

# Towards Computer Art



Wege zur Computerkunst



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## Wege zur Computerkunst

Manfred Mohr

Digital computer graphs

Freder Nake

Digital computer graphs

Georg Nees

Digital computer graphs

Ludwig Raas

Architectural graphs

Karl Seebig

An exhibition in collaboration with the  
"Goethe-Institut zur Pflege deutscher Sprache  
und Kultur im Ausland e.V.", Munich.



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# Towards Computer Art Wege zur Computerkunst

An exhibition in collaboration with the  
"Goethe-Institut zur Pflege deutscher Sprache  
und Kultur im Ausland e.V.", Munich.

Klaus Basset	Typewriter graphs
Pierre Cordier	Chimigrammes
Herbert W. Franke	Analogous und digital graphs
Hein Gravenhorst	Photo-mechanical transformations
Karl. M. Holzhäuser	Mechano-optical research
Gottfried Jäger	Diaphragm structures
Manfred Mohr	Digital computer graphs
Frieder Nake	Digital computer graphs
Georg Nees	Digital computer graphs
Ludwig Rase	Architectural graphs
Karl Siebig	Transformations of basic motifs with the aid of computers

## COMPUTERS IN GRAPHIC ARTS

The ability and facility of somebody's interest in art is in close relation to the comprehension of symbols and the capability of learning and recovering, reactions which can be initiated by an esthetic object. Computer art can not only be explained as the theory of energy but also as the phenomenon of information. An automated art does not gain such satisfying results which can be derived when using program controlled machines. Today we have come to a technical level where the development of computers opens the way towards automated graphic arts. A computer is the ideal instrument for the creation of esthetic structures. Why there was made so little use of these possibilities yet is explained in the following points.

1. Rational esthetics, useful to a basic theory, are only understandable in relation to the scientific progress. In

principal the cybernetic esthetics are not derived from philosophical principles but seize the human consciousness, ideas, thoughts, and behaviour.

2. Up to now the necessary devices for a satisfying fulfilment in the visual restoration of esthetical demands were not available. The equipment used for the creation of automated graphs was merely constructed for technical use.

3. It is rather difficult to place computer art within the scope of traditional esthetics. It took a long time, probably several decades, before the automated art was established and fully accepted. So it can not be seen as a temporary artistic style just in vogue. Though the computer can be applied in objective and momentous creations (interesting effects by mixing or destroying of data sequences) in the present time it offers only works according to the general tendency in construction methods. It is obvious that geometrical graphs, performed by computers, are not the logical conclusion of all methods already applied before. There are on the one hand artistic creations performed with the aid of non-computer-controlled calculating machines and on the other hand automated graphs realized in a time spending way using displays. The present exhibition shows apparative graphs of different provenance. It will demonstrate in a plastic manner the historical and logical coherence between computer art and other design methods. Besides a new concept is practised: the works are continually completed with new works, further artists are invited to a temporary or lasting participation. The adaptation to the respective context, e.g. a professional meeting or a seminar, is realized by a specific selection and additional informations. To address people of all sections of the society, it is intended to seize each opportunity to avoid the conventional places of artistic representation in the benefit of laboratories, public centers, schools, etc. Further editions of the pictures can be easily sent on command to exhibitions overseas. The first representation of this exhibition at a common meeting of the Massachusetts Institute of Technology and the "Technische Universität", Berlin in 1968, where computer generated and apparative graphs were first shown in common, was supposed to be a risk. Meanwhile the exhibition "Wege zur Computerkunst" is fully accepted in technical literature and textbooks and by this means part of the history of latest activities in the esthetic-creational scope of art. Nevertheless this exhibition did not become historical. The present selection of pictures shows the latest level in the development of computer art and in all probability it will change its mode as quickly as before.

# KLAUS BASSET – CURRICULUM VITAE

1926 born in Berlin.

Study: Graphic design at the "Meisterschule für das Kunsthandwerk", Berlin, by Fred Gravenhorst; state examination.

Since 1957 in Stuttgart.

1958–60 Constructive cardboard sculptures and kinetic interference objects.

1960–62 Engaged with drawings of organic and anorganic microstructures.

Since 1962 a serial of pictures derived from 8 basic motifs.

1962–69 Programmed structures with 8 basic motifs and playboards.

1963–72 Head of the "Galerie am Berg", Stuttgart.

Since 1966 teacherships. Lecturer of decoration at the "Grafische Fachschule", Stuttgart.

Since 1969 Typewriter graphs: typo-structures, systematic drawing research, cube descriptions, representation of meta-spaces.

## EXHIBITIONS

1964 "Elemente", "Galerie am Berg", Stuttgart;  
"Galerie im Zimmertheater", Tübingen, personal exhibition.

1965 "Konkrete Kunst-Grafik Texte", Townhall of Delft Emden; "Galerie am Jakobsbrunnen", Stuttgart, personal exhibition.

1966 "Stuttgarter Künstler", City Park Forum in Graz;  
"Determinierte Formen", Leibniz-Kolleg, Tübingen;  
"Behr-Galerie", Stuttgart; "Bergambergamberg",  
"Galerie am Berg", Stuttgart.

1967 "Determinierte Formen", "Haus Michael", Bochum;  
"postkarten", "Galerie am Berg", Stuttgart; "Woche der jungen Kunst", Rottweil; "Galerie Patio", Frankfurt, personal exhibition; "Galerie Daedalus", Berlin, personal exhibition.

1968 "Parallel", "Bürgermeister-Ludwig-Reichert-Haus", Ludwigshafen/Rh.; "Galerie Senatore", Stuttgart;  
"Kunst aus dem Computer", "Technische Universität", Berlin; "Nacheinander nebeneinander", "Galerie am Berg", Stuttgart; "4 Stuttgarter Künstler", "Gessmann-Galerie", Neu-Isenburg.

1969 "Frühjahrsmesse Berliner Galerien", "Biennale 1969"; "Artistic Library", Berlin; "Schaufenster-Galerie", Bielefeld, personal exhibition; "Atelier NW 8", Beindersheim, personal exhibition.

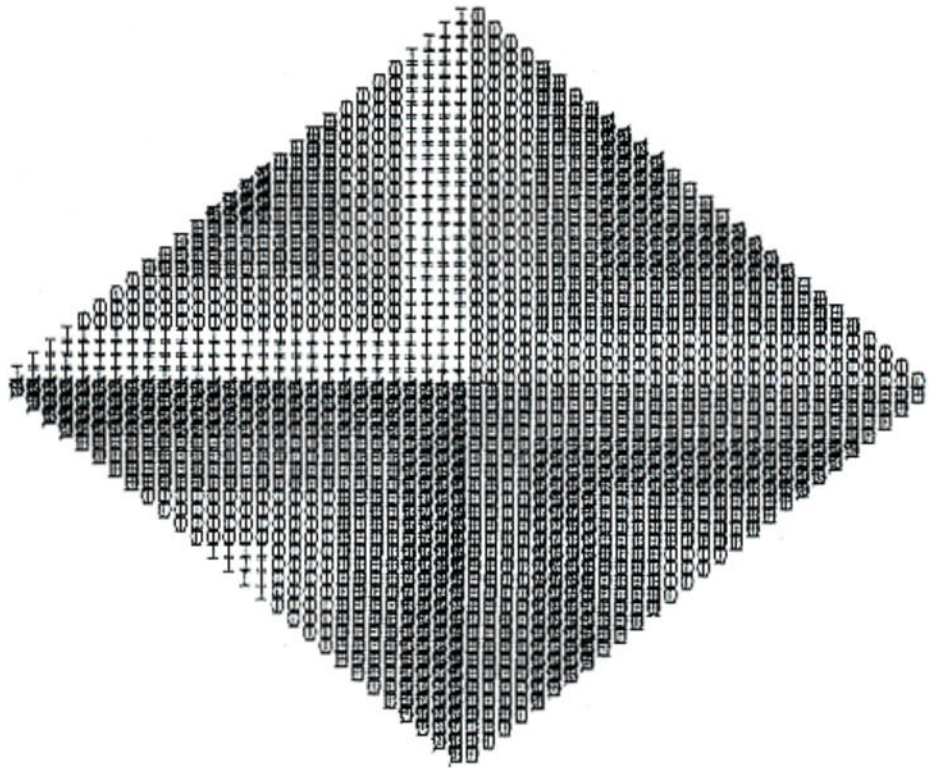
1970 "Werkstatt Breitenbrunn", Austria, personal exhibition.

1974 "Galerie Wahlandt", Schwäbisch Gmünd, personal exhibition.

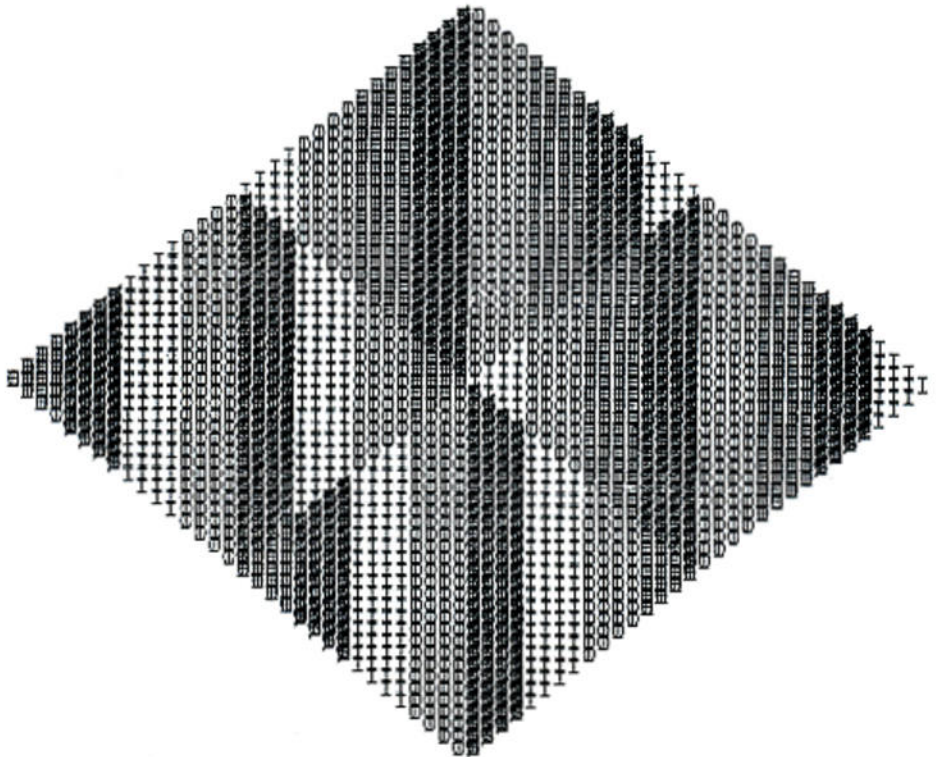
1975 "Staatsgalerie", Stuttgart, personal exhibition.

KLAUS BASSET: Typewriter graphs. Selected signs will be dispersed by certain algorithms on an elementary data network.

Address  
Heimgartenstraße 71  
7000 Stuttgart-Hedelfingen  
Germany



Angles on a quadratic surface  
composed of the letters I, O, H, %.



Stripes on a quadratic surface  
composed of the letters I, O, H, %.

## PIERRE CORDIER – CURRICULUM VITAE

1933 born in Brussels.

Study: Politics at the Free University of Brussels;  
practical course of 4 months at the college of Dr. Otto  
Steinert, Saarbrücken.

1956 Discovery of the first "chimigramme".

1957 Voyages to Turkey, Syria, Irak; professional  
photographer.

1963–73 Distinction at the "Jeune Peinture Belge".

1965 Teacher of photography at the school E.N.S.A.A.V.  
"Ecole Nationale Supérieure d'Architecture et des Arts  
Visuels", Brussels.

1971 Correspondent member of the DGPh, "Deutsche  
Gesellschaft für Photo"; member of the CBG,  
"Chambre Belge des Graphistes".

### EXHIBITIONS

1958 "Subjektive Fotografie III" and "Selbstportrait"  
from Prof. Dr. Steinert; "Otto Steinert and Disciples",  
Frankfurt, Essen, Amsterdam.

1960 "Ungegenständliche Fotografie", "Gewerbe-  
museum", Basel; "Fotografi della Nuova Generazione"  
(rewarded with a gold medal), Milan.

1961 "Salon du Portrait" and "Biennale de la Photo-  
graphie", Paris.

1962 "Studio 28", Paris, personal exhibition.

1964 "Pierre Vanderborght Gallery", Brussels, personal  
exhibition.

1965–66 "Salon Comparaison", Paris.

1966–67 "Photo-Graphie", Knokke, Anvers, Louvain,  
Namur, Charleroi, Wuppertal, Verviers, Mons, Liège,  
Brussels.

1967 "Artek Gallery", Helsinki; "An European Experi-  
ment", Museum of Modern Art, New York.

1968 "Generative Fotografie", Bielefeld.

1969 "Vision and Expression", Eastman House,  
Rochester; "6 Belgian Photographers", itinerant  
exhibition.

1970 "Image I", "Palais des Beaux-Arts", Brussels;  
"Il Diaframma", Milan, personal exhibition.

1971 "Contemporary Photographs I", Fogg Art Museum,  
Harvard University.

1972 "Prayer Show", Minor White.

1973 "Folkwang Museum", Essen; "Photographers  
Gallery", London; "Sicof", Milan.

1974 "Galerie Volkaer", Brussels, personal exhibition.

1975 "Galerie Disque Rouge", Brussels, personal  
exhibition; "Generative Fotografie", Internationaal  
Cultureel Centrum, Antwerpen; "Photo as Art, Art as  
Photo", Châlon-sur-Saône, Kassel; "Fotografie 1929–  
1975", Stuttgart, "Musée des Beaux Arts", Dunkerque.

1976 "Galerie Spectrum", Barcelone, personal exhibi-  
tion; "Galerie Die Brücke", Vienna, personal exhibition.

### FILMS

1962 Film by the "Groupe Recherche Image" of the  
O.R.T.F./Paris; directed by Pierre Shaeffer; colour,  
16 mm, 6 minutes.

1963 "Chimigrammes" realized with the help of the  
Board of Culture and National Education of Belgium;  
colour, 35 mm, 12 minutes.

1974 "Start" realized in collaboration with Marc Lobet;  
colour, 35 mm, 5 minutes.

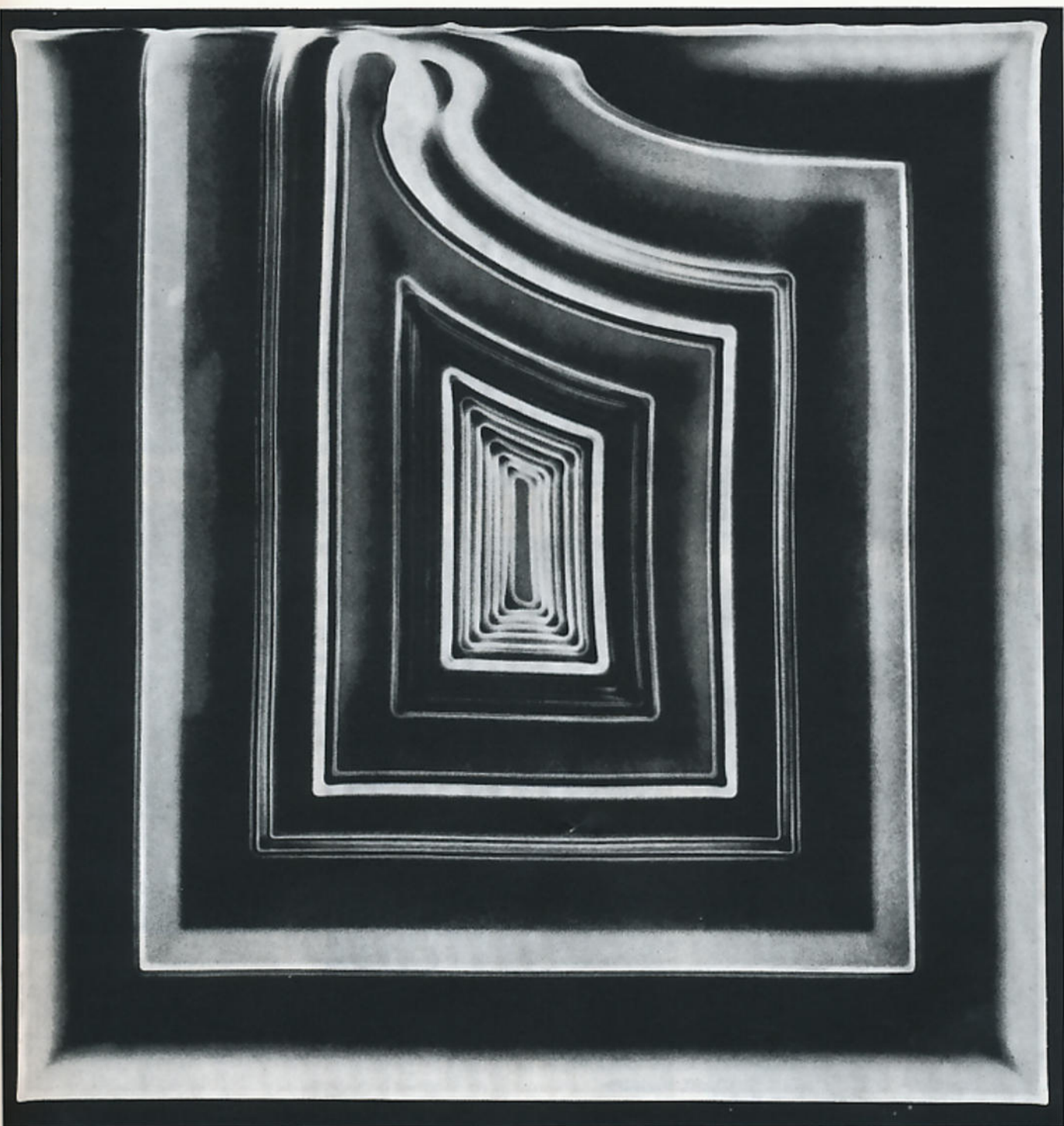
### TV

1968 "Chambre Noire" in collaboration with Albert Plécy  
and Michael Tournier; O.R.T.F. – 2e chaîne.

PIERRE CORDIER: "Chimigramme". A chemical  
reaction is initiated on the surface of a photographic  
emulsion and a visual structure arises. The emulsion is  
used as catalyst. It is possible to initiate the reaction  
with the aid of empiric methods or with program con-  
trolled optical procedures.

Address  
Rue Reigersvliet 20  
1040 Bruxelles  
Belgium





Transformation of a basic motif with the aid of chemical products – successive enlargements and distortions.

# HERBERT W. FRANKE – CURRICULUM VITAE

1927 born in Vienna.

Study: Physics, chemistry, psychology, philosophy at the University of Vienna; Optical electronics at the "Technische Hochschule", Vienna.

1951 Research work at the "Technische Hochschule", Vienna; consulting for the dating of secondary limestone with carbon 14.

1951–56 Industrial activities by Siemens in Erlangen. Since 1952 Geochronological works.

1954 Decorative radiography and design of luminous graphs.

Since 1955 Rational esthetics.

Since 1956 Free writer on special topics.

1956 Use of an analog computer and a cathode-ray oscillograph in experimental esthetics.

1965 Optimal principle of esthetics; head of a course at the "International College" in Alpach.

1968–69 Head of a seminar "Kybernetik und Informationstheorie" at the University of Frankfurt.

1969 Research work on futurology in collaboration with Dr. Dr. E. H. Graul, professor at the University of Marburg/Lahn.

Since 1970 Design of computer graphs with digital computers.

1971 Picture processing; series of tests with the "Bildspeicher N".

1973 Computer films: "Projektionen" and "Rotationen", works on multi-media representations; teacher of cybernetic esthetics at the University of Munich.

## EXHIBITIONS

"Experimentielle Ästhetik" and "Elektronische Graphik", Vienna, London, Zurich, Munich, Stuttgart, Kaiserslautern.

1970 Biennale, Venice.

1971 Biennale, Nuremberg.

1972 Festival of Music, Film, Slides, and Light, Munich.

1975 "Kunst aus dem Computer", Vienna.

## PUBLICATIONS

"Kunst und Konstruktion", published by F. Bruckmann, Munich 1957.

"Phänomen Kunst", published by H. Moos, Munich 1967, DuMont Schauberg, Cologne 1974.

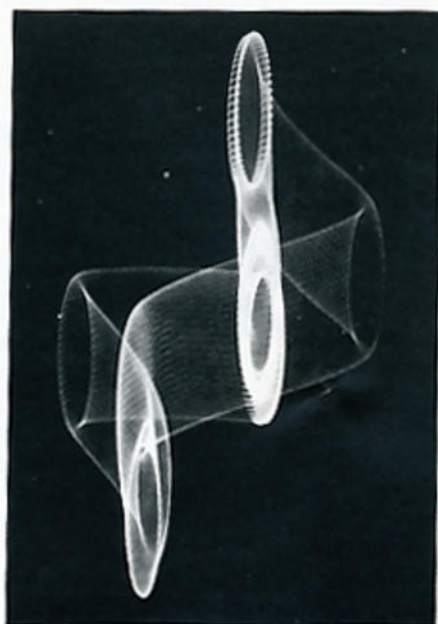
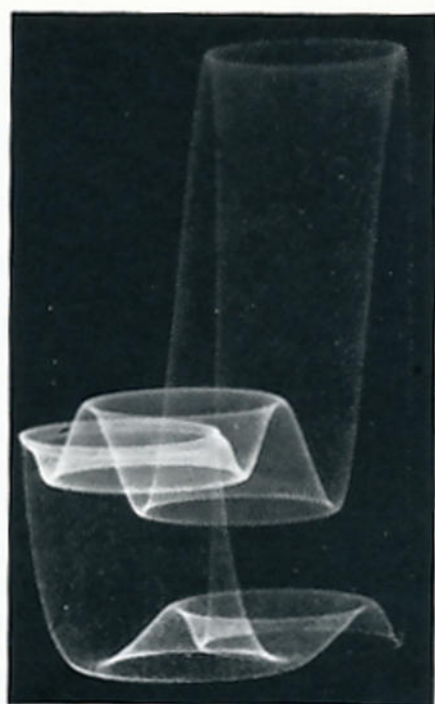
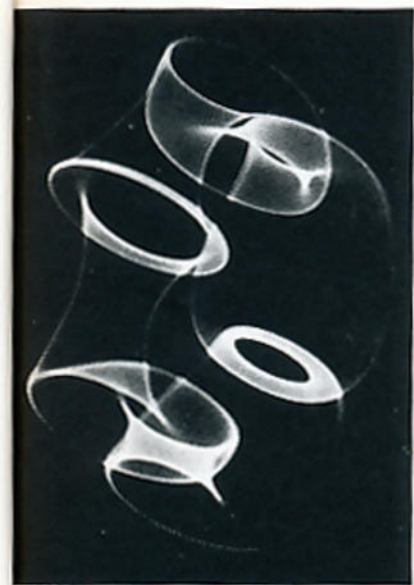
"Sinnbild der Chemie", published by Basilius Presse, Basel, 1967 and H. Moos, Munich 1968.

"Computergraphik – Computerkunst", published by F. Bruckmann, Munich 1971.

"Apparative Kunst" in collaboration with Gottfried Jäger, published by DuMont Schauberg, Cologne 1974.

HERBERT W. FRANKE: "Elektronische Grafiken" – electronical graphs with the aid of an analog computer and a cathode-ray oscillograph. The creation is produced on an operator's console and mixed under visual control.

Address  
Pupplinger Au  
8195 Puppling 40  
Germany



Six pictures, instantaneously configured and continually modified on a screen of a cathode-ray oscillograph.

## HEIN GRAVENHORST – CURRICULUM VITAE

1937 born in Germany.

Study: Photography and graphic design in Berlin; state examination.

1956 First experimental photography, stimulated and supported by his parents.

1957–60 Study of film technics in well known productions in Berlin and Munich.

1960–62 Works on films and graphs.

1962–63 Head of a trick film production.

1963–69 Owner of a studio for "foto-graphic-design" near Stuttgart; works for Ciba, Thomae, Scheering, Zeiss.

Since 1964 Visual experiments on reflex rotations and translations, exhibitions, and publications.

Since 1965 Theoretical research on basic problems of visual esthetics, information esthetics, and fundamental research on cybernetic esthetics by Herbert W. Franke; new visual experiments, methodic-systematic generation of picture structures, serial transformations with new photo-mechanic procedures.

Since 1968 Collaboration with the artists Kilian Breier, Pierre Cordier, and Gottfried Jäger in the group "Generative Fotografie"; first common exhibition in the "Kunsthaus", Bielefeld; further exhibitions and publications in Germany and foreign countries.

1970–76 Lecturer of photo design and visual communication at the "Fachhochschule", Kiel.

### EXHIBITIONS

1964 Stuttgart, Tübingen, Zurich.

1965 Emden, University of Colorado, Brussels.

1966 At the "Photokina" fair in Cologne; Biberach/Riß.

1967 Hanover.

1968 "Generative Fotografie", inaugural exhibition, Bielefeld; "Technische Universität", Berlin; Jihlava; Rochester; MIT, Massachusetts.

1969 Zagreb; Karlsruhe.

### PUBLICATIONS

1962 "DU", published by Conzett und Huber, Zurich.

1965 "Gebrauchsgraphik", published by F. Bruckmann KG, Munich; "Kunst heute – Personen, Analysen, Dokumente", edited by Jürgen Claus, published by Rowohlt in the series "Rowohlts Enzyklopädie".

1966 "Camera", No 2/1966, Luzern; "et 2" and "et 3", "edition et", published by Grützmaier, Berlin.

1967 "Photography of the World", published by Heibonsha, Tokyo; "Phänomen Kunst" scientific basis of esthetics, edited by Herbert W. Franke, published by Nadolski, Stuttgart-Moos and Munich.

1968 "Generative Fotografie", in collaboration with Gottfried Jäger, published by the authors; "Camera", No 5/68, Luzern; "Internationale Phototechnik", published in Munich; "Naturwissenschaft und Kunst" published in the congress catalogue of the University of Hamburg.

1969 "das deutsche Lichtbild", published by Dr. Wolf Strache, Stuttgart.

1973 "Apparative Kunst" in collaboration with Herbert W. Franke and Gottfried Jäger, published by DuMont Schauberg, Cologne.

1975 "Generative Fotografie" in collaboration with Gottfried Jäger and Karl M. Holzhäuser, published by Otto Maier, Ravensburg.

### TV

1968 "Fotografie zwischen Wissenschaft und Kunst", TV-film in collaboration with Herbert W. Franke, Hajek Halke, Gottfried Jäger, Manfred Klage, produced by NDR.

HEIN GRAVENHORST: Photo-mechanical transformations. Forms with a distinct outline which originate from simultaneous actions of technical and theoretical elements:

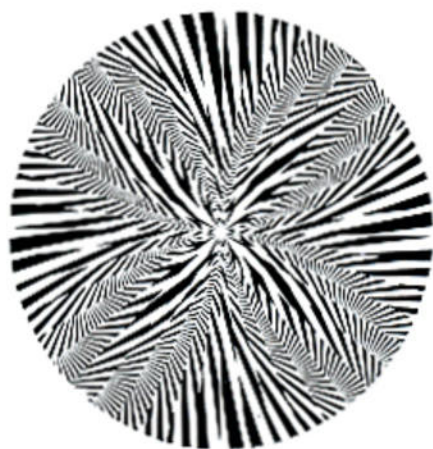
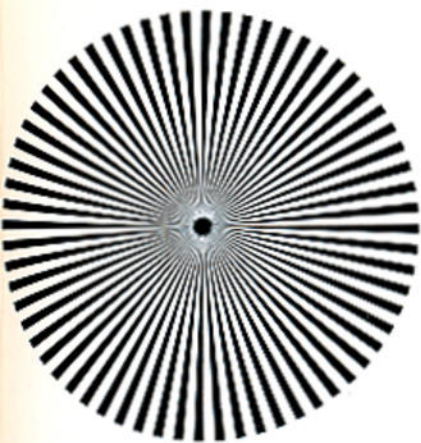
- A. 1. mathematical and geometrical laws.  
2. esthetical laws.
- B. 1. optical procedures and photo-mechanical reactions.  
2. system of coordinates with a rotating component.

The altering results between the data of the problem and the technical and theoretical elements permit the use of a plan (program). Its realization (operation) and incorporation, anticipated by control, work retroactively and modify the problem until its maximum.

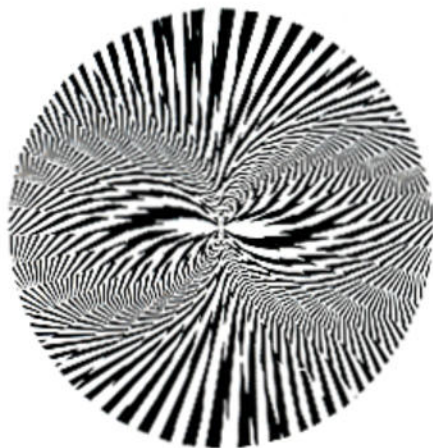
### Address

Sophienblatt 48a  
2300 Kiel  
Germany

Hochschule für Gestaltung  
Lorentzendam 6/8  
2300 Kiel  
Germany



Symmetric basic motif, performed by rotation.



Six examples of transformations.

# KARL M. HOLZHÄUSER – CURRICULUM VITAE

1944 born in Gardelegen.

Study: Photographer apprenticeship; studies at the "Werkkunstschule", Darmstadt, "Werkkunstschule", Saarbrücken, "Hochschule für Bildende Künste", Hamburg, and "Institut für visuelle Kommunikation" by Kilian Breier, Prof. Michel, Max Bense, Bazon Brock.

1962–65 Works on possibilities of estrangements in technics, artistic structures, double and multiple exposures; different publications in exhibition catalogues of several museums in Berlin.

1966 Works on motion photograms and photo documents.

1967 Optic-mechanical research work; besides adviser for advertising photo concepts.

1967–69 Works on chronophotometrics, a series of photo documents; first works on optic-mechanical research; research work on forms of photo representation for the publicity of an industrial plant in Hamburg; on request: photo documentation, showing the aims of the public library in Hamburg; photos for the fashion magazine "Für Sie".

1969 Advertisement photographer in Nuremberg.

Since 1969 Art Director of Photography at the "Vogel-sänger Studios" near Bielefeld; conception for a series of photos for magazines and publications.

Since 1970 Professor of Photography at the "Fachhochschule", Bielefeld, advertisement designs.

Since 1971 Lecturer.

Since 1975 Professor of Photo Design at the "Fachhochschule", Bielefeld.

## EXHIBITIONS

1965 "Sehen", "Volkshochschule", Cologne; "Musée des Arts Decoratifs", Zurich; "Werkkunstschule", Saarbrücken.

1967–69 "Projekt Mr. X" at the "42. Bundestag" of the BDA at Hanover; "Bauzaun Hamburg", direction and documentation of a public drawing action at an underground building site in Hamburg; on request new conception and realization of exhibitions for the Stock Exchange and the Chamber of Trade and Commerce in Hamburg.

1968 "Fotografie elementar", "Volkshochschule", Cologne.

1970 "Fenstergalerie", Bielefeld; "3. Kunstmarkt", Göttingen; "Galerie Die Brücke", Vienna; "Galerie Debatte", Berlin, personal exhibition; "Galerie Latin", Hamburg, personal exhibition.

1972 "Mechano-optische Untersuchungen", "Galerie Latin", Hamburg.

1973 "Canadian Computer Show", Toronto; "Die Bedeutung der Fotografie im Leben der Menschen", "Museum für angewandte Kunst", Vienna.

1975 "ICCH/2, Computer Graphics and Art", University of Los Angeles; "Generative Fotografie", "International Cultureel Centrum", Antwerpen; "Recherches mécano-optiques", "Galerie Le Disque Rouge", Brussels; "Fotografie als Kunst, Kunst als Fotografie", "Maison Européenne de la Photographie", Châlon-sur-Saône.

1976 "Dokumente, Illustrationen, Experimente", "Galerie der Deutschen Gesellschaft für Photographie", Cologne.

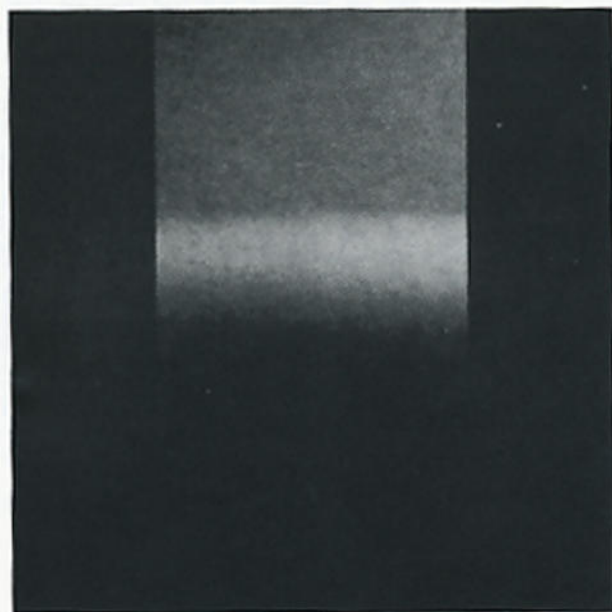
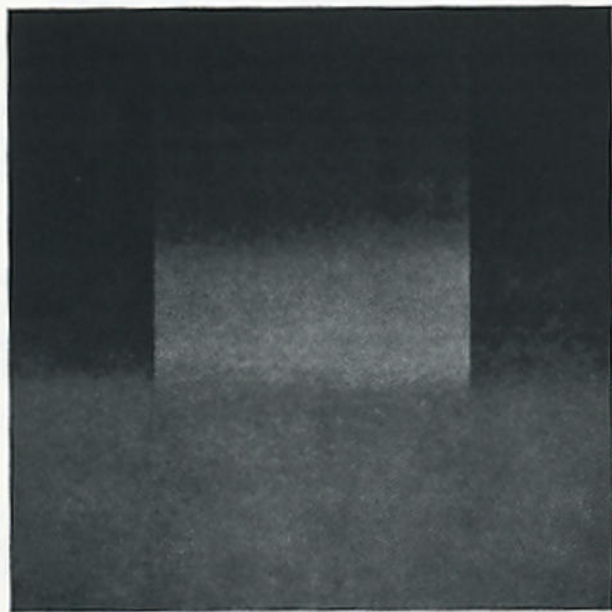
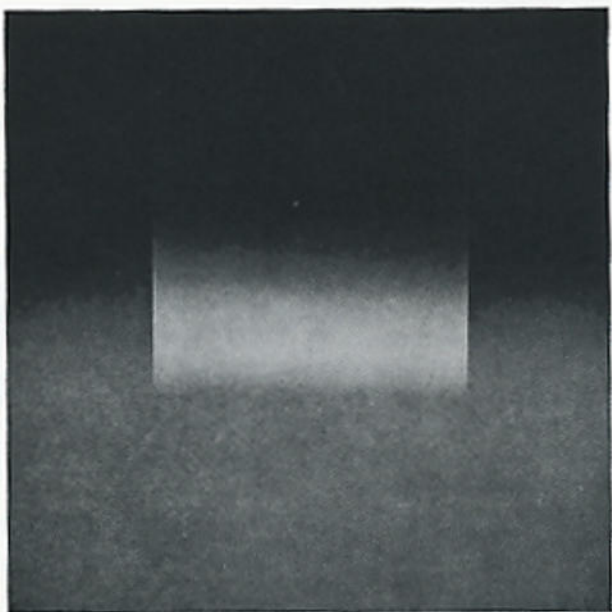
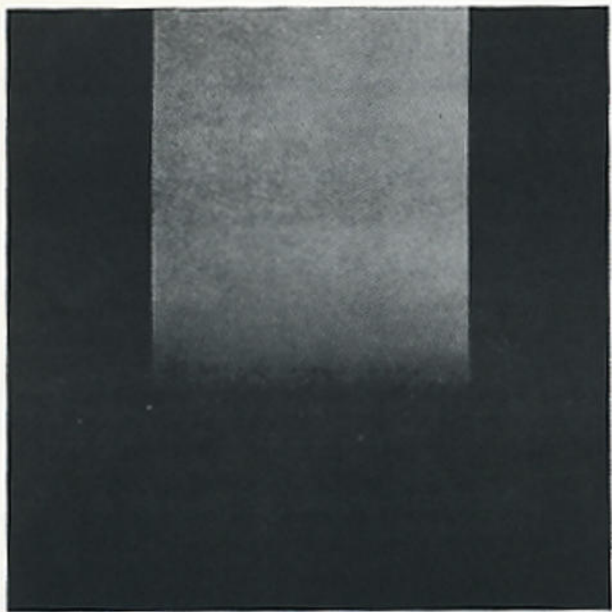
## PUBLICATIONS

1972 "Mechano-optische Untersuchungen", published in the periodical "Color", No 8/1972, Munich.

1975 "Mechano-optische Untersuchungen", published in the periodical "Camera", No 2/1975, Luzern; "Generative Fotografie, Theoretische Grundlagen, Kompendium und Beispiele einer fotografischen Bildgestaltung", in collaboration with Gottfried Jäger, published by Otto Maier Verlag, Ravensburg.

KARL M. HOLZHÄUSER: Mechano-optical research. Study of superimpositions of coloured shadows of quadrangular stencils, which are fixed in irregular intervals within the optical axis of a projector.

Address  
Jüngststraße 6  
4800 Bielefeld  
Germany



Four examples of a research series (original pictures in colour).

# GOTTFRIED JÄGER – CURRICULUM VITAE

1937 born in Burg.

Study: Photographer apprenticeship at the "Staatliche Höhere Fachschule für Fotografie", Cologne.

Since 1960 Professor at the "Werkkunstschule/Fachhochschule", Bielefeld; works on photographic designs – textile designs and research work on several photographic procedures; further activities: counsels, visualisations, photographic designs and graphs for publishers, industrial plants, agencies; organization of several exhibitions with personal participation.

1964 Photos for "Roman" by Helmut Heissenbüttel, published by the author.

1966 First programmed series of pictures; photo-optical research with the aid of a camera with different diaphragms.

1968 Introduction of the item "Generative Fotografie", used as title of an exhibition in Bielefeld; first application of generative esthetics in photography by Max Bense; activities on problems of computer art.

Since 1971 Lecturer.

Since 1973 Professor of photography and film at the "Fachhochschule", Bielefeld.

1974–76 Dean at the design section of the "Fachhochschule", Bielefeld.

## EXHIBITIONS

1966 "Fotografie zwischen Wissenschaft und Kunst", at the "Photokina" fair, Cologne.

1968 "Fotografie elementar", "Volkshochschule", Cologne; "Der Computer in der Universität", "Technische Universität", Berlin; "Experiments in Art and Technology", Brooklyn-Museum, New York.

1969 "nova tendencija", "Galeria grada", Zagreb.

1971 "Generative Fotografie", "Deutsches Kulturinstitut", Cairo.

1975 "Apparative Grafik", "Galerie Le Disque Rouge", Brussels; "Generative Fotografie", "Internationaal Cultureel Centrum", Antwerpen; "Apparative Grafik", "Galerie Jesse", Bielefeld.

## PUBLICATIONS

Since 1966 Participation at several conferences and publications about the professional education in photography.

1969 Program realization and participation at the annual congress of the DGPh "Deutsche Gesellschaft für Fotografie e.V.", Bad Godesberg.

1969 "Ausbildungswege zur Photographie", 12<sup>th</sup> textbook of the DGPh.

1971 "Ästhetische Aspekte der Photographie", report and publication about the annual congress of the photo section of the DGPh.

Since 1971 Editor of the communications magazine "Format".

Since 1971 Contribution to the fundamental insertion of generative photography, professional productions, studies.

Since 1972 "Ästhetische Aspekte der Fotografie" serial in the magazine "Color".

Since 1972 Member of the directing committee of the DGPh, member of the Association of German Graphic Artists, member of the Social Democratic Party of Germany (SPD).

1972 "Ausbildungswege zur Fotografie" and "Generative Fotografie" in the periodical "Format" No 1/2 1972, Karlsruhe; "Ästhetische Aspekte der Fotografie von morgen" in the periodical "Format" No 6/1972, Karlsruhe.

1973 "Apparative Kunst, vom Kaleidoskop zum Computer" in collaboration with Herbert W. Franke, published by DuMont Schauberg, Cologne.

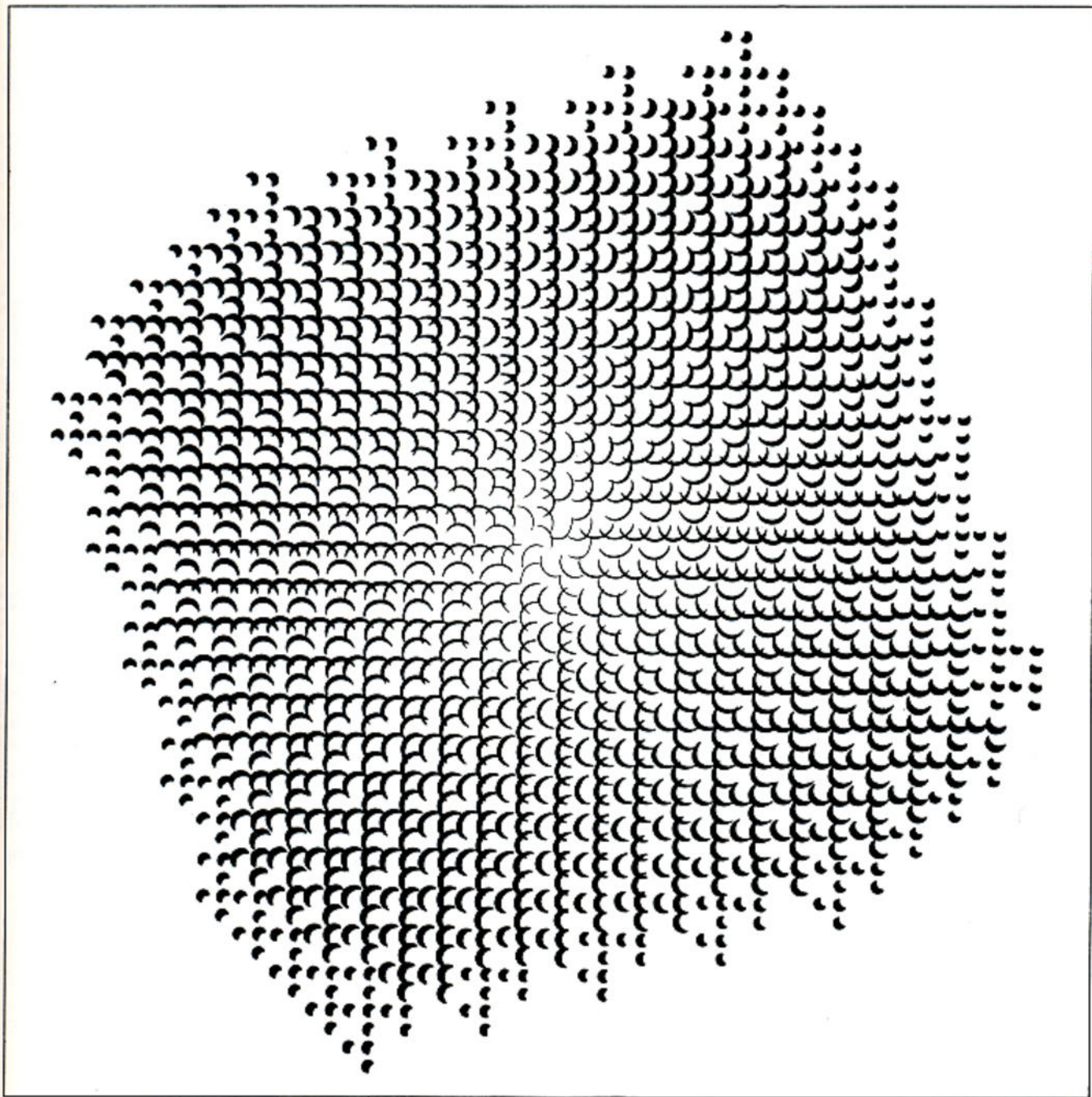
1975 "Generative Fotografie" in the periodical "Camera" No 2/1975, Luzern; "Generative Fotografie, Theoretische Grundlagen, Kompendium und Beispiele einer fotografischen Bildgestaltung", in collaboration with Karl M. Holzhäuser, published by Otto Maier Verlag, Ravensburg.

GOTTFRIED JÄGER: Diaphragm Structures. The principle of a "camera obscura" is used several times: spots, lines, luminous surfaces, etc. (design repertory 1) geometrically arranged will be photographed using diaphragms with a linear or a crossed structure (design repertory 2). The superimposing of the designs, limited by the object and the diaphragms, define the well determined structures.

The quality (colour, contrast) and the complexity (dispersion, density) of each structure as well as the succession of a series are performed automatically. The program corresponds to the composition of the designs, their angular position and their intervals, one in regard to the other. The optical devices and procedures can also lead to different structures or can be superimposed by disturbances.

Address  
Von-der-Recke-Straße 4  
4800 Bielefeld  
Germany





Apparative graph, diaphragm structure  
3. 8. 14. 3. 2. 2. - 1967.

# MANFRED MOHR – CURRICULUM VITAE

1938 born in Pforzheim.

Study: At the "Kunst- und Werkschule Pforzheim"; music (tenor saxophone, hautboy); mathematics and information.

Since 1963 in Paris; activities in esthetical information, mathematics, and program languages.

1968 Co-founder of the seminar "Art et Informatique", Paris.

Since 1969 Computer graphs.

1973 Prize-winner at the 10<sup>th</sup> Biennale, Ljubljana, and the World Print Competition, San Francisco.

## EXHIBITIONS

1965 "Noir et Blanc", "Galerie Paul Fachetti", Paris.

1966 "Divergenzen", "Galerie Margarete Lauter", Mannheim.

1967 "Concordancia de Arte", "Galerie Juana Mordo", Madrid.

1968 "1. Biennale Internationale de l'Estampe", "Musée d'Art Moderne", Paris; "Galerie Daniel Templon", Paris, personal exhibition.

1969 "Galerie Anne-Marie Verna", Zurich, personal exhibition; "Serigraphies", "Galerie La Hune", Paris, "Musée d'Art Moderne", Paris, "Galerie Intermedia", Heidelberg, "Salon de Mai", Paris.

1970 "Computer Graphics", "Bühmann Papier", Amsterdam; "Computer Graphics 70", London; "Generación Automática de Formas Plásticas", Madrid; "Computer Grafiek 1", "Galerie Mangelgang", Groningen; "Galerie Paul Fachetti, Zurich.

1971 "ARC", "Musée d'Art Moderne", Paris, personal exhibition; "Sicob", Paris, personal exhibition; "Galerie Mangelgang", Groningen, personal exhibition; "Galerie Weiller", Paris; "Arte y Cibernetica", Buenos Aires; "Kunstzone", Munich; "Arteonica", São Paulo; "2. Biennale", Nuremberg.

1972 "Galerie Swart", Amsterdam, personal exhibition; "Impulsos", "Instituto Alemán, Madrid, Barcelona, Bilbao; "L'Art et les Technologies Industrielles", Vitry-sur-Seine; "Kunstverein Pforzheim", Pforzheim; "Computerkunst und Musikalische Texturen", "Staatsgalerie, Stuttgart; "International Computer Art Exhibition", Montreal; "Cracap, Art et Technologie, Le Creusot", "Galerie Weiller", Paris; "Musik/Film/Dia/Licht Festival", Olympic Games, Munich.

1973 "Galerie Wahlandt", Schwäbisch Gmünd, personal exhibition; "Programm-Zufall-System", "Museum", Mönchengladbach; "10. Biennale de la Gravure", Ljubljana; "Grenzgebiete der Kunst", "Städtisches Museum", Schwäbisch Gmünd; "Tendencije-5", Zagreb; "Circuit", Michigan University; "Interact", Edinburgh Festival; "World Print Competition '73", San Francisco; "Ordinateur et Creation Artistique", "SESA", "Espace Cardin", Paris; "Contact II", "SIGMA", Bordeaux; "Computer Art Exhibition", Toronto; "Computer Grafiek", "Kunstverein", Laupheim; "Cybernetic Artrip", Tokyo.

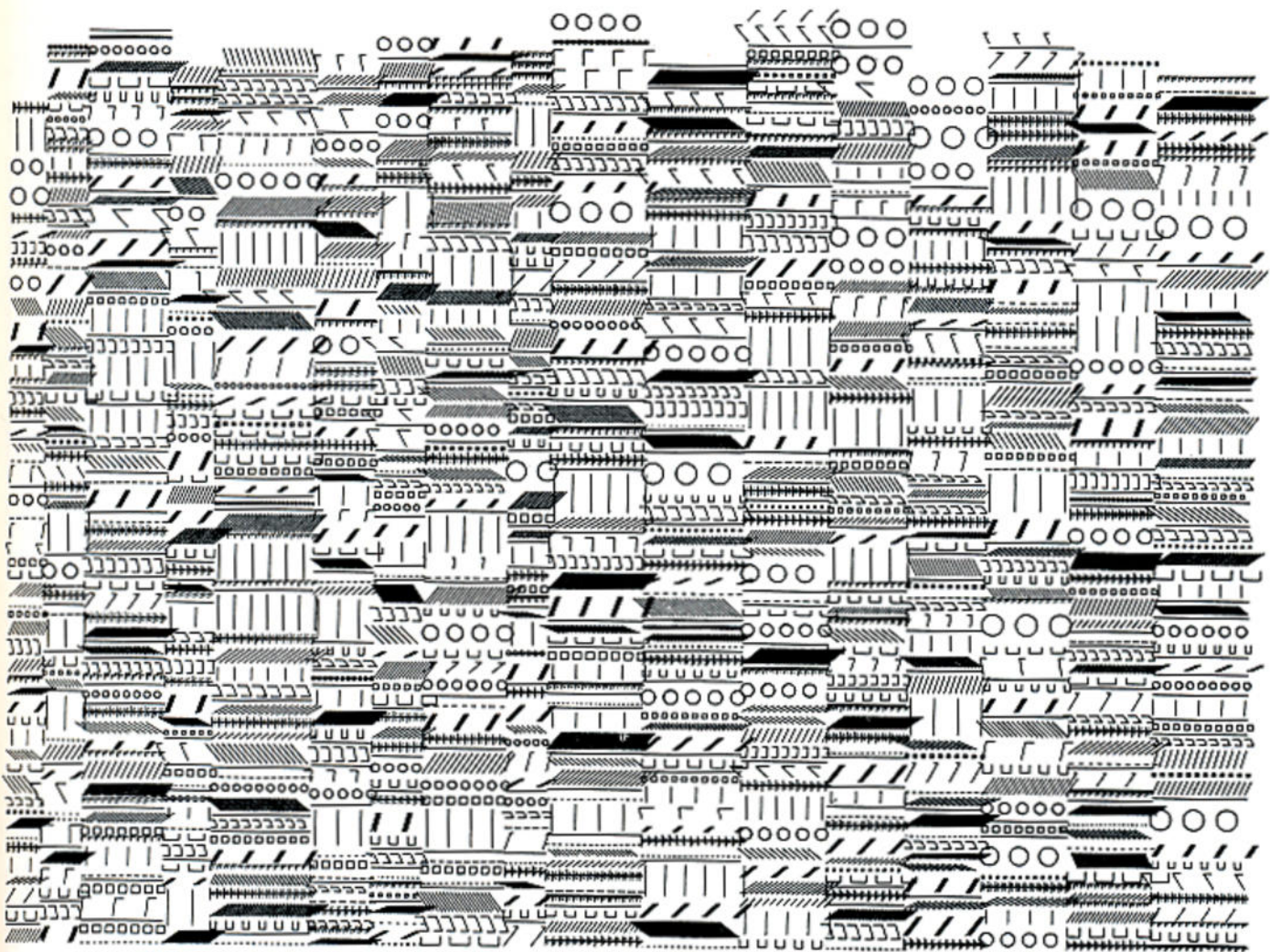
1974 "Galerie Weiller", Paris, personal exhibition; "Galerie Gilles Gheerbrant", Montreal, personal exhibition; "Instituto Alemão", Lisbon; "Miedzynarodowe Biennale Grafiki", Krakow; "Fourth British International Print Biennale", Bradford; "I.S.E.L.P. Art et Ordinateur", National Forest, Brussels; "International Computer Graphics", Polytechnic of London and Lucy Milton Gallery; "Multimedia Show", Bonn; "Bohun Gallery", Henly-On-Thames, Oxon; "Le Musée Cybernétique", "Musée d'Art Contemporain", Montreal; "International Computer Art Exhibition", Montreal; "Computer Arts '74", Tokyo; New School Art Gallery, New York.

1975 "Galerie Weiller", Paris, personal exhibition; "Galerie Swart", Amsterdam, personal exhibition; "11. Biennale de la Gravure", Ljubljana; "ICCH/2", Los Angeles; "Grafikbiennale", Vienna; "Second International Drawing Biennale", Middlesbrough; The Western Australian Art Gallery, Perth.

1976 "Galerie Mueller-Roth", Stuttgart, personal exhibition; "Galerie Media", Neuchâtel, personal exhibition.

MANFRED MOHR: Digital graphs. FORTRAN IV programs were processed on a CDC 6400 computer. The data were output on a Benson-Drawer. Most of the graphs are an arrangement of signs or elements of them, generated using the principle of controlled probability. The elements and their probable relations are selected with the aid of an "esthetic filtre", implemented in the program.

Address  
58 Bld. Latour-Maubourg  
Paris 7<sup>eme</sup>



Succession of signs – this picture is composed of successive columns with variable extent. The sum of the signs is fixed. Each column is filled with signs. The signs are organized according to a given logic.

# FRIEDER NAKE – CURRICULUM VITAE

1938 born in Germany.

Study: Mathematics, physics, philosophy.

1961–64 Assistant at the data processing center and part-time assistant at the Institute of Mathematics at the University of Stuttgart.

1964 Scientific assistant at the data processing center of the University of Stuttgart; works on the theory of probabilities, statistics, computer graphs and esthetics.

1965–66 Editor of the student's newspaper THS.

1967 Conferment of a degree of Dr. rer. nat. on a thesis of probabilities.

1968–69 Fellow of the National Research Council of Canada.

1972 Professor at the University of Bremen, section electrical engineering; works on topics of the technology of systems of instructions.

## EXHIBITIONS

1965 Stuttgart.

1966 Darmstadt, Recklinghausen, Munich, Stuttgart, Frankfurt, Dortmund.

1967 Zurich, Ulm, Montreal, Stuttgart, Marseille.

1968 Brno, Jehlava, Gottwaldov, Breitenbrunn, London, La Haye, Berlin, Stuttgart.

1969 Zagreb.

## PUBLICATIONS

1966 "Bemerkungen zur Programmierung von Computer-Grafik", Darmstadt.

1966 "futura 13", Stuttgart.

1967 "Computer-Grafik", published in the periodical "esthétique exacte", No 5/1967.

1967 "Künstliche Kunst", published in "Art and Cybernetics".

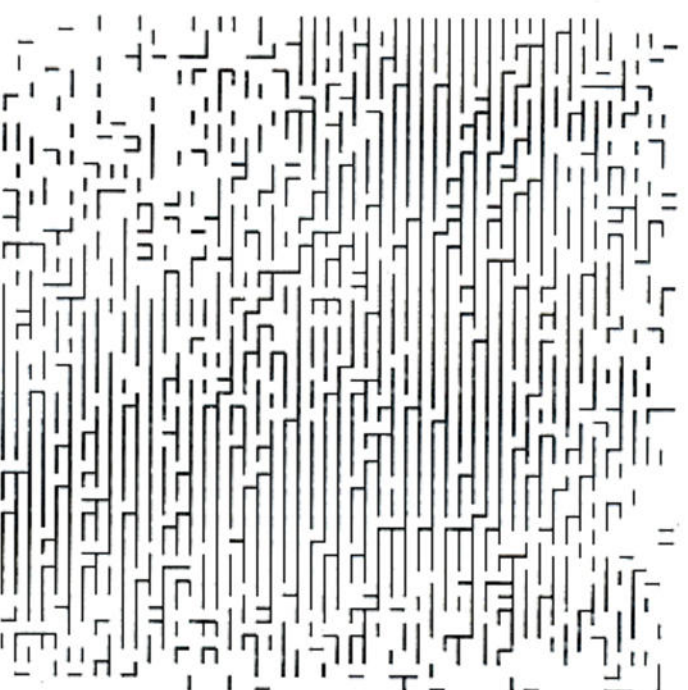
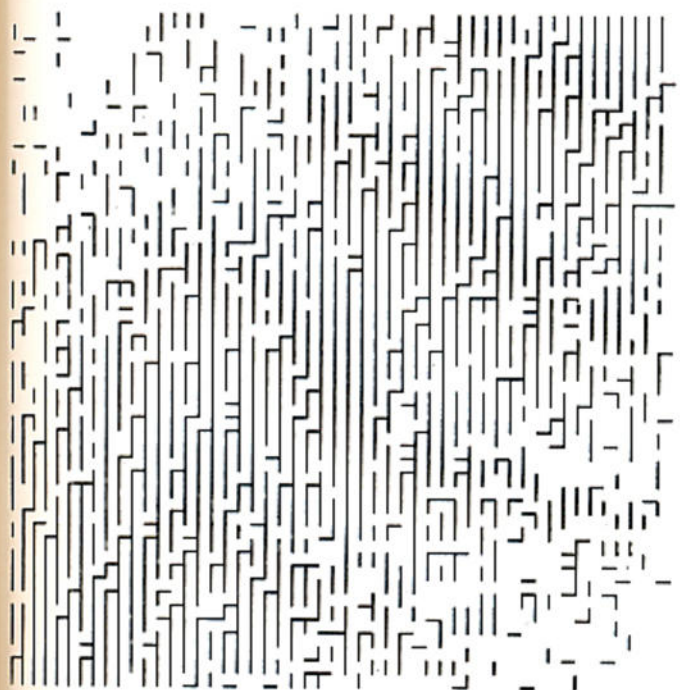
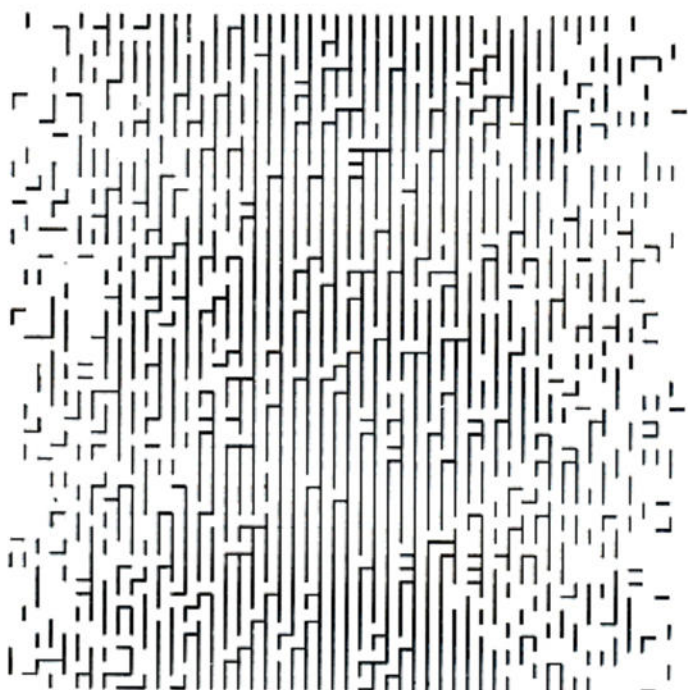
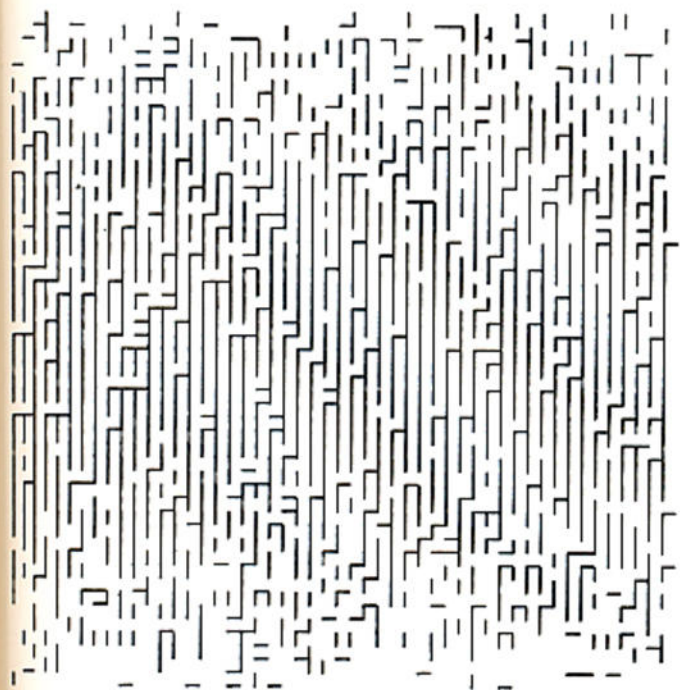
1967 "Matrizenmultiplikation", published by "Edition hj mayer", Stuttgart.

1968 "Herstellung ästhetischer Objekte mit Rechenanlagen", published in "Traitement de l'Information Non-numeric", published by Springer, Vienna.

1968 "Die Kunstproduktion als Entscheidungsprozeß", published in the periodical "bit international", No 2/1968.

FRIEDER NAKE: Digital graphs. One studies systematically the pictures stored in matrices. These elements are the signs which are distributed on a quadrangular network. This representation will be transformed, using the matrix calculation methods.

Address  
Brahmsstraße 4  
2800 Bremen  
Germany  
Universität Bremen, OBN  
2800 Bremen  
Germany



Four variations of one program. The distribution and arrangement of the elements change from one place to the other, depending on the sign used before, using a function of probability.

# GEORG NEES – CURRICULUM VITAE

1926 born in Nuremberg.

Since 1964 Works on problems of computer graphs.

1965 Introduction of a thesis about computer graphs at the chair of philosophy and theory of science at the University of Stuttgart by Professor Max Bense.

1968 Début of works on computer plastics.

1969 "Einsatz des Computers in der gestaltenden Architektur", in collaboration with Ludwig Rase; head of an informatics course at the University of Erlangen-Nuremberg.

## EXHIBITIONS

1965 "Studio-Galerie der Technischen Universität", Stuttgart, first exhibition showing computer graphs created with the aid of digital computers.

1968 "Cybernetic Serendipity", London.

1969 "Computerkunst – On the Eve of Tomorrow", "Kubus", Hanover.

1970 "Auf dem Wege zur Computerkunst", "Neues Kongreßhaus", Davos; "Biennale", Venice.

1971 "Biennale", Nuremberg.

## PUBLICATIONS

1964 "Computer-Grafik", published in the periodical "Grundlagenstudien aus Kybernetik und Geisteswissenschaft", Vol. 5/1964 No 3/4.

1964 "Statistische Grafik", published in the periodical "Grundlagenstudien aus Kybernetik und Geisteswissenschaften", Vol. 5/1964.

1964 "Variationen von Figuren in der statistischen Grafik", published in the periodical "Grundlagen aus Kybernetik und Geisteswissenschaften", Vol. 5/1964.

1965 "Computer-Grafik", published in the periodical "rot", No 19/1965.

1969 "Generative Computergrafik", Munich.

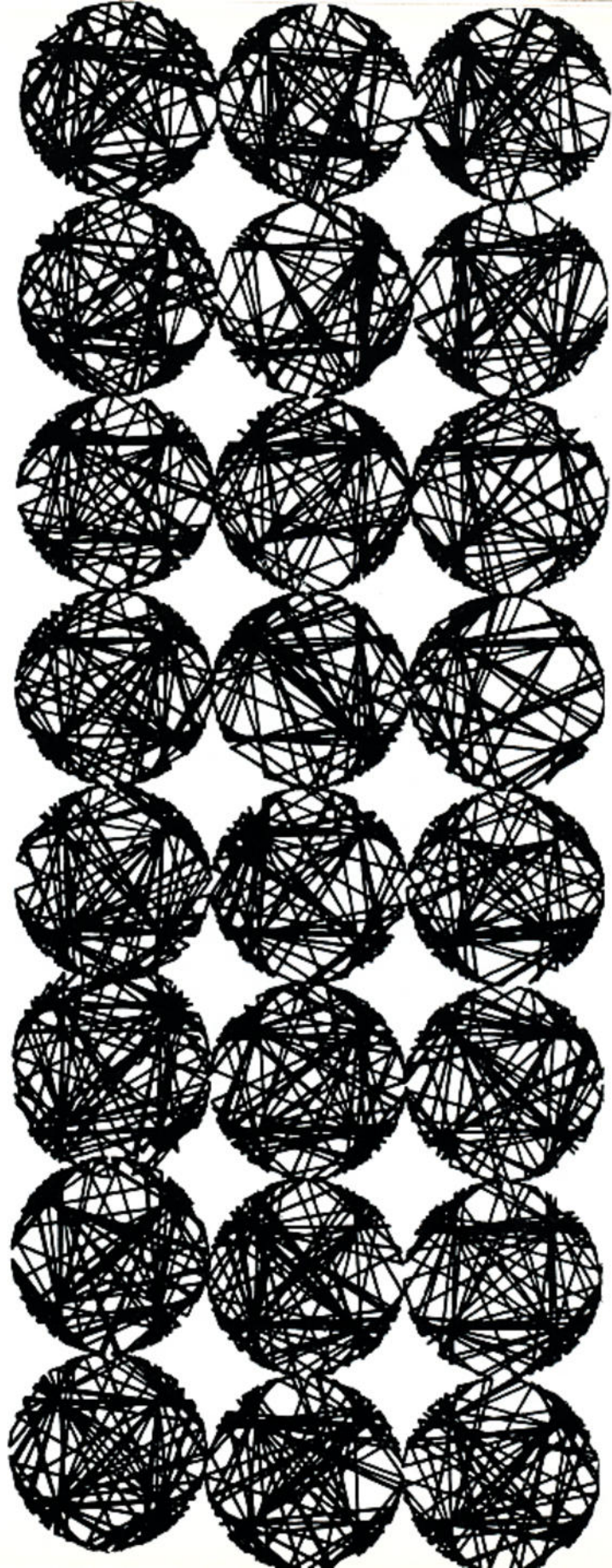
1969 "Vom bit zur dritten Dimension", published in the periodical "data report", Vol. 4 No 1/1969.

"Programming Stochastic Computer Graphics", published in the catalogue "Cybernetic Serendipity".

1968–70 "Computer-Grafik und visuelle Komplexität", published in the catalogue "Auf dem Wege zur Computerkunst", Kiel, and in "bit international", No 2/1968.

GEORG NEES. Digital graphs, created with a data processing system Siemens 4004 and output on a Zuse-Graphomat. The data are generated by a random number generator. One can study the statistical relations of a picture and their esthetical effects.

Address  
Siemens AG, Bereich Energietechnik  
Günther-Scharowsky-Straße 2  
8520 Erlangen 2  
Germany



Collection of forms. The same program is processed several times, always under the influence of probable alternations of data.



# LUDWIG RASE – CURRICULUM VITAE

1925 born in Nuremberg.

Study: Architecture at the "Technische Hochschule", Munich; received several prizes in architecture and urbanization competitions.

Since 1969 Activities on computer supported design in collaboration with Georg Nees.

## EXHIBITIONS

1970 "Biennale", Venice.

1971 "Biennale", Nuremberg.

## PUBLICATIONS

1970 "Computerkunst – Teil der konstruktiven Kunst", conference at the "Haus der Technik", Essen.

1970 "Ordinateur et Art", published in "Le traitement électronique de l'information", tome 12/1970.

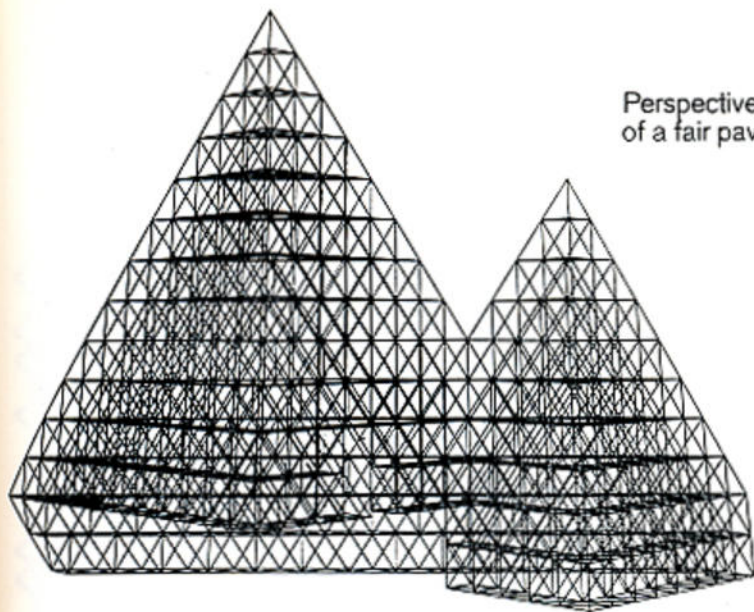
1970 "Konstruieren mit Hilfe des Computers", published in the periodical "Deutsche Bauzeitung".

LUDWIG RASE in collaboration with GEORG NEES: Computer architecture. The solutions of architectural problems of certain constructions with basic elements will be solved by program controlled research with the aid of computers. A computer controlled output device draws selected results in any perspective.

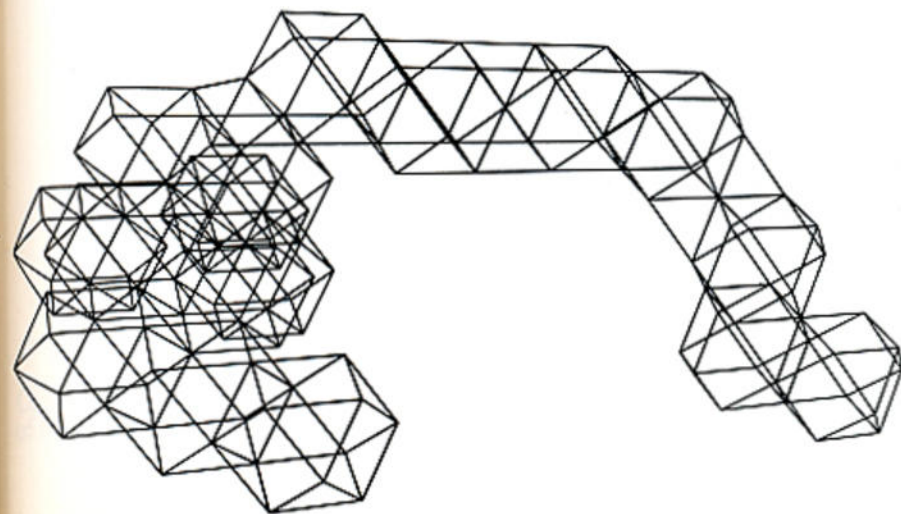
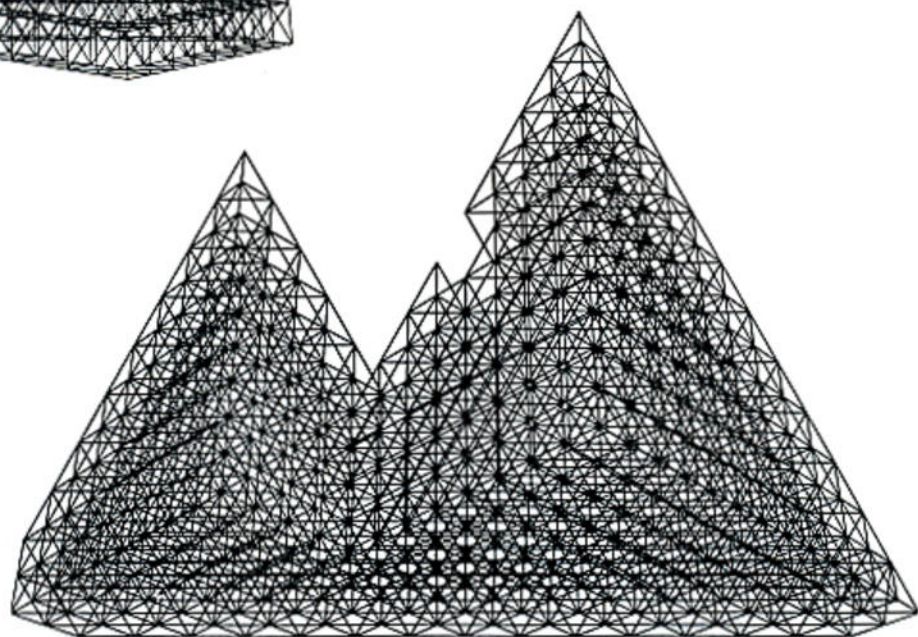
Address  
DIM (Design Institut München)  
Augustenstraße 38–42  
8000 München 2  
Germany



Perspective view of an elementary structure  
of a fair pavilion.



Ground plan of the pavilion.



Structure of basic residential elements.

# KARL SIEBIG – CURRICULUM VITAE

1947 born in Germany.

Study: "Fachhochschule für Gestaltung", Kiel, state examination in 1974.

1970 Activities on the theory of information and artistic cybernetics.

1971 Research work on generative photography; photo-mechanical transformations of computer graphs.

1970–71 Survey of the results in an elaboration: introduction to theoretical aspects of the creation of new visual structures with the aid of computers and programmed phototechnical procedures.

1972–73 Research work on semantic structures using generative procedures.

1974 Research work on semiotical theories with regard to icones and symbols.

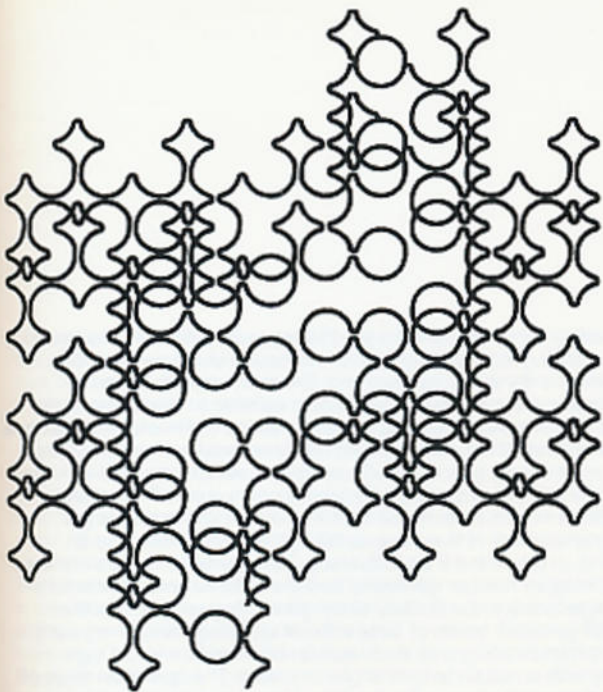
1974–75 Assistant at the "Fachhochschule für Gestaltung", Kiel.

Since 1975 Study at the "Deutsche Film- und Fernsehakademie", Berlin.

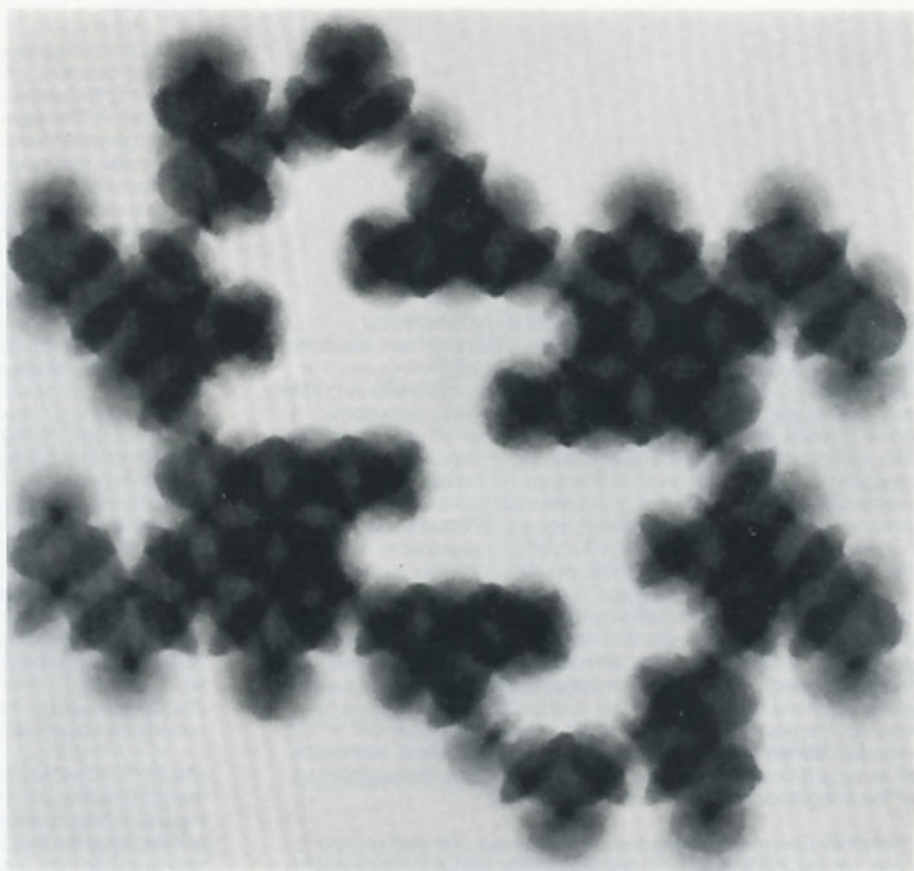
KARL SIEBIG: Transformations realized by a computer with the program system DRAKULA (Herbert W. Franke) with the aid of a photo-optical procedure.

Address  
Am Großen Kamp 32  
2350 Neumünster  
Germany  
at present:  
Riemannstraße 3  
1000 Berlin 61  
Germany

Elementary form of a computer graph.



ART AND COMPUTERS



Optical transformation  
of the same graph.

# ART AND COMPUTERS

Not long ago, computers were discovered as new technical instruments which affect artistic creations. The result was electronic art – a very controversial subject – which, in its beginning, was tied to the conventional forms of expressionism, especially in graphic arts, poetry, and music. But nowadays new sensitive evolutions come forward, leading to a new unknown domain of great promise. The application procedure is always the same: a program must be designed which is made up of instructions for certain logical and mathematical catenations the computer must realize. At this point we already face a particularly significant aspect: of course it is necessary to have a picture of the formal and quantitative mode and the structure of the wanted esthetic creation, whether it is a graphic representation, a poem, or a piece of music. When the artist gets to this point he has a wide range of programming languages at his disposal, like a universal notation. At first the results of the arithmetic procedures are situated in the abstract symbolism of magnetic tapes and punch cards. This information controls the output devices: plotter (derived from to plot, in this context to draw a diagram, to connect the point-by-point coordinate values), teletypewriter, vocoder (device for acoustic output), etc. An immediate instruction of an output device, supported by a computer, was the beginning of the integration of art in modern technology.

**GRAPHS.** Computer graphs can be performed with plotters and other reproductive electronic systems which have a certain resem-

blance to conventional TV-sets. The manual realization of a design or a drawing lasts several minutes or hours. Using an electronic device it is done in a split second. The extraordinary speed of automatic reproduction is particularly suitable to comprehend the logic of the process leading beyond a series of structures or patterns to an individual sequence of pictures: successive changes during the projection, e.g. on a screen, animated designs created with the aid of a computer, games with graphs on a screen. The possible applications are determined by the structure of the respective programs: most of them are variable; they do not describe an individual graph but a total diversity. These programs are processed by a random number generator and the data reserve accidental a storage location, particularly when generating program routines which generate series of data without any recognizable regularity. The program assigns to each accidental number a visual sign, a line with a certain length, angle, or colour. The operation mode of these programs permit the creation of any quantity of unforeseen structures.

**FILM.** Like computer graphs, computer films are also based on technico-scientific principles. The first computer film was created in 1963 by E. E. Zajac in the laboratories of the Bell Telephone Corporation. The film shows the movement of a satellite in the earth's gravitational field. Soon after this début, several artistic efforts were made, particularly by Charles Csuri, A. Michael Noll, Lloyd Sumner, John Mott-Smith, Georg Nees, and Ludwig Rase. These cineasts designed phase-pictures and assembled them into motion picture sequences using a computer controlled drawing device. The pioneer of computer motion pictures, John Whitney, made his début with experimental nonfigurative graphs in motion pictures. Later he went to IBM's scientific center in Los Angeles to learn the necessary technical know how. His favorite program is based on works of Jack Citron. John Whitney realized the basic material on a screen with the aid of a computer; he "colours" his films using an optical bench. The individual parts were assembled corresponding to their effects. The sons of John Whitney also have a certain reputation in making remarkable computer films e.g. "Mosaic of Binary Digits" by Michael Whitney. One of the most interesting programs in the domain of the development in cinematographics we owe to the suggestion of K. C. Knowlton. It is a kind of process based on the application of microfilms. The pictures are composed like a mosaic under a given characteristic pattern. The inventor used this process in many variations and other film-makers followed, particularly Lillian F. S. Schwarz with his film "Pixillation".

Vladimir Bonacić did it in a different way; he constructed a luminous screen. During a continual process the single compartments can be illuminated in symmetric positions of an extreme diversity. This diversity comprises such a wide range of configurations which nobody can ever evaluate.

**EVERYBODY CAN PARTICIPATE.** Certain experiments which allow the participation of everybody in the creation of pictures resulted in an absolute nonacceptance of classical models. For this reason it is indispensable that the process is under visual control. That is only possible with the help of electronic screens. The easiest method

to practice it: the spectator can choose by pushing a button the characteristic values which are reserved by the program. The spectator takes the part of the random number generator. During a later phase it will be conceivable that the spectator is engaged in a kind of dialogue with the esthetic program and will be involved in a graphic game. In the more distant future when each household will be connected with an input and output device via a general computer network to a data processing center, as predicted by futurologists, there might raise up intellectual and creative rivalry again. The methods of large picture projection and the development created now will result in an augmentation of the effects. Back to the present time one can only find the modest beginnings in an attractive domain of great promise which is being realized at the moment. Using a program designed by Klaus Thomas, IBM Germany, the spectator pushes 8 numeric buttons. Thus he determines the outlines of a given picture on a screen which is composed of straight black and white lines. Everybody who wants to execute this picture for himself with the aid of a plotter is allowed to do so. Another possibility is a special graphic recorder, a device first developed by Helmut Schenk and Hans-Jürgen van Kranenbrock for use in medical scintilligraphy. This device is controlled by a punched paper tape. The perforated information describes a picture which can be drawn in several colours on the screen of a display. It is also possible to calculate the picture before with the aid of another computer. The graphic recorder is an "intelligent terminal" and so it is possible to change the pictures which are determined by the data and stored on a tape. One also can change point by point the realized mosaics on the continually coloured surface or the dot density of the ink ribbons. The colours can take place on each point of the chromatic scale. Finally it is possible to separate some of the sixteen standard colours. The artist can determine the effects of his creation; they are given by the program routines, the devices, and the possibility of further evolutions in the program area. Thus many attractive graphic and chromatic shades can be created all based on one basic motif.

**MUSIC AND GRAPHIC STRUCTURES.** The fact that the same programs and peripheral computer devices can be used for all applications mentioned above facilitates the combination of different representations. Thus it is possible to create at the same time e.g. music and graphic structures. This was achieved in particular by the group "Ars Intermedia" in Vienna under the direction of Otto Beckmann. In future it will be possible to create a centralized method of representation with several devices. A startling example is the program system SPASMO by Alan Sutcliffe à Bracknell which is controlled by magnetic tapes. It manages the projection of slides, the recitation of poems, etc. In 1969 the first show of this event took place in London, Queen Elisabeth Hall.

ART? As before this question is still unanswered today: are the manifestations written in this article due to the domain of art or not? Obviously the technical evolution does not care about this theoretic dilemma. It is of little importance how it may be called when new visual, audible, and sensible regions are conquered by technology. Its application in art will enrich the world and make it less prosaic and materialistic than it would be without.

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