he founded the software house *paralax* in Amsterdam, which improved the manipulation of typography for TV and video productions.

Apart from computer-generated images in the daily use of banknotes and post stamps, the queen's portrait and several public art installations, the imagination of the general public of all age groups was captured by the Evoluon, a permanent industrial exhibition run by the Philips electronics company. It opened in 1966 in Eindhoven, and from 1971 it was equipped with a P855 computer. **The Senster** by **Edward Ihnatowicz** (1926 - 1988, PL / UK), an interactive cybernetic-robotic sculpture controlled by a computer, was in operation at the Evoluon from 1970 until 1974, where it was developed and assembled.⁴⁶ Realization of the Senster took more than two years. Engineers from Philips and Mullard (a British manufacturer of electronic components) as well the Mechanical Engineering department of University College London helped **Ihnatowicz**. The computer program for the **Senster** was written by **Ihnatowicz** with help from **Peter Lundahl**. About 4 meters long, the **Senster** consists of six independent electro-hydraulic servo-systems based on the articulation of a lobster's claw, allowing six degrees of freedom. **The Senster** has a 'head' with four sensitive microphones, which enable the direction of a sound to be computed, and also a close-range radar device that detects movement. The whole is controlled by a Philips P9201 digital computer, which tells the servo-system how to move in response to various combinations of sound and movement from visitors to the Evoluon.⁴⁷ Sudden movements or loud noises would make it shy away. The complicated acoustics of the hall and the completely unpredictable behavior of the public made the **Senster's** movements seem a lot more sophisticated than they actually were. It soon became obvious that it was that behavior and not anything in its appearance that was responsible for the impact that the **Senster** undoubtedly had on the audience.

R. A. Leeuw wrote as part of his doctoral studies in art history a thesis on computer art.⁴⁸ The thesis was completed in 1970 and tries to provide an introduction to computer art for art historians. The technical aspects are therefore discussed only if they are important for understanding why a particular artwork is created. Chapter 1 covers the history of computation and its operation, only elaborating on the key visual output media: line printer, plotter and cathode ray tube. Chapter 2 examines how the interest in machinery and technology arose, that drove artists to no longer produce works by themselves, but rather through machines. The era of the Industrial Revolution and Futurism are discussed in depth. After a treatment of some aspects of art and cybernetics finally follows a critical discussion of computer art and a discussion of the work of some artists, such as **Struycken**, **Barbadillo**, **Nake**, **Nees**, **Lecci**, **Oxenaar**, **Sumner**, **Computer Technique Group Japan**, **Cordeiro**, **Moscatti**, **Whitney** and **Metzger**.

⁴⁵ Ministerie van Binnenlandse Zaken

⁴⁶ See: 'De senster in het Evoluon', Evoluon-publicatie EE2/0008/CT-IO772/CT, dd 9 juni 1971, Eindhoven. Website edited by Aleksandar Zivanovic dedicated to this project at <http://www.senster.com/index.htm>.

⁴⁷ rce: Jonathan Benthall, *Science and Technology in Art Today*, Thames and Hudson, London, 1972. The same article was published in *Studio International*, 1971.

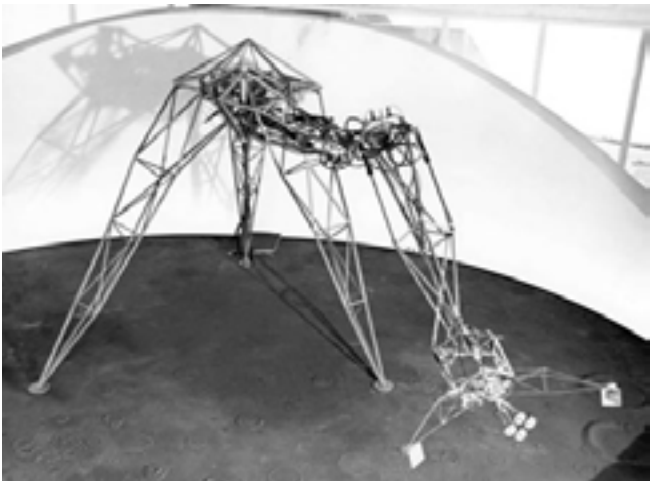
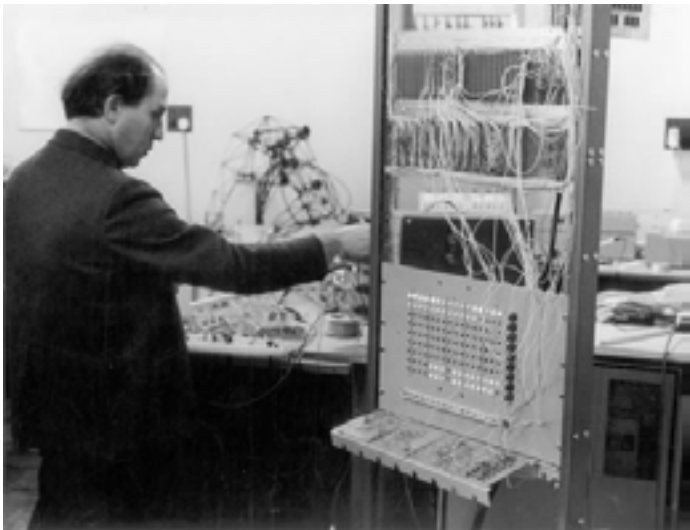
⁴⁸ R. A. Leeuw, Instituut voor kunstgeschiedenis, Groningen, September 1970



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Edward Ihnatowicz, *The Senster*, interactive cybernetic - robotic sculpture controlled by a computer, 1970 (in operation until 1974). Computer program (far left) written by Ihnatowicz with help from Peter Lundahl. *Senster* consists of six independent electro-hydraulic servo-systems based on the articulation of a lobster's claw, allowing six degrees of freedom; 'head' with four sensitive microphones, which enable the direction of a sound to be computed, and also a close-range radar device that detects movement. Controlled by a digital computer Philips P9201, which tells the servo-system how to move in response to various combinations of sound and movement from visitors to the Evoluon



Reconstructie. Een moraliteit., 1968 - 1969, opera by Louis Andriessen, Peter Schat, Reinbert de Leeuw, Misha Mengelberg and Jan van Vlijmen. Hugo Claus and Harry Mulisch wrote a libretto. Program and LP. The opera was dedicated to Che Guevara, Parts of score by Andriessen and Harry are computer-generated, in collaboration by Lambert Meerten and Leo Geurts, by Electrologica EL X8 and score printed by EL X1 in the Mathematisch Centrum, Amsterdam

Computer-generated art from activist and leftist positions

After the mid-1960's Concrete Art and related systematic visual research start to loose the edge of their political (new) left positions that were dominant in the late 1950's and early 1960's. The notion of participation art that was inaugurated within such art discourses by *Arte Programata* (**Umberto Eco**, 1962) and the related demystification and democratization of art with the progressive positions of the *New Tendencies* (since 1961) and similar phenomena were lost in the commercialization of mainstream contemporary art and the related cultural industry. Their ideas entered the mainstream and were reshaped using simplifications, while their leftist social engagement, once at the forefront, was being neglected. The 'Responsive Eye' exhibition was held in the Museum of Modern Art in New York in 1965 and numerous politically engaged artists participated as well. However, their work was immersed in the commercial context focused more on retinal effects than on the social dimension of artistic work; visuals lost the seriousness of 'systematic research' and started to be used in pop culture and fashion (after this exhibition, the term 'op art' appeared). Many artists, as they gained international recognition, bent their style in commercial directions and blended into the commercial system of the culture industry, which they had often severely criticized earlier.

A positive output of such an appreciation of the mainstream we can see in the inauguration of visual research, gestalt theories and modernistic aesthetics within the sphere of graphic design, the trend that continues until today and has a strong presence in the Netherlands as well.

In general, the Dutch art scene of the 1960s and 1970s was impregnated with rebellion, anarchistic and other leftist positions and activism. A famous pre-1968 hybrid of art and activism was conducted by **Provo** (1965 - 1967) in the public spaces of Amsterdam.

In 1967 **Remko Scha** and his improvisational multi-media band **The New Electric Chamber Music Ensemble** played in the Sigma Centrum (Kloveniersburgwal, Amsterdam)⁴⁹, a center for anarchist culture that at the time served as the home base of **Provo**, as well at the conference "Culture and Society", organized in Maastricht by the left wing of the P.v.d.A. ("Tien over Rood") and the local branch of Provo ("Ontbijt op Bed")⁵⁰. **Remko Scha** also presented the installation "**Touwverbindingen**" ("Rope Connections") at the opening night of the new headquarters of **Provo** in the Apollo Bioscoop in Amsterdam.⁵¹ Those works were not computer-generated, but they did lead to other similar artworks conceived for computer, described above, and show us the political context of **Scha's** art activities and their presentation in both official and non-official venues.

Lambert Meertens worked at the Mathematical Centre in Amsterdam but he was also chairman of the Pacifist Socialist Party (PSP)⁵² from 1975 to 1981. He and his colleague **Leo Geurts** were deeply involved with the creative use of computers since 1967, which led them to make computer-generated music as well as the computer graphics mentioned before. They wrote the programs to generate parts of compositions⁵³ by **Louis Andriessen** and **Peter Schat** that were part of a collaborative work, the opera **Reconstructie. Een moraliteit.** (1968 - 1969)⁵⁴. Other participating composers were **Reinbert de Leeuw**, **Misha Mengelberg**, **Peter Schat** and **Jan van Vlijmen**. **Hugo Claus** and **Harry Mulisch** wrote the libretto. The opera was dedicated to Che Guevara, openly showing the political orientation of the authors. **Meertens** and **Geurts** collaborated with **Andriessen** on

⁴⁹ February 3, 1967

⁵⁰ 25 February 1967.

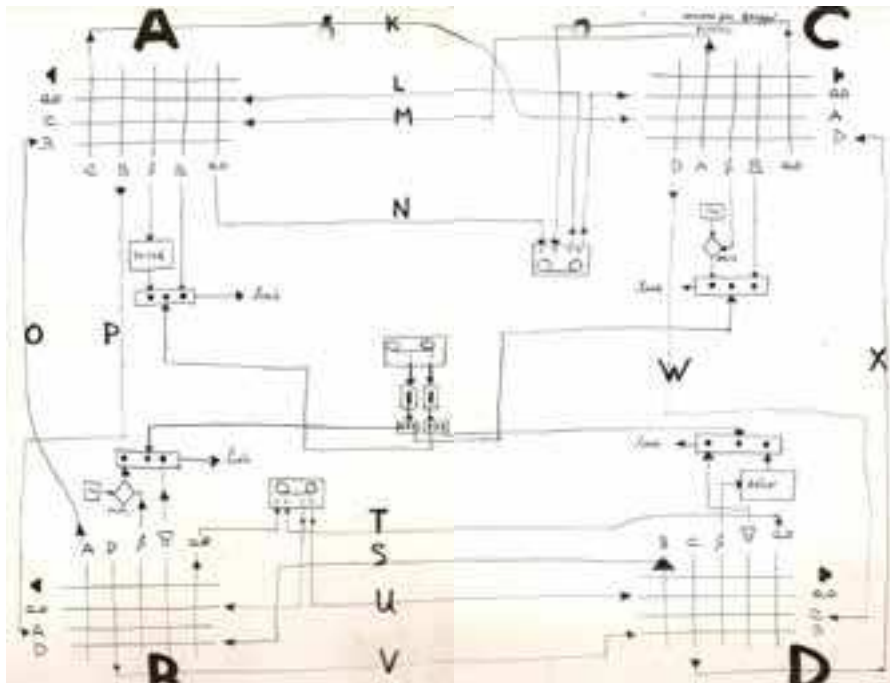
⁵¹ early April 1967, Provo-Bioscoop, Haarlemmerdijk, Amsterdam

⁵² Pacifistisch Socialistische Partij (PSP),

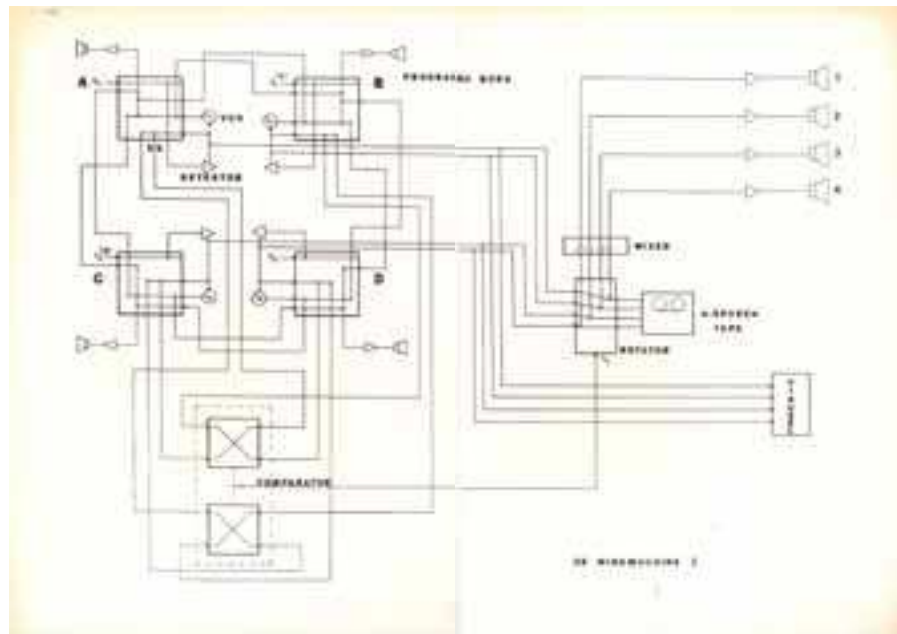
<http://www.parlement.com/9353000/1f/j9vvhy5i95k8zx/vh8lnhrp8wsk>

⁵³ Computing was done by Electrologica EL X8 and score printed by EL X1 in the Mathematisch Centrum, Amsterdam

⁵⁴ premiere was 29th Jun 1969 at the Holland Festival, Theater Carré, Amsterdam.



Victor Wentink: *Quadraat Stelling I (De Windmachine I)*, 1971, sound installation with an interactive hardware-programmed man-machine network, the technological set-up drawing (drawing: Dick Raaymakers)



Victor Wentink: *Quadraat Stelling II (De Windmachine II)*, 1973 - 1976, audio-visual live performance / installation with an interactive hardware-programmed man-machine network, the technological set-up drawing (above) and painting (left).



several occasions.⁵⁵ The *Volkslied* (1971) - *For an unlimited number and kinds of instruments (in all octaves)* by **Louis Andriessen** was programmed by **Leo Geurts** on the Electrologica X8 computer of the Mathematical Centre, Amsterdam. The score starts with the Dutch national anthem *Wilhelmus van Nassouwe* and then gradually, with small steps, morphs into the socialist hymn 'The International'.

Interactive man-machine networks by Victor Wentink

Composer and visual artist **Victor Wentink** (1948) made a step further in interactivity and participative art with his original notions of horizontal and vertical computing. He developed such ideas considering political notions of an author in relation to power structures and technologies.

Quadraat Stelling I (De Windmachine I) (1971) is a sound installation with an interactive hardware-programmed man-machine network. The set-up is based on a display of horizontal entities, both human and technological, creating an interactive network, or "new ground of existence".⁵⁶ Four people sitting in the room, interacting via a matrix board and pins (consisting of 0's and 1's) with the sound-producing electronic equipment that was set-up on the floor in the same space. The four nodes of the established network are made of two pairs (that can be extended without limits), following the logic of multiplied communication in pairs. **Wentink** views the traditional orchestra as a mainframe machine controlled by the conductor and the score. Further, considering the idea of computerizing the world and the power of mainframe computers, this installation was designed as an opposition - democratizing technology. **Wentink's** idea was to decentralize and deconstruct the man-machine relationship represented in the mainframe computers, and create a personalized and intelligent technology network, that will empower the interaction of the human body and technology in the creation of the "slow human computer". It follows the idea of socializing technology after **Marx** and **Benjamin**. The installation was intended to be used in the private environment of a group of musicians; four such sessions were held in May 1971 by members of the student's electronic instrumental group *Het Leven* in the Koninklijk Conservatorium in Den Haag. The group consisted of eight musicians, involving **Dick Raaymakers**, who did technical preparations and made the drawing of the technological set-up.⁵⁷ All electronic circuits and the matrix board were designed and built by **Wentink**. It also included commercial sound equipment: two stereo amplifiers, a Moog analogue music synthesizer, two product modulators (that multiply two sound inputs into a complex output signal), three tape-recorders (for storing and playing sounds) and a reverb device. In 1979 the Installation was also presented in a museum space.⁵⁸

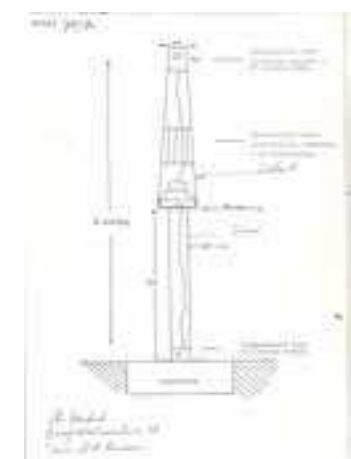
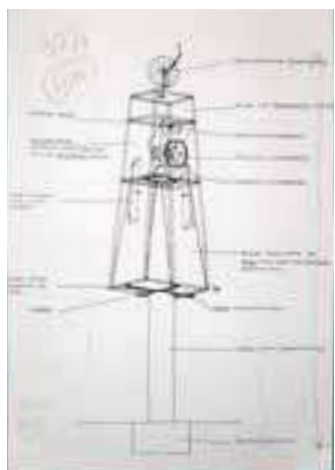
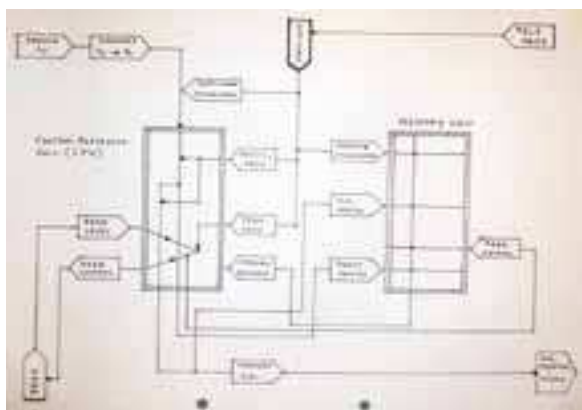
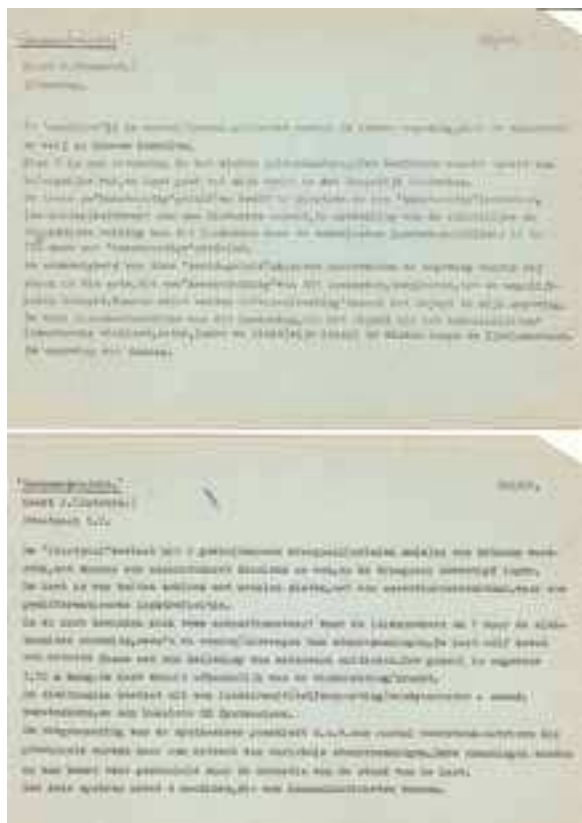
From 1973 - 1976 the *Quadraat Stelling II (De Windmachine II)* was made and performed as an audio-visual live performance / installation with an interactive hardware-programmed man-machine network. Four people performed a preprogrammed audiovisual score, composed for four audio and of three visual channels. Six paintings (oil on canvas) by **Wentink** were displayed in the space, one showing the figure of **Karl Marx** in a bourgeois interior taken from a **Vermeer** painting. Participants via switches control and perform a preprogrammed 6-part audiovisual score of 90 minutes, that is based on *Das Manifest* by **Bertold Brecht**. The third part of the score is a recording of the *Eemnes Machine*. Visuals consists of approximately one thousand slides, ranging from reproductions of historic photos of industrial areas and technology, to details from the displayed oil paintings and contemporary photos by the autor (of personal situations). The score was the software. The installation consists of a 4-track tape recorder (TEAC 3340 S), a rotator (to control direction of four loudspeakers, custom-built in Steim by technician **Johan den Biggelaar**), and 4 control switches (commercial matrix boxes, unlike the custom-made ones in *Quadraat Stelling I*) and 3

⁵⁵ three of them were co-authors of *Sonate opus 2 No. 1 voor piano en blazers*, premiered 21st September 1969 in Stedelijk museum, Amsterdam

⁵⁶ as stated by Wentink to author

⁵⁷ 2nd may 1971. Archives Victor Wentink

⁵⁸ *Tektonik* solo-exhibition in het Haags Gemeentemuseum, March 1979. Cat.



projection screens (each with a pair of 35 mm slide projectors). The concept of the preprogrammed visual's duration-control machine - *Imaginator* - was developed but not built. The concept of control was that is automated but can be influenced by humans as well. *Quadraat Stelling II* was premiered in the Shaffy Theatre, Amsterdam, in May 1976, and toured different festivals; it was also shown in gallery and museum environments.⁵⁹

Wentink continues to develop *Quadraat Stelling* series and horizontal computing until today (from 1997 it is entirely internet-based). Horizontal interactive participatory technology realized in these works enabling all combinations of audiovisual communication and feedbacks in different directions simultaneously and in real-time (one-to-one, one-to-many, many-to-many etc), preceding the internet based social networks in the beginning of the 21st Century.

Another long-term project with several developing phases is an interactive hardware-programmed self-composing sound machine titled ***Eemnes Machine*** (1975 – 1979). It was designed by **Victor Wentink** and implemented by the author in collaboration with **Johan den Biggelaar** at STEIM in Amsterdam. All electronic circuits were built from scratch. Inputs were sound and light (and in concept wind and human movement), and real-time data processed by the machine resulted in unpredictable electronic sound output. The piece was intended as a permanent installation powered by solar energy in a desert-like environment, a new polder in Flevoland. Variable analog and digital voltage generators were employed in the design. In STEIM in 1975 the first print of a personal computer's motherboard was available. The idea to make machine with digital equipment was put into consideration, but it was deemed to be not flexible enough and therefore rejected. The work was inspired by the social circuitry of Hewitt Crane. The '*Eemnes Machine*' was built in 1978 - 1979, (250 x 43 x 43 cm, and first presented at

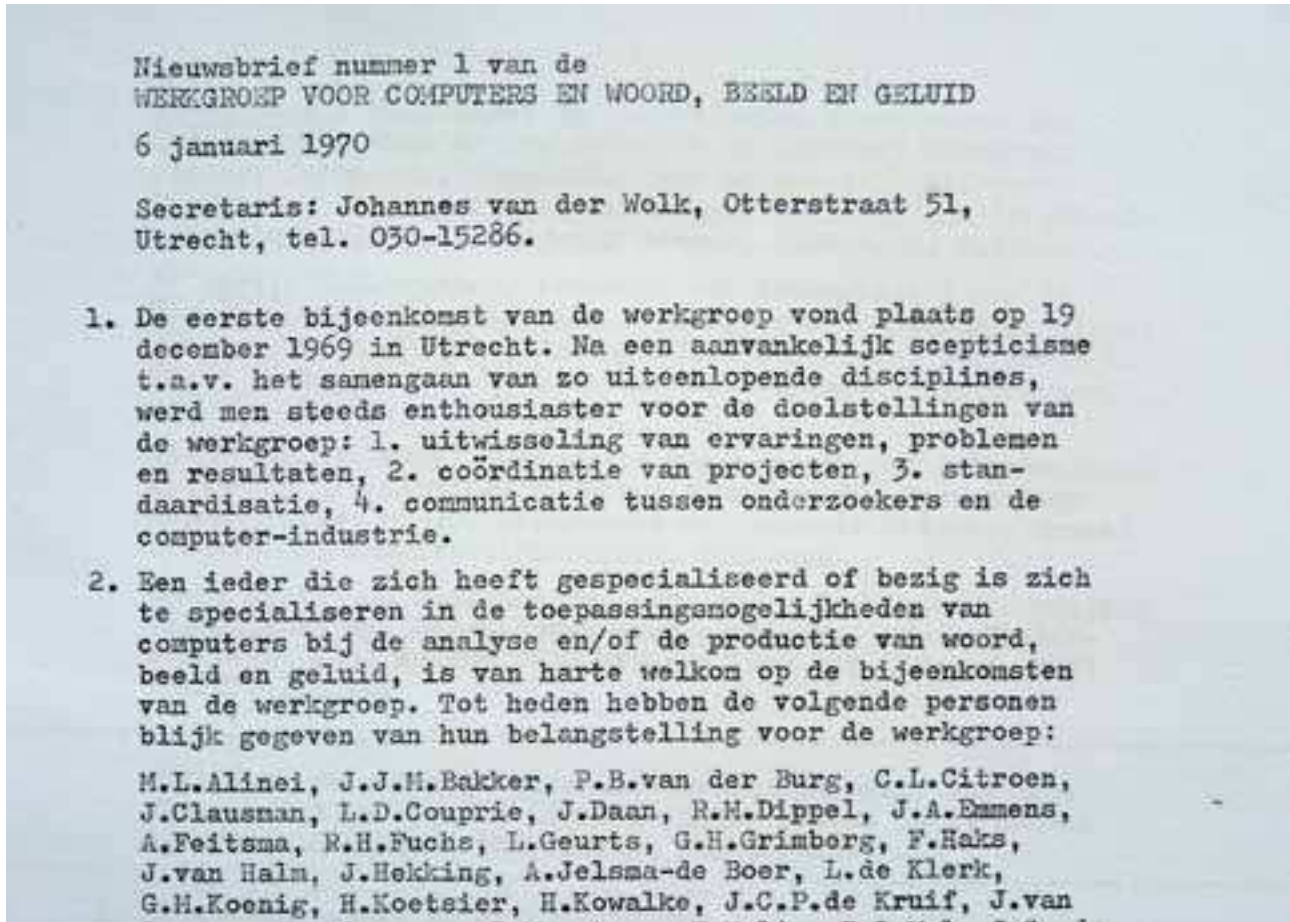
Tektonik solo-exhibition in het Haags Gemeentemuseum, March 1979. It was used in several music performances by the music group **Het Nieuwe Leven** (1980 - 1985) and exhibited in Zeeland by STEIM in 1985 for the last time.⁶⁰ A completely digital version of the machine under the name **Waterloo-Machine** was designed in concept in 1983 but never built (the Apple II, owned by STEIM, was not suitable). Some ideas of this work were later developed into the *Waterpaviljoen* in Zeeland, 1997 (in collaboration with **Edwin van der Heide**). The theoretical and technical background of *Schakelkunst (Circuitry Art)* employed in this work are elaborated Wentink's book ***De Vrolijke Techniek (Happy Technology)*** (1975, not published).

Wentink's first completely digital audio-visual composition is **KAND digitale beeld/geluid-compositie voor Apple II computer** (1979 - 1980), coproduced by Studio Steim and Studio Amsterdams Conservatorium.⁶¹ **Floris van Maanen** did programming and handle data transfer from mainframe to personal computer. The Apple II computer performed audio-visual composition: sound from the computer was played through the concert's hall sound system and monitor output was transmitted from color TV monitor via an attachable lens system to the projection on the (curved) screen. The reproduction of the painting from **Kandinsky** was scanned manually with the help of transparent grid paper (1 mm resolution) - where 20 colors from the painting were transmitted into Arabic numbers and later on translated into a binary system and fed into the mainframe computer at the Amsterdam Conservatory. Stored data was then fed into the Apple II computer because of the color output. The color cubes appeared on the computer screen in vertical lines until the picture was completed, in approximately 10 minutes. The speed was adjustable. Each color was translated into mono sound, using the Apple II sound generator. Each vertical line performed at the monitor, was in real-time translated to a sound chord according to its color value.

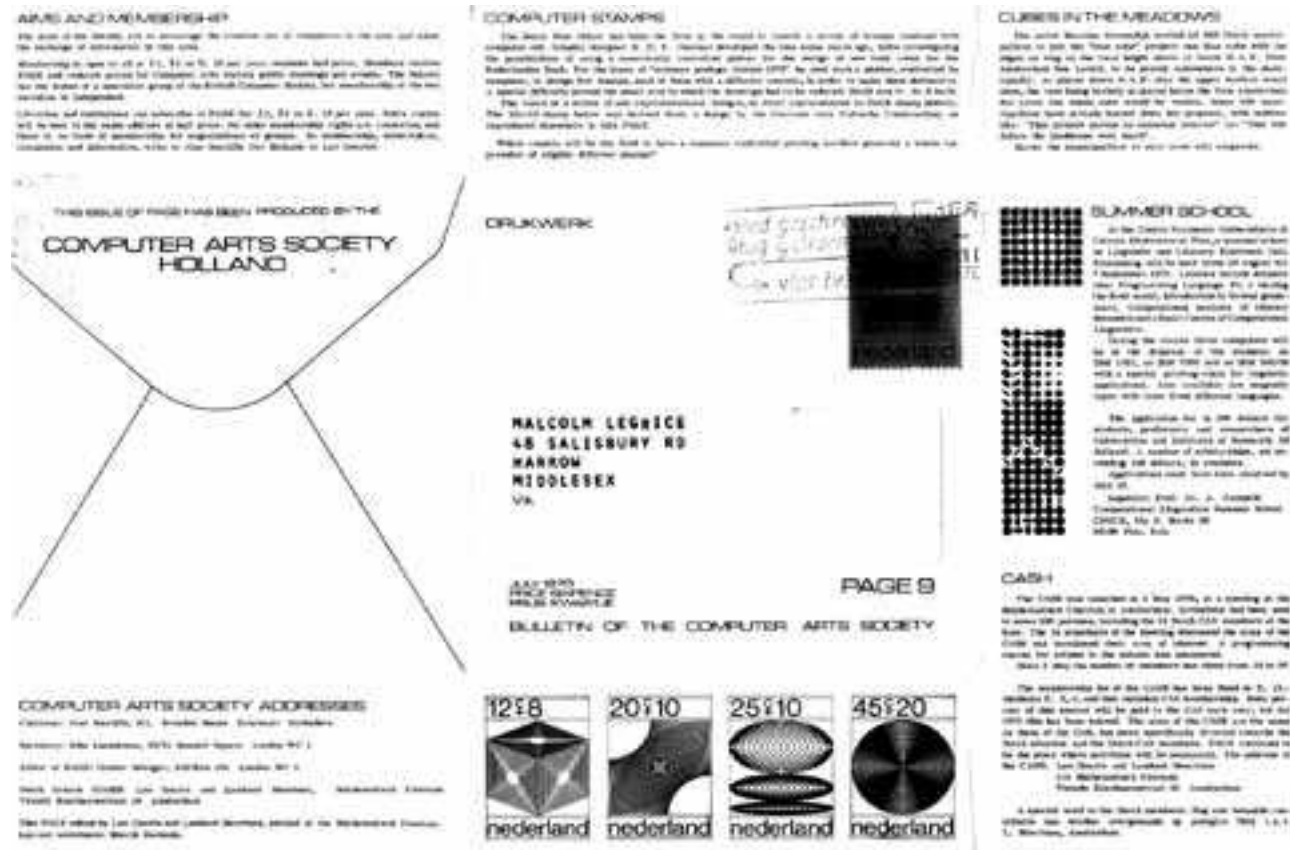
Transmedial artist **Andreas Maria Jacobs** (b. 1956) developed a game for three humans and one mainframe from 1979 to 1980, during his study of physics and musicology at the University of Amsterdam, using the mainframe computer of SARA. An interactive program was written in FORTRAN to feed to the computer with punch cards. **Jacobs** later made a fusion in his artwork of visual art and music 59 De Appel Gallery in Amsterdam in 1970s and in twice in het Haags Gemeentemuseum, 1977 and 1979

60 after this exhibition the work was lost, i.e. disappeared from STEIM's storage.

61 First performed in the Muziekcentrum de IJsbreker, Amsterdam, in 1980.



Working group for computers and verbal, visual and sonal research, *Newsletter no. 1*, 6 January 1970, Utrecht. Edited, self-published and distributed by Johannes van der Wolk. Detail of page 1



Page 9 bulletin (published by CAS, London) produced by CASH, edited by Leo Geurts and Lambert Meertens, printed at the Mathematisch Centrum, Amsterdam, layout assistance: Henrik Barends. July 1970

and radical political activism. He is publisher and editor of the *Nictoglobe* magazine that started in 1982 as a stenciled paper,⁶² went electronic and online since as early as 1986, and is still hectic.

Institutions and networks

Several networks and institutions have been active promoting computer-generated arts at the closure of the 1960s and beginning of 1970s.

The first meeting of the **Working group for computers and verbal, visual and sonic research** was held at the Institute of Art History of Utrecht University at 19th December 1969. The invitation was signed by **M. L. Alinei**, **Peter Struycken**, **F. de Tollenaere**, **H. van de Waal**, **F. C. Weiland** and **Johannes van der Wolk**. The program of the first meeting comprised both an agenda and a list of those who had announced their interest to participate. It was primarily a platform for the exchange of information between those who were pioneering in the use of computers in the fields concerned at both national and international level. Art historian Johannes van der Wolk, who edited, self-published and distributed eleven newsletters, exclusively handled the organization of working group.⁶³ The *Werkgroep* had no formal organization and Wolk's private address was used for its contact. The newsletters published 155 articles in total. Subscribers to the newsletter were considered as members and by 1972 the mailing lists consist of 126 subscribers; 92 from Netherlands and 34 from abroad. The members participated with information provided for publishing, and influenced the Newsletter's content via replies to published questionnaires. The questionnaire about expression of interest was published, and the following issue presented 38 responses of which ten were related to arts and creativity.⁶⁴ **Van der Wolk** initiated both *Symposia of the Dutch Working group for computers and verbal, visual and sonic research* that were held in 1970 in Delft and Amsterdam.⁶⁵ In the latter participated the following artists and researchers from Netherlands and abroad: **M. L. Alinei** (IT), **J. Daan** (NL), **Leo Geurts / Lambert Meertens** (NL), **Frans Haks** (NL), **John H. Holloway** (UK), **Joseph Raben** (USA), **C. E. C. de Reus** (NL), **Alan Sutcliffe** (UK), **K. Schröder** (DE), **Peter Struycken** (NL), **H. Swart** (NL), **F. de Tollenaere** (NL), **H. van de Waal** (NL) / **S. Sandström** (SE) and **Johannes van der Wolk** (NL).

Johannes van der Wolk defended in 1971 a doctoral thesis in art history that included topics like "The first experiments in computer use by the art historian and the possibilities for the future"; "Packing the same knowledge in various media as a contribution to smooth the process of scientific communication" and "Computers and visual creativity".⁶⁶ He started to work in the **Boymans van Beuningen Museum** in Rotterdam in 1971 and published numerous articles on computer art in various periodicals since 1986. When he started to work, the **Boymans van Beuningen Museum** already ran an annual program for 1971 with the subject 'art and technology'. The description of the 53 images of works from the collection begins with a brief reflection on 'technology'. A quote: 'Even bewust worden welke technische verworvenheid wij over het hoofd zien, als te gewoon en te vertrouwd; even ons er opnieuw over verwonderen; even het lachwekkende zien van een overtrokken bewondering; even de betrekkelijkheid voelen van zekerheid en onzekerheid. Even maar. Wat een belevenis'.⁶⁷

Lambert Meertens met **Alan Sutcliffe** before the above-mentioned 1970 symposia in Delft, at the *IFIP (International Federation for Information Processing) Congress* in August 1968 in Edinburgh, where his computer-generated *Quartet No. 1 in C Major for 2 Violins, Viola and Violoncello* was performed and won a special

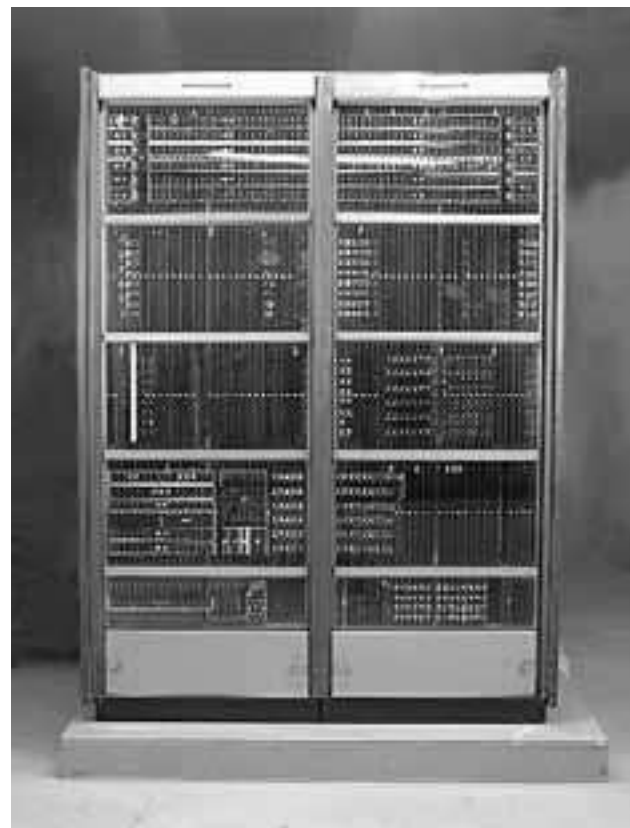
62 Firstly edited by Michel and Andreas Jacobs, now at <http://www.nictoglobe.com> (2011)
63 11th newsletter was made in November 1973, but not distributed
64 Newsletter no. 8 - 18 February 1970; no 9 - 30 Jun 1970.
65 Delft (13-2-1970) and Delft/Amsterdam (20/21-3-1970).
66 Rijksuniversiteit Utrecht / Kunsthistorisch Instituut Utrecht, September 1971.
67 "Just be aware that technical achievement we overlook as too common and familiar, here again we marvel, as the ridiculous seeing an exaggerated admiration, as the relativity of feeling of certainty and uncertainty. A moment. What an experience."

Departure of the Electrologica computer to the research institute Mathematisch Centrum, Amsterdam in 1958.



Digitizer or antiplotter, with the foot pedal (the forerunner of the mouse) for the De Telefunken TR4 from 1964 in Groningen.

(right) De Telefunken TR4 from 1964 in Groningen.



Graphic by Martin Newell Teapot (1975) printed at the Calcomp 565 at the University of Amsterdam

price of the jury.⁶⁸ At the *IFIP Congress* Sutcliffe initiated the initiative of **Computer Arts Society (CAS)** that was founded in London soon after. The spin-off organization **CASH - Computer Arts Society Holland** was initiated by **Leo Geurts** and **Lambert Meertens** and held its first meeting in May 1970. Out of thirty-four attendants⁶⁹ ten were creatively involved in art (visual arts, music, design, literature) and nine attendees dealt with art (art history, art criticism, musicology, museum). Sixteen of the participants had experience working with computers.

Leo Geurts and **Lambert Meertens** edited two issues of the *Page* bulletin of the **Computer Arts Society** (London), presenting new developments in the Dutch scene in 1970 and 1971.⁷⁰ Recognizing the essential problem of computer literacy for participants coming from the arts and humanities, **CASH** organized programming courses that were given at Honeywell Bull venues in Amersfoort and The Hague, with time-sharing using teletype consoles for input and output.

G. H. Bührmann paper wholesalers from Amsterdam hosted an exhibition *Computer Grafiek* from London's **Computer Arts Society (CAS)**, extended with works by **Oxenaar** and **Struycken** and presentation of computer films.⁷¹ In the exhibition space a Calcomp plotter was placed that produced computer graphics. Part of the exhibition was later on shown in **Galerie de Mangelgang** in Groningen, including works by the **Centrum voor Cubische Constructies** (**Jan Slothouber** and **William Graatsma**).⁷²

Composer **Roland Kayn** (DE, living in NL since 1970) was program adviser at the **Goethe Institute Amsterdam** that hosted the traveling group exhibition *IMPULSE: Computer-Kunst* set up by **IBM Company**. The exhibition that started in 1970 in Munich was presented in Amsterdam in 1971, and also traveled to other nine European cities.⁷³ In collaboration with the **Aesthetics Institute of Amsterdam University** an extensive program was executed, consisting of an exhibition, computer-music and computer-film program, computer time-sharing, a lecture by **Max Bense** (DE) and a forum chaired by **Matthieu Marie Aler**.⁷⁴

Amsterdam based underground film venue *Electric Cinema* (1970-1974), led by filmmaker **Barbara Meter** showed several programs of computer-generated films.

Typically for early computer-generated art, universities took an important part in creating environments and platforms for its production, sharing the know-how and networking.

The **Working Group for Computer Graphics** and **Architecture Working Group Komputer** was active at the Delft University of Technology since 1970, where the international *Interactive Computer Graphics Symposium* took place in 1970.

68 Composition as well took part in traveling exhibition *Impulse Computerkunst* (8. 5. - 7. 6. 1970: Kunstverein Munchen; 1971: Oslo, Rome, Brussel, Amsterdam, Liverpool, Athene, Milano; 1972: Madrid, Valencia, Barcelona).

69 Louis Andriessen, Gijs Bakker, Jan Baptist Bedaux, (Compos 68, Utrecht), P. de Boer, Carry Dupont-Van Lakerveld (Amsterdams Historisch Museum, Amsterdam / Bibliotheek Stedelijk Museum, Amsterdam), C. E. van Esch, Leo Geurts (Mathematisch Centrum, Amsterdam), William Graatsma, Frans Haks (Kunsthistorisch Instituut, Utrecht), H. Hofsteenge, L. de Hoogh, K. J. Huisman, Rene de Jong, Gerrit Krol, Henriette Kropman (Den Haag Instituut voor Sonologie-Rijksuniversiteit, Utrecht), Hans Koetsier, K. Koster, R. (Reinbert) A. Leeuw, Ton Limburg, H. van Meer, Lambert Meertens (Mathematisch Centrum, Amsterdam), Harry Mulisch, R. P. Nederpelt, R. D. E. Oxenaar (Dienst Esthetische Vormgeving PTT, Den Haag), P. de Roos, Hubert Rossy, Harrie van Rossum, J. G. Ruyter, Remko Scha, J. Schoonenberg, B. C. Sliggers, Peter Struycken, H.L. Swart (De Nederlandse Kunststichting, Amsterdam), Riekje Swart (Galerie Swart, Amsterdam), S. Tempelaars, Arthur. H. Veen, (Compos 68, Utrecht), Frans Verpoorten, Jan Vriend, Johannes van der Wolk.

70 "page 9", July 1970 and "page 17", July 1971, ed. Leo Geurts and Lambert Meertens, CAS, London / Mathematisch Centrum, Amsterdam

71 *Computer Grafiek* exhibition. G. H. Bührmann's Papiergroothandel N.V., (Keizersgracht 38) Amsterdam, 11 - 31 December 1970. Film program 17 December 1970 at RAI.

72 *Computergrafiek 1*, exhibition, Galerie De Mangelgang, Groningen, 22 January - 11 February 1971. Exhibition opening speech by R. A. Leeuw.

73 1970: Kunstverein Munchen; 1971: Oslo, Rome, Brussel, Amsterdam, Liverpool, Athene, Milano; 1972: Madrid, Valencia, Barcelona).

74 12 - 31 March 1971, Academie van Bouwkunst Amsterdam / Instituut voor Esthetica van de Universiteit van Amsterdam, Amsterdam



left: Invitation for the *Computer Grafiek* exhibition. G. H. Bührmann's Papiergroothandel N.V., (Keizersgracht 38) Amsterdam, 11 - 31 December 1970. Film program 17 December 1970 at RAI, Amsterdam.



Invitation for the *Computergrafiek 1*, exhibition, Galerie De Mangelgang, Groningen, 22 January - 11 February 1971.



Institute of Sonology, computerstudio with PDP-15 computer, Utrecht ,1971

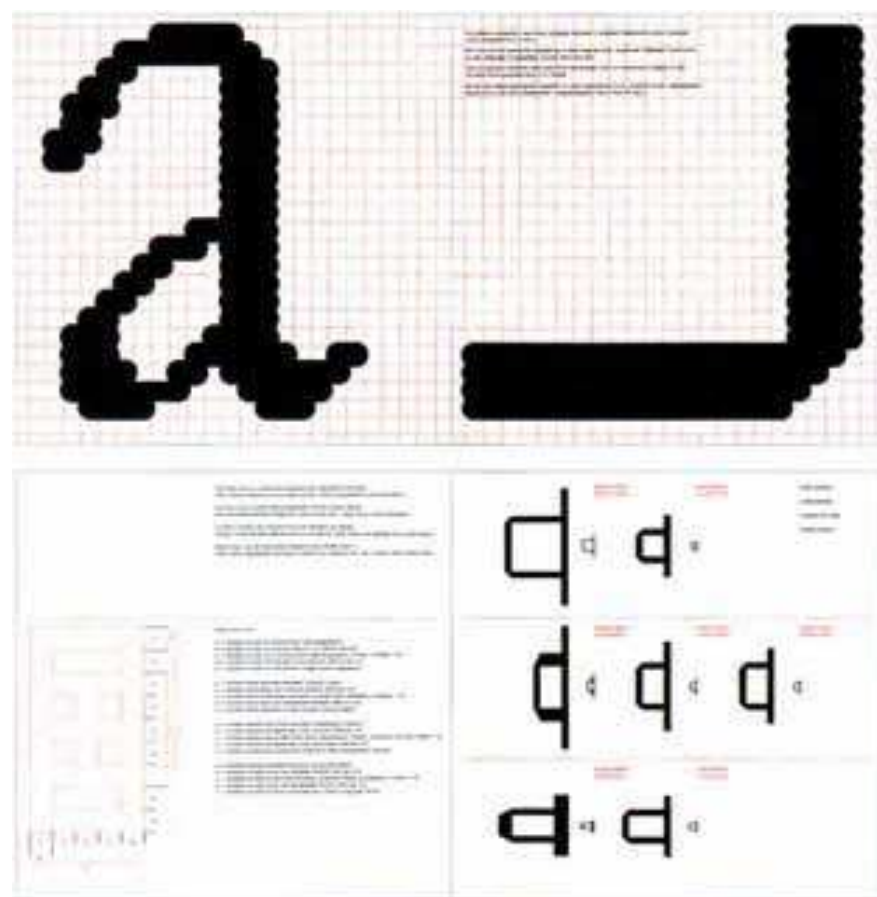
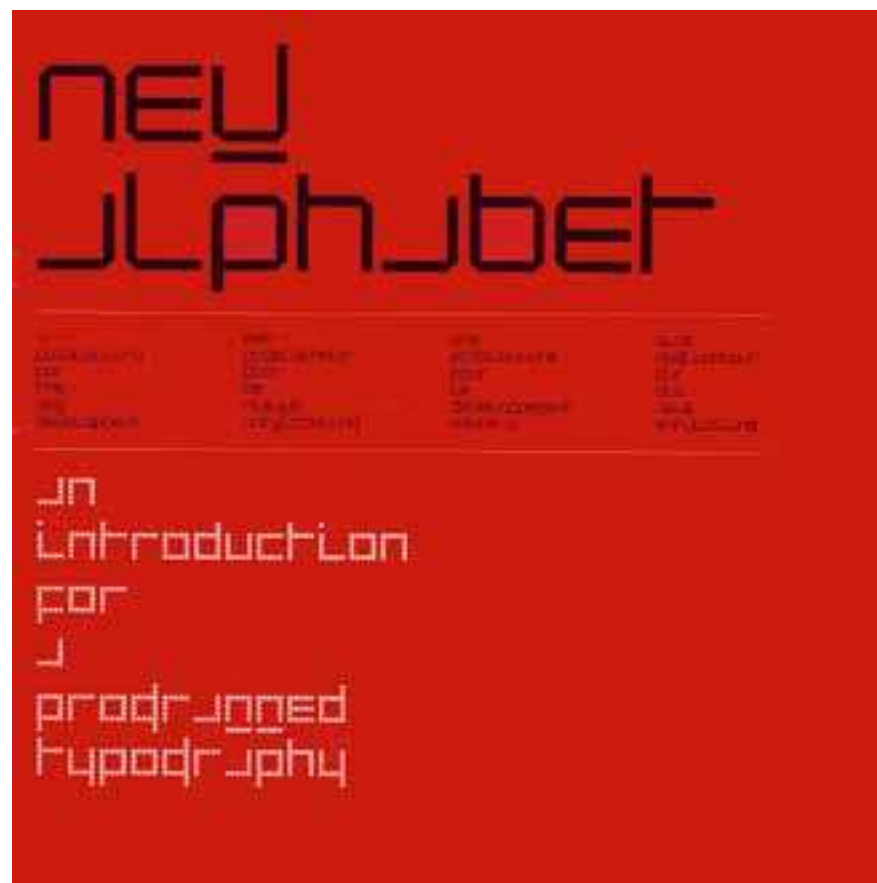
The secretary of the symposium was **L. H. Meuldijk** and presentations by **A. van Dam**, **B. Peters**, **P. Purcell** and **Nicholas Negroponte** were delivered.

Under the auspices of the **Dutch Architects Association** and the **Building Centre** in Rotterdam (div. Prototypes) the international **CAAD seminar Rotterdam** took place in 1971. The **IFIP working conference on principles of computer-aided design** was held in Eindhoven in 1972, organized by **IFIP Technical Committee 5, Computer Applications in Technology**.

There were several initiatives involving collaboration between the Eindhoven University of Technology and Philips' Research Laboratories. Both institutions jointly established the **Instituut voor Perceptie-onderzoek (IPO)** in Eindhoven 1957.

In 1956, **The Centre for Electronic Music - CEM** studio was opened within the acoustics department of Philips' Research Laboratories. **Henk Badings**, **Tom Dissevelt**, **Dick Raaijmakers** and **Edgar Varèse** took full advantage of these facilities. The artistic highlight of the electronic music activities at Philips was the *Poème électronique*, an automated performance with image, color, and electronic music in a building specially designed by **Iannis Xenakis** for the Brussels World Fair in 1958, with electronic music composed by **Edgard Varèse**. The Eindhoven studio moved to **Utrecht University** in 1960 and was called **Studio for Electronic Music (STEM)**, where German composer **Gottfried Michael Koenig** become artistic director in 1964. **STEM** became the **Institute of Sonology** in 1967 at the Koninklijk Conservatorium in Utrecht. International attention for the institute increased with the arrival of a PDP-15 computer which was used to develop programs for algorithmic composition and digital sound synthesis. Computer programs such as Project 1, Project 2, and *SSP (Koenig)*, *PILE (Paul Berg)*, *MIDIM/VOSIM (Werner Kaegi)*, and *POD (Barry Truax)* are landmarks in the history of computer music. For many renowned composers such as **Cort Lippe**, **Robert Rowe**, **Dirk Reith**, **Amnon Wolman**, **Jean Piché**, and **Takayuki Rai**, their experiences at the **Institute of Sonology** formed the basis for their later work. In the area of voltage-control technique in the analog studios, the **Institute of Sonology** continued to design and build new equipment. This tradition continues today. The institute moved to the Royal Conservatory in The Hague in 1986. *Interface - Journal of New Music Research* started in 1972 as the continuation and merger of *Jaarboek* (Seminar for Musicology, Ghent, BE) and *Electronic Music Reports* of the **Institute of Sonology** in Utrecht. *JNMR* seeks to establish an interdisciplinary foundation for the creation and study of music by means of the most advanced technologies, by publishing material which is both scientifically rigorous and musically relevant. *JNMR* draws on disciplines ranging from musicology (music theory, aesthetics, sociology), psychology (from psychoacoustics to cognitive psychology - with emphasis on modelling), acoustics (including sound engineering), computer science (from signal processing to artificial intelligence), philosophy (epistemology and methodology) to brain sciences. The journal is still being published today.

STEIM (STudio for Electro Instrumental Music) was founded in Amsterdam in 1969 by a group of up-coming composers: **Louis Andriessen**, **Konrad Boehmer**, **Reinbert de Leeuw**, **Misha Mengelberg**, **Dick Raaijmakers**, **Peter Schat** and **Jan van Vlijmen**. They were offered a budget for their collective multimedia opera *Reconstruction* (where **Geurts** and **Meertens** took care of the computer-generated parts of the score) which was premiered in 1969. The technology used in this opera was then taken to the Prinseneiland which was STEIM's first location. STEIM is a center for research and development of new musical instruments in the electronic performing arts, still active today. Artistic and Managing Director 1971-1981 was **Peter Schat** (1935-2003).



Wim Crouwel, *New alphabet. A possibility for the new development. An introduction for a programmed typography*, Steendrukkerij de Jong & Co., Hilversum, 1967. Typography conceived for computer prints

The **Foundation Experiments in Art and Technology**⁷⁵ was active from 1971 to 1976, with art historian **Cor Blok** was coordinating the exhibition program. They published *Orientation materials on science and art* edited by **Cor Blok**, **P. H. van de Poel** and **Stan Tempelaars**, in 1975.⁷⁶

Most participants of the early 1970's networks and institutions became in the following decades a new establishment of Dutch culture, as curators and directors of several major museums and members of different decision-making boards. They inaugurate art, science and technology and related computer-generated art into the fabric of the cultural life of the Netherlands. Despite the fact that many early protagonists lost their interest in media art,⁷⁷ the foundations they established indirectly led a new generation of artists and related institutions and networks to solid ground.

Conclusion

Apart of few exceptional experiments and works made prior to 1969, computer-generated art in the Netherlands started relatively late but quickly reached a critical mass and had its full swing in 1970 and 1971. The production gradually faded out by the middle to late 1970's. In general, the trends in the Netherlands have followed global streams with about a half decade delay, which created a unique regional situation that will show some advantages in follow-up developments. The new wave of computer-generated art was propelled by the use of personal computers in the 1980's, and therefore did not have such a dramatic discontinuity as in the rest of the (Western) world. Only computer-generated music has a continuous history of production, institutions and education under the umbrella of electronic music, which continues without breaks over the decades and is still active today. Such a situation is typical for the field of digital art globally.

Except for the art practices of **Peter Struycken**, **Victor Wentink** and **Remko Scha** there is no continuation of the first generation of digital art in the fine arts today in the Netherlands. From the mid-1970's onward **Peter Struycken** was perceived as the exclusive computer artist with almost no competition in the mainstream visual art world; in this situation he created numerous high-budget public art works using systematic research and the formal language of Concrete Art.

Unlike in the rest of the world, computer-generated art in the Netherlands got quickly inaugurated in the cultural mainstream that would support its activities and its gradual development from the 1980's onward. This trend continued until today, positioning the Netherlands as one of most developed country of media art networks and support, particularly with little or no distinction from the mainstream contemporary art world, unlike cultural policies in most of the world.

⁷⁵ Stichting Experimenten in Kunst en Techniek (E.K.T.), Amsterdam. Chairman was F. v.d. Blij. See: Wolk, Johannes van der, "Oriëntatie materiaal over wetenschap en kunst", in: *Museumjournaal*, vol. 20, no. 5, October 1975, pp. 226-227.

⁷⁶ Blok, Cor, P. H. van de Poel and C. Tempelaars (eds.), *Oriëntatie materiaal over wetenschap en kunst*, Stichting Experimenten in Kunst en Techniek (E.K.T.), Amsterdam, 1975.

⁷⁷ as for example Rudi Fuchs, director of Stedelijk museum, Amsterdam 1993–2003

CHRONOLOGY

EVENTS LEADING TO COMPUTER-GENERATED ART

1842 - *Koninklijke Akademie ter opleiding van burgerlijke ingenieurs*, from 1905 *Technische Hoogeschool van Delft*, from 1984 *Technische Universiteit Delft (TU Delft)*

11 February 1946 - *Mathematisch Centrum*. From 1983 *Centrum voor Wiskunde en Informatica, CWI - national research institute for mathematics and computer science in the Netherlands*.

1947 - 1956 - Computer Development in *Mathematisch Centrum*. ARRA I (Automatische Relais Rekenmachine Amsterdam, 1952) , ARRA II (1953) and FERTA (Fokker's Eerste Rekenmachine Type ARRA). First program ARMAC (Automatische Rekenmachine MATHematisch Centrum) in 1956. For computer *Electrologica X1* (1958), first compiler was made by E.W. Dijkstra and J.A. Zonneveld in ALGOL60 language.

1953 - 1958 - **PETER** (Philips Experimentele Tweekellige Electronische Rekenmachine) - first computer by Philips. Build in Natuurkundig Laboratorium from Philips by Wim Nijenhuis, Arie Slob and Adri Duivensteijn.

1956 - **ARMAC** (*Automatische Rekenmachine Mathematisch Centrum*) computer. Build by Carel Scholten and Bram Loopstra for Mathematisch Centrum in Amsterdam.

1956 - June - ballet '*Kaïn en Abel*' by **Henk Badings**, Koninklijke Schouwburg in Den Haag. Music made in *Natuurkundig Laboratorium van Philips* in Eindhoven.

1956 - Technische Universiteit Eindhoven (TU/e) -

1957 - **Instituut voor Perceptie-onderzoek (IPO)** (The institute for perception research IPO), a joint venture of Philips Electronics and Eindhoven University of Technology founded in Eindhoven.

1958 - *Poeme Electronique* by **Le Corbusier**, **Iannis Xenakis** and **Edgard Varèse** at the Philips Pavilion at World Fair in Brussels.

1960 - computers **STEVIN** (Snel Tel En Vermenigvuldig INstrument) and **PASCAL** (Philips Akelig Snelle CALculator), until 1972 in NatLab (Philips, Eindhoven).

1962 - **Herman de Vries** starts to work in field of visual programs with random organization.

1963 - *Wetmatige Constructies* - series of systematic artworks by **Peter Struycken**.

April 1964 - the first automatic mode in the Netherlands writing has appeared, with help of Electrologica computer.

1964 - 2000 - **Galerie Swart**, Amsterdam, led by Riekje Swart.

1965 - Philips produced first **electronic chip**.

1965 - **William Graatsma** and **Jan Slothouber** started to work together. 11th

December 1967 they formed the **Centrum voor Cubische Constructies** (*Centre for Cubic Constructions*).

24 September 1966 - the science museum **Evoluon** opened in Eindhoven by the Philips corporation.

1966 - **New Electric Chamber Orchestra** founded by Remko Scha in Amsterdam

1967 - **STEM became the Instituut voor Sonologie (Institute of Sonology)** (Koninklijk Conservatorium), Utrecht.

CHRONOLOGY OF COMPUTER-GENERATED ART IN THE NETHERLANDS

1962 - *Rekengeluiden van de PASCAL* - computer sounds by **Willem Nijenhuis** / **Philips Natuurkundig Laboratorium (Natlab)** in Eindhoven.

30 December 1964 - computer-generated music program by **Donald W. Smits**, Computing Centre, Rijksuniversiteit Groningen. Written in TEXAS for assembler of Telefunken TR4 computer. Assistant: P. Visser. A radio receiver was put on the TR4 and picked up the signals of the computer.

1965 - *random objectivations* - two artworks by **herman de vries** from the *random objectivations* series, with programmed output at the computer punch-card.

26 April 1966 - **R. D. E. Oxenaar** - **5 Gulden banknote**, design is partly computer-generated.

1966 - **Markov muziek** - **Opus 27** by **Remko Scha**. Algorithmic music work conceived for the computer.

December 1965 - 1967 - **New Alphabet** - typography conceived for computer prints by **Wim Crouwel**

1967 - 1975 - computer-generated visual research used in the first mathematical model for the returning motion of the boomerang by physicist **Felix Hess**. Program was co-written in Algol by **Felix Hess** and **Lambrecht Cook**. Graphics were made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

25 April 1968 - R. D. E. Oxenaar - 10 Gulden banknote, design is partly computer-generated. From the series of banknotes designed by Oxenaar.

august 1968 - *Quartet No. 1 in C Major for 2 Violins, Viola and Violoncello* by **Lambert Meertens** performed in Edinburgh.

september 1968 - The group **Compos 68** is founded by **Jan Baptist Bedaux**, **Jeroen Clausman** and **Arthur Veen** in Utrecht.

December - **Compos 68**: works *'Series 1'* and *'Series 2'* (both hand-colored computer-prints stylus (Electrologica X8 plotter), were produced at the computer EL - X8 Philips at the center of the department of mathematics of Utrecht University. Program written in ALGOL language.

December 1968 - *Strijkkwartet no. 1 in C*, performed by *Het Amsterdams Strijkkwartet* - computer-generated music by **Lambert Meertens**, Computing was done at the Electrologica - EL X8 computer at Mathematisch Centrum, Amsterdam.

1968 - introducing computer in the work by artist **Peter Struycken**, course of electronic music at the **Instituut voor Sonologie-Rijksuniversiteit**, leading to first computer-drawings in 1969. Firstly he got helped to write computer program for drawings by **Stan Tempelaars** and **Greta Vermuelen**.

1968 - **Untitled Algol Program** by **Remko Scha** conceive computer-generated spatial (gallery) installation where is employed an algorithm generating descriptions of ca. 600.000 conceptual assemblages (made of different objects). Computer program that generates texts is written in ALGOL language.

1968 - **Machine Poem Piece** by visual artist **Pieter Laurens Mol**.

January - March 1969 - **Compos 68**: work *'Example of the development of a program to generate lines'*, computer-prints stylus (Electrologica X8 plotter), written in ALGOL language. were produced at the computer EL - X8 Philips at the center of the department of mathematics of Utrecht University.

February 1969 - **Compos 68**: *'Hobby Box'* variable multiple, design generated by the ELX-8 computer of Utrecht State University. Multiple consists of the package with four colored cardboards, pin, variable pattern with stylus (Electrologica X8 plotter) and instruction manual (computer sheet).

February 1969 - **STEIM (STudio for Electro Instrumental Music)** is founded in Amsterdam by **Misha Mengelberg**, **Louis Andriessen**, **Peter Schat**, **Dick Raaymakers**, **Jan van Vlijmen**, **Reinbert de Leeuw**, and **Konrad Boehmer**.

March 1969 - **Mijn Naam volgens de IBM-29 Card Punch Machine** (*My Name according to the IBM-29 Card Punch Machine*) by visual artist **Pieter Laurens Mol**. Works was made in Volmac software company in Utrecht with IBM computer.

7 January - 2 April 1969 - **moment 1** (*working title*) - process-based conceptual artwork that made use of computer technology by visual artist **Pieter Laurens Mol**. The artwork took the form of personal gesture from artist to art collectors Martin and Mia Visser.

5 May - 30 June 1969 - **Compos 68** exhibited at the *tendencies 4 - computers and visual research* exhibition in Zagreb and received an award for the work *'Hobby Box'*. **Herman de Vries** exhibits as well, at the *'constructive visual research'* exhibition section

5 - 6 May 1969 - **Compos 68** participation at the symposium *computers and visual research'* (part of *tendencies 4'* program) in Zagreb.

14 - 28 - May 1969 - *Op de manier van de Kunst der Fuge I* by **Remko Scha** - computer-generated music score for four instruments. Computing was done at the Electrologica - EL X8 computer at TU Eindhoven. Written in ALGOL 60 MC computer language. Not performed (2010). Accompanying essay: *Mathematische analyse van enkele fuga's uit Die Kunst der Fuge*.

5 juni 1969 - foundation of the **GESTUR: Gezamenlijke Stuurgroep Amsterdams Universitair Rekencentrum**, Sekretaris dr. A.A.A.M. Brinkman, Amsterdam Buitenveldert (Joint Steering Group of Amsterdam University Computer Centre) - predecessor of SARA (Stichting Academisch Rekencentrum Amsterdam), founded January 27, 1972.

29 Juni 1969 - **Reconstructie. Een moraliteit**. (1968 - 1969) opera premiered at the Holland Festival in Theater Carré, Amsterdam. Composed by **Louis Andriessen** (partly computer-generated in collaboration with **Leo Geurts** and **Lambert Meertens**, Computing was done by Electrologica EL X8 and score printed by EL X1 in the Mathematisch Centrum, Amsterdam.), **Reinbert de Leeuw**, **Misha Mengelberg**, **Peter Schat** (composition was partly computer-generated in collaboration with **Leo Geurts** and **Lambert Meertens**), and **Jan van Vlijmen**.

Hugo Claus en **Harry Mulisch** wrote a libretto.

21 september 1969 - *Sonate opus 2 No. 1 voor piano en blazers* - by **Louis Andriessen**, **Leo Geurts** and **Lambert Meertens**. - 'an essay on Bethoven' premiered in the Stedelijk Museum, Amsterdam. Computing was done in the Mathematisch Centrum, Amsterdam.

September 1969 - Computer art graphic by **Cornelis Andries ten Seldam**, theoretical physicist, Van der Waals laboratorium in University of Amsterdam, published in *CalComp Newsletter*. Made with CDC 1700 (Control data computer), and Calcomp 565 drum plotter.

12 October - 30 November 1969 - *Profile IX Nederlandsche Kunst heute*, Städtische Kunstgalerie Bochum, Bochum (DE). Exhibition included work by **Peter Struycken** and his text in the catalogue: *Erfahrungen mit Anwendung des Computers bei der Bildherstellung*.

19 November 1969 - **Jacob Vlietstra** (Philips Research Labs) was one of twenty present at the SIGGRAPH (Special Interest Group for Computer Graphics) meeting, San Francisco Hilton (in conjunction with ACM Conference August 25 - 29, San Francisco).

27 November - 19 December 1969 - **Compos 68** exhibits '*Hobby Box*' at the *Kunst und Computer* exhibition, Datenzentrum der Zentralsparkasse, Vienna. (with Fanke, Stiegler, Beckmann/Grassi, Alsleben/Pasow, Adrian and Nake).

November 1969 - Computer art graphic by physicist **Dick Oepts**, Van der Waals laboratorium in University of Amsterdam published in *CalComp Newsletter*. Made with CDC 1700 (Control data computer), and Calcomp 565 Digital Incremental drum plotter.

19 December 1969 - the first meeting of the *Werkgroep voor computers en woord, beeld en geluid* (*Working group for computers and verbal, visual and sonal research*) was held at the Kunsthistorisch Instituut (Afdeling Studiebegeleiding) of Utrecht University. The invitation was signed by **M.L. Alinei**, **Peter Struycken**, **F. de Tollenaere**, **H. van de Waal**, **F.C. Weiland** and **Johannes van der Wolk**. The program of the first meeting comprised both an agenda and a list of those who had announced their interest to participate.

1969 - *Computerstructuren*, 8 paintings, first computer-generated works by **Peter Struycken**. Made at the Instituut voor Sonologie van de Rijks Universiteit, Utrecht.

1969 - *nixmur (automatisering)* - installation for computer and printer by **Remko Scha** - Computer with ALGOL program prints out the text 'nixon moordenaar' endlessly (at the printer, using long sheets of paper). Computer program is handwritten in ALGOL.

January - February 1970 - *Computer-output als esthetisch object* - essay by **Jan Baptist Bedaux**, presented March 1970 at Aesthetics course at the Art history and archeology department, Catholic University of Leuven CUL (BE). Not published.

6 January 1970 - '*Werkgroep voor computers en woord, beeld en geluid*' *Nieuwsbrief nummer 1* (# 1-5). Secretaris Johannes van der Wolk.

8 - 21 January 1970 - Exhibition *Komputerstructuren* by **Peter Struycken**. Verfindustrie Jac. Eyck nv, Heerlen.

13 February 1970 - *Symposium of the Dutch Working group for computers and verbal, visual and sonal research* in Delft. Organized by Johannes van der Wolk.

16 February 1970 - '*Werkgroep voor computers en woord, beeld en geluid*' *Nieuwsbrief nummer 2* (# 6-17). Secretary Johannes van der Wolk.

20 February 1970 - **conference on computer graphics** organized by the math department / workgroup computer graphics from T.H. Delft.

February - June 1970 - **Lambert Meertens** and **Leo Geurts**: *Kristalstructuren*, ("crystal structures") is a family of algorithms which all use majority voting. Series of 8 computer graphics.

February 1970 - series of five (or more) computer graphics by **Jan Kraak** showing horizontal lines with a random deviation. The ALGOL-60 program used an interpolation routine based upon the Akima algorithm, and a subroutine called '*bibber*', in order to form unequal - jitter ('bibber', Dutch) line. Graphics were made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

16 March 1970 - *Werkgroep voor computers en woord, beeld en geluid* *Nieuwsbrief nummer 3* (# 18-22). Secretary Johannes van der Wolk.

18 March 1970 - *Werkgroep voor computers en woord, beeld en geluid* *Nieuwsbrief nummer 4* (# 23). Secretary Johannes van der Wolk.

20 en 21 March 1970 - *Symposium of the Dutch Working group for computers and verbal, visual and sonal research* in Delft. Organized by Johannes van der Wolk. T. H. Delft. / Galerie Swart, Amsterdam. Participants: M. L. Alinei (IT), **J. Daan** (NL), **Leo Geurts** / **Lambert Meertens** (NL), **Frans Haks** (NL), John H. Holloway (UK), Joseph Raben (USA), **C. E. C. de Reus** (NL), Alan Sutcliffe (UK), K. Schröder (DE), **Peter Struycken** (NL), H. Swart (NL), **F. de Tollenaere** (NL), **H. van de Waal** (NL) / S. Sandström (SE), **Johannes van der Wolk** (NL).

March 1970 - first rapport of the **De Werkgroep Architectuur Komputer (WAK)**. Members from the Technische Hogeschool te Delft: B. **Emmens**, **Kees van Esch**, **G. J. Majoor**, **D. Messnig**, **C. E. C. de Reus**, **P. Versnel**, **T. Vroon**, **T. van der Zee**, **P. van Zutphen** en **Bob van Zijl**.

5 - 26 April 1970 - Exhibition of computer graphics by **Frieder Nake** (DE) and *random objectivations* by **Herman de Vries**, Galerie Swart, Amsterdam

7 April 1970 - *summer postage stamps 1970*, series of five computer-designed post stamps and five graphics / posters by **R. D. E. Oxenaar**, made in collaboration with the group numerical control of the department business science Technical University Eindhoven, issued by PTT. The 15c+10 stamp was derived from a design by the **Centrum voor Cubische Constructies**.

10 April 1970 - **G. H. Grimberg** provides a demonstration of the Haromat coordinatograaf (digitizer) and Zuse drawing equipment. Hagen Systems, Rotterdam.

April 1970 - *Computer Arts Society Holland (CASH)* - letter by **Leo Geurts** and **Lambert Meertens**, Stichting Experimenten in Kunst en Techniek (EKT), .

2 May 1970 - First meeting of **Computer Arts Society Holland (CASH)**, Mathematisch Centrum, Amsterdam gehouden. 34 attendands: Louis Andriessen, Gijs Bakker, Jan Baptist Bedaux, P. de Boer, Carry Dupont-Van Lakerveld, C. E. van Esch, Leo Geurts, William Graatsma, Frans Haks, H. Hofsteenge, L. de Hoogh, K. J. Huisman, Rene de Jong, Gerrit Krol, Henriette Kropman, Hans Koetsier, K. Koster, R. A. Leeuw, Ton Limburg, H. van Meer, Lambert Meertens, Harry Mulisch, R. P. Nederpelt, R. D. E., P. de Roos, Hubert Rossy, Harrie van Rossum, J. G. Ruyter, Remko Scha, J. Schoonenberg, B. C. Sliggers, Peter Struycken, H.L. Swart, Riekje Swart, Stan Tempelaars, Arthur. H. Veen, Frans Verpoorten, Jan Vriend, Johannes van der Wolk.

14 May 1970 - **100 Gulden** banknote issued. Design is partly computer-generated by **R. D. E. Oxenaar**.

15 May 1970 - **Werkgroep voor computers en woord, beeld en geluid**
Nieuwsbrief nummer 5 (# 24-42). Secretary Johannes van der Wolk

27 May 1970 - IBM in Amsterdam organized presentation by artist **John Whitney** (UK) on “motion graphics” made with the IBM 2250 computer.

May 1970 (started March 1969)- master thesis by **Remko Scha**: *Het filteren van pianosignalen m.b.v. een digitale computer*. Afd. der Elecrotechniek, TU Eindhoven, thesis and computer program. Program does pitch analysis and tone generation, that intended to automatically removing scratches from vinyl recordings of piano music, as well to be used in artistic creations.

May 1970 - excursion of members of **Werkgroep Architectuur Komputer (WAK)** in London

June 1970 - ‘**Computerkunst**’ - 17-pages theme of the magazine *Graficus revue* by Jacques G. de Jong, with an introduction and notes to the illustrations Paul Mijksenaar

July 1970 - **Page 9** bulletin (published by CAS, London) - produced by CASH, edited by **Leo Geurts** and **Lambert Meertens**, printed at the Mathematisch Centrum, Amsterdam, layout assistance: Henrik Barends.

24 June - 25 October 1970 - **centrum cubische constructies (Jan Slothouber en William Graatsma)**, represents Netherlands at the 35de Biënnale van Venetië,

6 August - 14 September 1970 - Exhibition of computer art by **D. Mittleman** and **M. T. Malm**. Organized by The Aemstelle in Amstelveen, in collaboration with Sperry Rand Holland NV, Univac Division.

12 September -15 November 1970 - Exhibition *Kontraster., 22 Nederlandse kunstenaars van nu*, Den Haag, Gemeentemuseum, incl. **Peter Struycken**

21 September 1970 - **Werkgroep voor computers en woord, beeld en geluid**
Nieuwsbrief nummer 6 (# 43-64). Secretary Johannes van der Wolk.

September 1970 - 1974, The Senster, cybernetic/robotic sculpture controlled by a computer by **Edward Ihnatowicz** (PL / UK) officially put in operation at the Evoluon in Eindhoven.

September 1970 - **R. A. Leeuw** wrote as part of his doctoral studies in art history thesis on a computer art. Instituut voor kunstgeschiedenis, Groningen.

26 - 28 October 1970 - **Interactive Computer Graphics Symposium**, Computing Centre, Delft University of Technology, Delft. The secretary of the meeting was **L. H. Meuldijk**, Computing Centre, Delft University of Technology. Lectures by **A. van Dam**, **B. Peters**, **P. Purcell** and **N. Negroponte**.

October 1970 - third rapport of **De Werkgroep Architectuur Komputer (WAK)** (Afdeling bouwkunde van de Technische Hogeschool, Delft.)

9 December - **Werkgroep voor computers en woord, beeld en geluid**
Nieuwsbrief nummer 7 (# 65-83). Secretary Johannes van der Wolk.

11 - 31 December 1970 - **Computer Grafiek** exhibition at the G. H. Bührmanns Papiergroothandel N.V., Amsterdam, from Computer Arts Society, London (Summer, Barbadillo, Cordeiro, Knowlton, Mohr, Mattox, Nash, Schroeder and Zajec), extended with works of **Oxenaar** and **Struycken** and presentation of computer films at RAI. In exhibition space an Calcomp plotter was placed that produced computer graphics. Opening speech was held by R.A. Leeuw. Part of the exhibition was later on shown in Galerie de Mangelegang, Groningen 11 feb - 22 jan 1971.

17 December 1970 - Computer-animated films program at RAI, Amsterdam. Organized by G.H. Bührmanns Papiergroothandel N.V., Amsterdam. Program: Computer Image Corp. (Advertising spots), Whitney, Fetter, Lillian Schwartz, Ken Knowlton, and *Beeldprogramma I* by **Peter Struycken** (Made for TV by **Frans Haks** for Openbaar Kunstbezit).

29 December - 7 February 1970 - **cyac - arte y cybernetica**, Buenos Aires - participation by **Peter Struycken**

1970 - 1971 - *Computerstructuren*, series of 14 two-dimensional black/white works by **Peter Struycken**. Made at the Instituut voor Sonologie-Rijksuniversiteit, Utrecht, with PDP-15 computer. Struycken use it with LINARC program, and made prints at the Rekencentrum in Utrecht.

1970 - *Beld en geluid programma 1*, 1970 - (*Image and Sound programme 1*, 1970) computer-generated work by **Peter Struycken**. Lightbox with sound. Program to synchronize sound and image is designed with **Stan Tempelaars**, Utrecht.

1970 - first version of *Algemene Beeldinformatie* by **Peter Struycken**, **Rudi Fuchs** and **K. Vogt**

1970 - production of the *ENTROPY PE 31* by **Roland Kayn** (DE, living in NL since 1970) in the Institute of Sonology in Utrecht. Premiere 1970 in Hamburg.

1970 - **Roland Kayn** Becomes program adviser at the Goethe Institute Amsterdam. In co-operation with the Stiftung Gaudeamus in Bilkthoven and VARA-Radio Hilversum establishing the series *Forum der neuen Musik* with the Goethe Institute AND Beginning of the series *film + experiment* in co-operation between museums and Goethe Institute, which is organized country-wide until 1989 in ten cities.

july 1970 - 1971 - *Random scharen* - series of computer graphics by **Jan Kraak**. In summer 1970, as a free work, Kraak wrote an ALGOL-60 program to draw the *pattern for a ladies dress (dames grond patroon)* based upon 9 measures of the female body. It is based on a real instruction for a tailor how to draw a patron based upon some measures of the human body. 21 juli 1970 computer-print was plotted, with Telefunken TR4 computer and T Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen. Part of the drawing is a scissor (schaar). In January and February 1971 series of prints *Random scharen* is made.

around 1970 - computer graphic by **Jan Kraak** based on *Computer Composition With Lines - Mondrian Experiment* by A. Michael Noll. Program in ALGOL-60 that draw a + symbol with random size and random X and Y position and Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

1970 - 1971 - *Decoratie van glezen scheidingswanden*, first computer-generated public art by **Peter Struycken**, KLM-hoofkantoor, Amstelveen, architect: Rein Fleddeurs. Design is based at the series *Computerstructuren*.

8/9, 15/16 and 22/23 January 1971 - **CAAD seminar Rotterdam** - Onder auspicien of the Bond Nederlandse Architecten and the Bouwcentrum in Rotterdam.

22 January - 11 February 1971 - **Computergrafiek 1**, exhibition, Galerie De Mangelgang, Groningen. It is part of the exhibition from (December) 1970 organized by Bührmanns Papiergroothandel N.V in Amsterdam.

January 1971 - The editors of *De Vakidoot*, monthly for the sub-faculty of mathematical physics and astronomy (University of Utrecht) organized in fall 1970 a **Computer art contest**. The jury was **F. Haks**, **S. G. van der Meulen**, **H. Mulisch** and **Peter Struycken**. The winners were **O. Dokken** and **T. Licorice**. The jury,

the winning piece and a subsequent explanation by **O. Dokken** were printed in *De Vakidoot* in January 1971.

January 1971 - **Stichting Sonologies Centrum voor Zuid-Nederland** founded in Tilburg. In addition to the facilities for editing and sound generation focus on electronic and electro-instrumental music for exhibitions, theater and film.

10 February 1971 - **R. D. E. Oxenaar** - **25 Gulden** banknote, design is partly computer-generated. re-design of 1966 version.

18 February 1971 - **Werkgroep voor computers en woord, beeld en geluid Nieuwsbrief nummer 8** (# 84-103). Secretary Johannes van der Wolk.

24 February 1971 - a lecture by Peter Struycken about structure as a visual medium, the program of the Studium Generale of the 1970-1971, Technische Hogeschool Delft

February 1971 - series of (eleven or more) computer graphics by **Felix Hess**. Digital re-enactment of the *Vega 200*, by **Victor Vasarely** (1968). Works were digitally programmed variations of vector files - image reduced to the black outlines of the geometric shapes. Graphics were made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

5 March - 2 April 1971 - **Geluid <=> Kijken** (Sound <=> Sight), *drie audio-visuele projecten: Ton Bruynèl, Dick Raaijmakers, Peter Struycken*, Stedelijk Museum, Amsterdam, curated by **Jan Martinet** in collaboratin with **Frits Weiland**. Audio-visual object by Peter Struycken: *Beeld en geluid programma 1, 1970. Dynamische lichtstructuur*, lightbox with sound was commissioned by SM. Within the catalogue, three floppy-vinyl records were issued, including **Struyckens Beeld en geluid programma 1, 1970 - 1971, Structuren 1 - 120**.

12 - 31 March 1971 - **IMPULSE: Computer-Kunst** - traveling group exhibition (1970 - 1972) at the Academie van Bouwkunst Amsterdam, organized by Goethe-Institut Amsterdam and Instituut voor Esthetica of Universiteit van Amsterdam. In the first exhibition 1970 in Munich, the work *Quartet No. 1 in C Major for 2 Violins, Viola and Violoncello* by **Lambert Meertens** was included. In Amsterdam additional works were exhibited by **Geurts and Meertens; B. G. Sliggers / R. Bakker** and **R. Oxenaar**. Program consisted of a lecture, exhibition, computer-music, film program, computer time-sharing and forum. **Lecture**: 12 March: Max Bense (DE), Instituut voor Esthetica van de Universiteit van Amsterdam; **Forum**: 13 March: , Academie van Bouwkunst, Amsterdam, chair: **Jan Matthieu Marie Aler**. Discussion: **Computer en Kunst**; papers: **Max Bense** (DE), **Abraham B. Frielink** and **Lambert Tegenbosch**.

March 1971 - **Arteonica** - exhibition, Pinacoteca do Estado de Sao Paulo, Sao Paulo, Brasil, organized by Waldemar Cordeiro (BR) - participations by computer-music **the work is a flexible form: no begin, no end** (1971) by **Louis Andriessen; Kees van Esch** (De Werkgroep Architectuur Komputer, WAK, Technische Hogeschool Delft) with text **Architect and Computer** and *computer-programmed calendar 1971* by **Peter Struycken / Stan Tempelaars / P. C. Cossee**.

2 April 1971 - **Gerrit Krol**, *Twee fragmenten uit APPI (Automatic Poetry by Pointed Information)* and **K. L. Poll (Kornelis Lubbertus Poll)**, *Een kind kan de was doen, NRC/Handelsblad, Cultureel Supplement*.

16 - 17 April 1971 - first in series of four (weekend) **workshops for computer programming** (7&8 May, 28&29 May, 18&19 June) organized by **CASH** in Honeywell-Bull building in Amersfort, with time-sharing with computer in Den Haag. Weekend 1: programming in BASIC; 2: music; 3: graphic (Calcomp plotter); 4: text.

May 1971 - *Quaadraat Stelling I (De Windmachine I)* - the sound installation

with an interactive hardware-programmed man-machine network developed by composer and artist **Victor Wentink**. Four sessions have took place in May 1971 by members of students electronic instrumental group **Het Leven** in the Koninklijk Conservatorium in Den Haag. The group consisted of eight musicians, involving **Dick Raaymakers**, who did technical preparations and draw the technological set-up drawing.

23. May 1971 - **Computerstructuren**, opening of the solo exhibition by **Peter Struycken**, Galerie Swart, Amsterdam. Accompanying pamphlet *Het uitgangspunt en de gevolgde methode voor de computer structuren nrs.I-10, 1970-1971*

30 June 1971 - **Werkgroep voor computers en woord, beeld en geluid Nieuwsbrief nummer 9** (# 104-109). Secretary Johannes van der Wolk.

19 June - 15 august 1971 - **Sonsbeek buiten de Perken** - open air exhibition, Arnhem. During the exhibition the Het Diskussiecentrum, Het Kommunikatiecentrum and De Videostudio were opened the communication with audience in different ways. Kommunikatiecentrums were open later on in Rotterdam and Enschede, collecting data from questionnaires. Information was computed (programs AJD / ORSIRIS II) and results of statistics published in two volumes edited by **Otto Valkman** (in 1971 and 1973, by dr. e. boekmanstichting - sociaal wetenschappelijk studiecentrum voor kunst en cultuur). Participans among other Dutch artist were Wim Schippers, Ad Dekkers, Carl Visser, Hans Eyklboom and among international artists were Sol le Witt, Donald Judd and Joseph Beuys.

June 1971 - De **Computer Arts Society Holland**, Amsterdam in collaboration with **Honeywell-Bull** (Nederland) N.V. computer course of BASIS computer language, via time-sharing.

June 1971 - **Gottfried Honegger** (Swiss) solo exhibition, Collection dart, Amsterdam

July 1971 - **Page 17** bulletin (published by CAS, London) - produced by CASH, edited by **Leo Geurts** and **Lambert Meertens**, printed at the Mathematisch Centrum, Amsterdam. Participations by **Lambert Meertens: Designing letter-like shapes; Peter Struycken: Computer-structures 1970-1971** and **Leon de Hoogh: Is beauty random?**.

September 1971 - **Johannes van der Wolk**, defended his **doctoral theses** in art history 1971 that included subjects of The first experiments in computer use by the art historian and the possibilities for the future ; Packing the same knowledge in various media as a contribution to smooth the process of scientific communication and Computers and visual creativity . Rijksuniversiteit Utrecht, September 1971 / Kunsthistorisch Instituut Utrecht

29 September - 15 October 1971 - **Computergrafiek II**, exhibition by **Manfred Mohr** (DE), Galerie De Mangelgang, Groningen

October 1971 - first issue of the **Interface Journal of New Music Research**, Electronic Music Reports, published in English by the Instituut voor sonologie, Rijksuniversiteit te Utrecht, Utrecht

30 October 1971 - **Computerfilms** - program presented by **Malcom Le Grice** (UK) in Amsterdam film venue *Electric Cinema*, led by filmmaker **Barbara Meter**. Films by **John Stehura, James Whitney, Stan van der Beek, Lillian Schwartz, Perre Hebert, Malcom Le Grice, Colin Emmert, Computer image Corp., Bob Weiss, J. Schwartz**. Program was shown again in the Fatcity 2nd November.

23 November 1971 - **Stan van der Beek** - program of computer films, Fatcity (Amsterdam ?)

Fall 1971 - artists and composers **Bernardus Franciscus (Dick) Raaymakers**

and **Victor Wentink** together with art historian **Albert Blankert** and writer **Jacq Vogelaar** wrote a collective project proposal for the Gemeentemuseum in The Hague. Their idea is to exhibit the three *Ideophones* in combination with a learning exhibition of three months (children age 12 - 16). The proposal, entitled *Exhibition of a School*, is rejected.

1971 - **APPI: Automatic Poetry by Pointed Information: Poëzie met een computer** by **Gerrit Krol** is published by Querido, Amsterdam in 1971.

1971 - **Structuurverschillen van tijd en plaats** - computer-generated film by **Peter Struycken**.

1971 - solo exhibition by **Peter Struycken**, Galerie Swart, Amsterdam

1971 - *Van Appel tot Sykora*, group exhibition, Kunsthistorisch Instituut, Amsterdam, incl. computer-generated works by Sykora (CHZ) and **Peter Struycken**

1971 - **Seminar on Computer Aided Architectural Design** - and related book *Verslagboek van het Seminar on Computer Aided Architectural Design*, Bouwcentrum, Rotterdam, 1971. Including article by Lambert Meertens: *Computers and creativity*.

1971 - **Stichting Experimenten in Kunst en Techniek** (E.K.T.), Amsterdam. Chairman **F. v. d. Blij**, coordinator EKT-Exhibition: **Cor Blok**.

1971 - **Boymans van Beuningen museum** in Rotterdam run annual program for 1971 with the subject *art and technique*.

1971 - **Volkslied** - For an unlimited amount and kinds of instruments (in all octaves) - computer-generated music by **Louis Andriessen**, programmed by **Leo Geurts** on the Electrologica X8 computer of the Mathematical Centre, Amsterdam. A score starts with the Dutch national anthem *Wilhelmus van Nassouwe* and then gradually turns into the socialist hymn *The International*.

1971 - 1975 - **Cluster** - series of paintings in color by **Peter Struycken**. Program that making use of 24 colors designed with **Stan Tempelaars**.

January 1972 - **J. Fukken** en **P. Hollenberg** (Higher Technical School for the Apparel Industry Mr: Koetsier School, Amsterdam) developed a program for computer aided design patterns for the clothing industry.

January 1972 - Computer art graphic *Pussycat* by **Dr. E. J. Kaptein** published in *CalComp Newsletter*. Graphic was drawn on CalComp 565 drum plotter operating on-line with CDC-1700 computer in the Physics Laboratory at the Free Univesrsity, Amsterdam.

9 February 1972 - **Werkgroep voor computers en woord, beeld en geluid** *Nieuwsbrief nummer 10* (# 110-134). Secretary Johannes van der Wolk.

4 March 1972 - **Computer en Kunst** - discussion meeting at the Nederlandse Studiekring voor Esthetica, Amsterdam (secretariaat: Drs. **E. J. Willems**). Discussion follows up the Forum from 13 Mart 1971.

12 March - 1 April 1972 - *Kristalstructuren* - **Leo Geurts** en **Lambert Meertens**, exhibition, Galerie Swart, Amsterdam. The portfolio of prints, with four silkscreen prints (of computer graphics) published by Galerie Swart.

13 - 17 March 1972 - **Toeval**, group exhibition curated by **Frans Haks**. Studium Generale, Rijksuniversiteit Utrecht. Included computer-generated works *Kristalstructuren* by **Leo Geurts** / **Lambert Meertens** and **Peter Struycken**. In catalogue is published an essay *Kunst en computer* by **Hoos Blotkamp**.

30 March 1972 - **R. D. E. Oxenaar** - **1000 Gulden** banknote, design is partly

computer-generated.

30 May - 1 June 1972 - **Canadian Computer Show 1972 - International Computer Art Exhibition**, Place Bonaventure, Montreal - participation by **Peter Struycken**

10th June - 1st July 1972 - *8 Space Constructions*, exhibition by **Tony Longson** (UK), Galerie Mathoom, Den Haag

16 - 18 October 1972 - **IFIP working conference on principles of computer-aided design**, Eindhoven. Organized by IFIP Technical Committee 5, Computer Applications in Technology.

October 1972 - **integration** (review for a new conception in art and culture), no. 13-14, *formes cubiques. rapport d une recherche fondamentale. 1955-1970*, edited by **herman de vries**, Eschenau, 1972. Including texts on computer-generated art: Frieder Nake (DE): *Computer an die Akademien!*; Michael Noll (USA): *Gaussian quadratic*; Zdenek Sykora (CHR): *Ma méthode de travail*.

8 dec. 1972 - 28 jan. 1973 - **Struktuur - een thema, een methode** - group exhibition, de tentoongestelde kunstenaars: **c.c.c., dekkers, v.d. ende, geurts en meertens, von graevenitz, hilgemann, roskam, v. rossum, struycken, de vries**. De Lakenhal, Leiden.

1972 - **Computerstructuren** - series of 6 paintings by **Peter Struycken**: *1A-72, IA-I, IIA-II, IIIA-III-72, II-72*. (new titles: *1A-72, 2A-72*)

1972 - 1974 - **Peter Struycken** develops and using the PLONS computer program to manipulate colours.

1972 - group exhibition **Programmi Sistematici: Dekkers, Hilgemann, Schoonhoven, Struycken, De Vries**, Galleria Milano, Milan, Italy.

1972 - group exhibition **Peter Struycken, Ad Dekkers, Jan Schoonhoven, Carel Visser**, Lens Fine Art, Antwerp, Belgium.

1972 - **Drukkerij Rosbeek** (1969 - 2006), Limburg, known for working close with artists (Peter Struycken, Ad Dekkers, Ger van Elk, Carel Visser, William Graatsma) equipped the printing house with computer (first in the Netherlands?)

1972 - **Interface - Journal of New Music Research** is the continuation and merger of *Jaarboek* (Seminar for Musicology, Ghent, BE) and **Electronic Music Reports**, of the Institute of Sonology in Utrecht.

1972 - **Manfred Mohr** (DE) - solo exhibition, Galerie Swart, Amsterdam

1972 - **Peter Struycken** - solo exhibition, Galerie Swart, Amsterdam (cat.)

1965 - 1972 - Until 1972 **Casper C. Bosveld** made experiments with computer art vector graphic. Finally, in 1972 **Bosveld** finished experimental phase with computer graphics, and start to conceive such work as artworks.

1972 - **Leo Geurts** is a visiting lecturer (Computer Programming) at the Academy of Fine Arts in Arnhem. (Gallery owner **Bob de Wit** and artist **Samuel Meyering** attend the programming course for artists alongside others).

1972 - **Multi Art Points** gallery opened in Amsterdam with exhibition of **Ad Dekkers**, runned and owned by **Bob de Wit**. In its program gallery exhibited multiples only, alongside other works computer-generated art by **Samuel Meyering** and **Manfred Mohr** (DE).

4 March 1973 - **Computer and Art** - seminar. Report of the Seminar pubilsjed by Leo Geurts, "Artist and Programmer - Some Discussion on the handles of

Computer and Art “, in: *Lier en boog*, journal for philosophy of culture and art, Volume 1, No. 1, October 1975.

17 March - 29 April 1973, **De consequenties van de machine: Dertien Joegoslavische kunstenaars** (*The Consequences of the Machine: Thirteen Yugoslav artists*) Museum Boijmans van Beuningen, Rotterdam. Curated by Dimitrije Bašičević, including computer-generated works by **Vladimir Bonačić**, **Peter Milojević** and **Edward Zajec**.

28 March 1973 - **R. D. E. Oxenaar** - **5 Gulden** banknote, design is partly computer-generated. Re-design of 5 Gulden version from 1966.

18 April 1973 - *Computer Art*, graphic by **Johan Krook**. Graphic is made with Telefunken TR4 computer and Benson-Lehner plotter at the Rekencentrum of the Rijksuniversiteit Groningen.

May 1973 - Computer art graphic *Hare* van nuclear physicist **E. J. Kaptein** published in **CalComp Newsletter**. *Hare* was drawn on CalComp 565 drum plotter operating on-line with CDC-1700 computer in the Physics Laboratory at the Vrije Universiteit Amsterdam.

27 - 31 august 1973 - **Computers in the Arts Conference/Event/Exhibition, INTERACT Machine: Man: Society**, Edinburgh, organized by the Computer Art Society. Dutch participants: **Otto Laske** presents paper *Foundation of a Generative Theory of Music* at the conference. **Peter Struycken** exhibits diagrams of Computerstructures and films *Beeldprogramma I-72* and *Beeldprogramma II -72*. **Greta Monach** exhibits *automatergon* - sound and visual poetry.

7 October - 5 November 1973 - **Varianten** - exhibition of Dutch Constructivists, organized by Nederlandse Kunststichting, De Aaart, Hilversum, including work by **Peter Struycken**.

30 November 1973 - **Werkgroep voor computers en woord, beeld en geluid Nieuwsbrief nummer 11** (# 135-155). Secretary Johannes van der Wolk. Not distributed, last issue.

1973 - solo exhibition by **Peter Struycken**, Galerie Swart, Amsterdam.

1973 - *Beeldprogramma II* - computer-generated film by **Peter Struycken**.

1973 - *Serie 13*, 7.11.73, computer drawings by **Peter Struycken**.

1973 - 1974 - *ASTRA I* - computer-generated film by **Peter Struycken**, made with computer program ASTRA.

1973 - *Compoëzie* by **Greta Monach** published by Samson Automatiserings Service Centrum Alphen a/d Rijn. Computer-generated visual poetry.

1973 - **herman de vries: chance-fields, an essay on the topology of randomness** / *chance-felder, ein essay über die topologie des zufalls* - art book with computer-generated graphics by **herman de vries**. Computer calculations of the chance-ranges by Michael Herbert; drawings: Susanne Goepfert. Published by edition.e.

1973 - 1976 - **Quadrat Stelling II (De Windmachine II)** - audio-visual live performance / installation with an interactive hardware-programmed man-machine network, by composer and artist **Victor Wentink**. Premiered in Schaffer theater, Amsterdam, May 1976, and toured different festivals, as well shown in gallery environment (De Appel Gallery in Amsterdam and in Haags Gemeentemuseum, 1977 and 1979.)

1973 - musician **Paul Berg** (USA) comes to Instituut voor Sonologie, Utrecht, where he works as an assistant to a computer sound synthesis system (PILE) and

also teaches. PILE was capable of real-time signal processing and as such an early example of its kind.

1974 - **Peter Struycken** - solo exhibiton, Galerie Swart, Amsterdam, films **Afstra** 1,2,3,4

1974 - 1975 - **Peter Struycken** - traveling solo exhibition, Centraal Museum, Utrecht, Stedelijk Van Abbemuseum, Eindhoven; Museum Boymans van Beuningen, Rotterdam; Museum voor de Schone Kunsten, Antwerp

1974 - **Willem Sandberg** (director of Stedelijk Musuem Amsterdam 1945 - 1963) participated at the international seminar **The Interaction of Art and Science**, organized by the *Jerusalem Program in Art and Science*, an interdisciplinary program for study and research at the Bezalel Academy of Arts and Design in Jerusalem, in collaboration with the Hebrew University of Jerusalem and the Israel Museum.

1974 - **Samuel Meyering** (1944- 2006) creates computer art with the computer. (source: Wikipedia)

1975 - **Number Tape Weaves** - computer-inspired systematic textile works by **Ellie Vossen**. In anticipation of the computer, the *Number Tape Weaves* were produced in every possible variation of a single structuring principle.

1975 - **Peter Struycken** - solo exhibiton, Galerie Swart, Amsterdam

1975 - **Peter Struycken** - solo exhibiton, Lucy Milton Gallery, London

1975 - **Manfred Mohr** (DE) - solo exhhibition, Galerie Swart, Amsterdam

1975 - *Orientatie materiaal over wetenschap en kunst* - publication by the **Stichting Experimenten in Kunst en Techniek** (E.K.T.), Amsterdam. Ed: **Cor Blok**, **P. H. van de Peol** and **C. (Stan) Tempelaars**.

1975 - **Willem Sandberg** received the *Erasmus Prize* in Amsterdam. On Sandberg's recommendation, half of the prize was dedicated to the **The Jerusalem Program in Art and Science**, lead by **Vladimir Bonačić** (CRO) from the **bcd – cybernetic art team**.

1975 - **Demos** - digital typeface by **Gerard Unger**.

1975 – 1979 - **Eemnes Machine** - Interactive hardware-programmed self-composing sound machine developed by composer and artist **Victor Wentink** and assembled by author in collaboration with technician **Johan den Bergelaar**. It is developed and built in STEIM, Amsterdam. Inputs of sound and light and real-time data processed by machine, resulted in unpredictable electronic sound output. It was built in 1978 - 1979, and first time presented at *Tektonik* solo-exhibition in het Haags Gemeentemuseum, March 1979. It was used in several music performances by music group *Nieuwe Leven* (1980 - 1985) and exhibited in Zeeland by STEIM in 1985.

1975 - 1984 - **Peter Struycken** - Works on a computer controlled color picture tube and generate color-changing images generated in collaboration with **C. Wissenburg** (the Electrical Engineering Department, T.H. Delft), and **G. van der Wal** (the Department Garphics Group).

1976 - first real-time computer animated images by **Peter Struycken**, recorded on video, developed by Struycken at the Graphic Group of T.H. te Delft between 1976 en 1977. Video parts (each with voice over): *Waves*, *Disp* (1976), *Vloei* (1976), *Square*, *Grid 3*, *Lijn 1*.

1976 - **Peter Struycken** - solo exhibition, Stedelijk Van Abbemuseum, Eindhoven

1976 - **Peter Struycken** - solo exhibition, Galerie Megert, Bern

1976 - 1980 - **Casper C. Bosveld** programming at his studio computer-graphics with computer *Tektronix 4051* and an Interactive *Digital Plotter Tektronix 4662*.

1976 - **Toeval Kunst**, Netherlands Ministry for Cultural Affairs, Recreation and Social Welfare / Nederlandse Kunststichting - traveling exhibition that included works by Struycken.

28 July 1977 - **R. D. E. Oxenaar** - **100 Gulden** banknote, design is partly computer-generated. re-design of 1970 version.

24 November 1977 - 8 January 1978 - **Computerdrawings** - solo exhibition by **Harold Cohen** in the Stedelijk Museum, Amsterdam.

1977 - **Roland Kayn** (DE, living in NL since 1970): co-operation with **Jaap Vink** at the Instituut vor Sonologie, Utrecht. Produces *MACRO I-III*. Collaborate with the architect **Frei Otto** concerning on the spatial projection of electronic music. From Stuttgarts South German broadcast he receives the commission for a transmission series about composing between computers and cybernetics .

1977 - **Struycken. Beelden en Projecten** - solo exhibition by **Peter Struycken**, Rijksmuseum Kröller-Müller, Otterlo.

1977 - **Peter Struycken** - solo exhibition, Galerie Swart, Amsterdam.

1977 - **Peter Struycken** - solo exhibition, Galerie megert, Bern.

1977 - **Peter Struycken. Neue Gemälde, Skulpturen und Zeichnungen** - solo exhibition, Städtische Kunsthalle, Düsseldorf (DE).

1977 - **Peter Struycken** - solo exhibition, Galerie Nouvelles Images, The Hague.

1977 - **Lijn 1, 2, 3** - real-time computer animated images by **Peter Struycken**, recorded on video. *Lijn 1* is from 1976.

1977 - **Sen Shostak** - owns one of first **personal computers in Netherlands** . **Shostak** was involved with first computer animation experiments in the early 1980s.

1977 - **Quaadrat Stelling IX: Rosa Nova** - science fiction short story by composer and artist **Victor Wentink**. Several machines are described, that are realized later in his artistic work, as an interactive field control of physical environment. The notion of cyberspace was named *Fase-ruimte* (phase-space). Not published.

16 January 1978 - **Proposal for the Exhibition Meta Language in Development of Computer Art** - by **Art and Science team (Willem Sandberg and bcd – cybernetic art team)**. Represented by **Vladimir Bonačić, Art and Science team** proposed the exhibition *Meta Language in Development of Computer Art*. Finally, *tendencias 6* began with the conference *Umjetnost i društvo [Art and Society]* in 1978 in Zagreb; the planned exhibition never took place.

2 - 22 November 1978 - **system + zufall** group exhibition, Landes pavillon Stuttgart - Stuttgart. Organised by d+c müller-roth, Stuttgart; participating artists: **Manfred Mohr** (computer art), **François Morellet**, **herman de vries**, **Ryszard Winiarski**.

1978 - **Peter Struycken** - solo exhibition, Galerie Nouvelles Images, The Hague

1978 - **Peter Struycken** - solo exhibition, Galerie Swart, Amsterdam

1978 - **Samuel Meyering** make public art a computer-generated chaotic line that all 18 lift lobbies of the Ministerie van Binnenlandse Zaken.

2 March - April 1979 - solo Exhibition **Tektonik** by **Victor Wentink** in het Haags Gemeentemuseum. Part of *Beeld en geluid (Image and Sound)* series of exhibitions by Haags Gemeentemuseum.

12 - 18 April - **Mobilodrom** by **Michael Fahres** performed at Music Biennale Zagreb, Zagreb. An electric car drive through the city and collected information like volume and pitch of environmental sounds, movement, air pressure and others. Those data were in real time translated into sounds by a computer. Software design and architecture: **Johan den Biggelaar**, STEIM.

22 September - 25 October 1979 - *Computer-schilderijen* - solo exhibition by **Zdenek Sykora** (CHZ), Kunstcentrum Badhuis, Gorinchem.

1979 - graphic designer **Jelle van der Toorn** Vrijthof introduced the computer in his company **Total Design**.

1979 - **Computerpoëzie** by **Gerrit Krol** published in *De tv.-bh.: Essays*, Amsterdam, Querido.

1979 - **Paul Brown** (UK / Australia) begins software development of what will become the *Aesthedes Workstation* (visual design system) for Claessens in Hilversum. **Henne Hautma** is in charge of electronics.

1979 - 1980 - **KAND digitale beeld/geluid-compositie voor Apple II computer (KAND digital audio visual composition for Apple II computer)** by composer and artist **Victor Wentink**. Produced by Studio Steim and Studio Amsterdams Conservatorium. **Floris van Maanen** did programming and data transfer from mainframe to PC. First performed in the Muziekcentrum de IJsbreker, Amsterdam, in 1980. Apple II computer performed audio-visual composition: sound from computer was played via sound system and monitor output was transmitted from color TV monitor to the video projection.

1979 - 1980 - game development for 3 humans and one mainframe computer by transmedial artist **Andreas Maria Jacobs**. Made during his study of physics and musicology at the University of Amsterdam, with Sara University computer. An interactive program, written in FORTRAN to fed to the mainframe with punch cards.

1979 - 1980 **Field 40** - 16 color photos by **Peter Struycken**.

March 1980 - **Muzak for Wijnand** - interactive computer-generated music object by **Remko Scha**. Object consists of old radio with built-in electronic chip, with the program that generates minimal music. Object enables interaction of changing the speed of music. Produced at Philips NatLab, Eindhoven. Program is written in assembly code *TWIN ASSEMBLER VER 2650*.

September 7 - October 13 1980 - *herman de vries : werken 1954-1980*, solo exhibition, Groninger Museum, Groningen. Shown works with punch cards from 1965.

1980 - **Apollo House Apollohuis** - venue for art and music, artist initiative, Eindhoven

1980 - 1981- **Peter Struycken - Struycken, structuur <=> elementen 1969 - 1980** - solo exhibition, **Museum Boymans-Van Beuningen**, Rotterdam.

1980 - **Peter Struycken** - solo exhibition, Galerie Swart, Amsterdam.

1980 - **Struycken & Panamarenko** - exhibition, Technical University, Eindhoven.

1981 - **Kunst en computer** - group exhibition, Haagse Kunstkring, The Hague

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