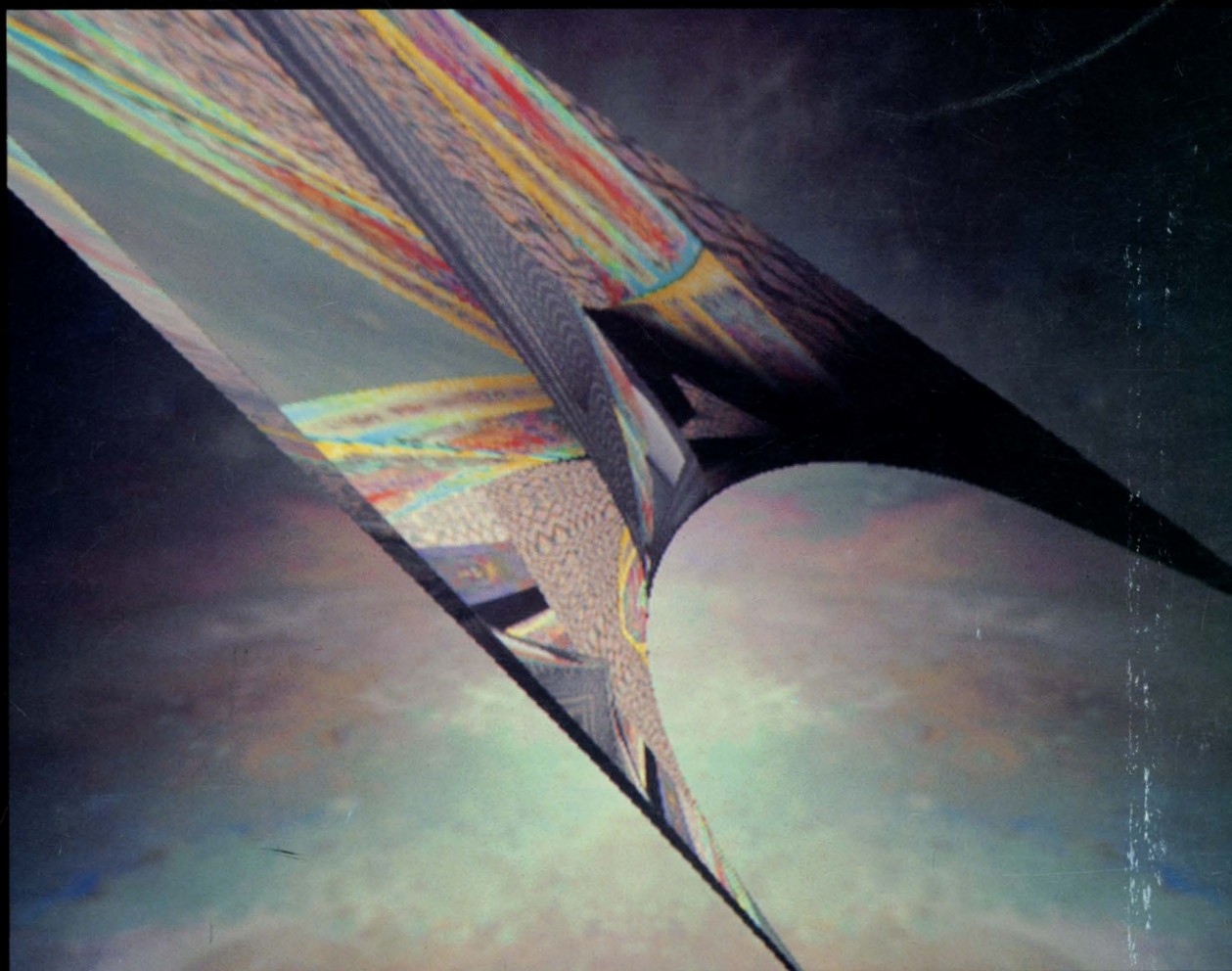


ACM SIGGRAPH 86

*13th Annual Conference
on Computer Graphics
and Interactive Techniques
Dallas Convention Center
Dallas, Texas
August 18-22, 1986*

*Sponsored by the Association
for Computing Machinery's
Special Interest Group on
Computer Graphics in
cooperation with the IEEE
Technical Committee on
Computer Graphics*

ART SHOW
CATALOG



ACM SIGGRAPH 86 ART SHOW

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Monochrome
Color

ESSAYS

Herbert W. Franke
John Whitney
Ken Knowlton
Frank Dietrich
Patric Prince

LISTS OF WORKS

Two-dimensional/Three-dimensional Works
Installations
Animations

1986 ACM SIGGRAPH ART SHOW: A RETROSPECTIVE

Since the mid-Sixties, computer art has been seen in museums and galleries world-wide, with several recent major exhibitions. However, the pieces shown were usually the artists' newer works.

It is appropriate and pertinent at this year's exhibition to show computer-aided art in the context of that which went before. The 1986 art show traces the development of computer art over the past twenty-five years through the work of artists who have been involved with it from its inception.

The 1986 art show is the fifth exhibition of fine art that ACM SIGGRAPH has sponsored in conjunction with its annual SIGGRAPH conference.

Patric D. Prince

ACKNOWLEDGMENTS

I thank Louise Ledeon for her support and advice, the Art Show committee for their billions and billions of donated hours, and the nucleus of dedicated volunteers who have worked diligently to produce this art show.

ARTWORKS AND ANIMATION MATERIALS HAVE BEEN LOANED BY THE ARTISTS AND

Dr. Prof. Herbert W. Franke, Puppling, West Germany
John Landsdown, Computer Arts Society, London, England
Greg McFarlane, Evans and Sutherland, Inc., Salt Lake City, Utah
Oliver Strimpel, Computer Museum, Boston, Massachusetts

POST-PRODUCTION FACILITIES PROVIDED BY

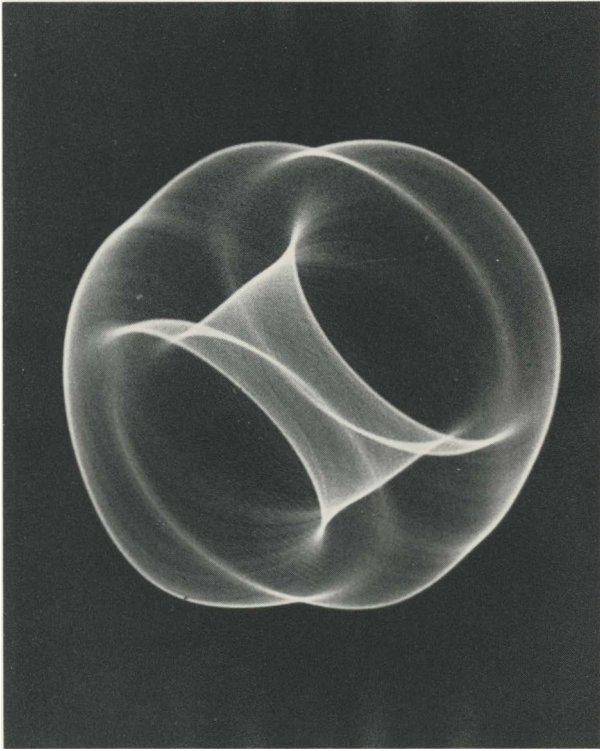
McDonnell-Douglas, Douglas Aircraft Company,
Motion Picture/Video Production Division,
Nathan Simmons

COMPUTERS AND SUPPORT PROVIDED BY

Apollo Computers, Chelmsford, Massachusetts
AT&T, EPIC Center, Indianapolis, Indiana
Chuck Kozak, Aurora Systems, San Francisco, California
Commodore-Amiga, Los Gatos, California
Electronic Arts, San Mateo, California
Island Graphics, Sausalito, California
Kurta Corporation, Phoenix, Arizona
Lufthansa Airlines, West Germany
Newtek, Topeka, Kansas
Silicon Graphics, Mountain View, California

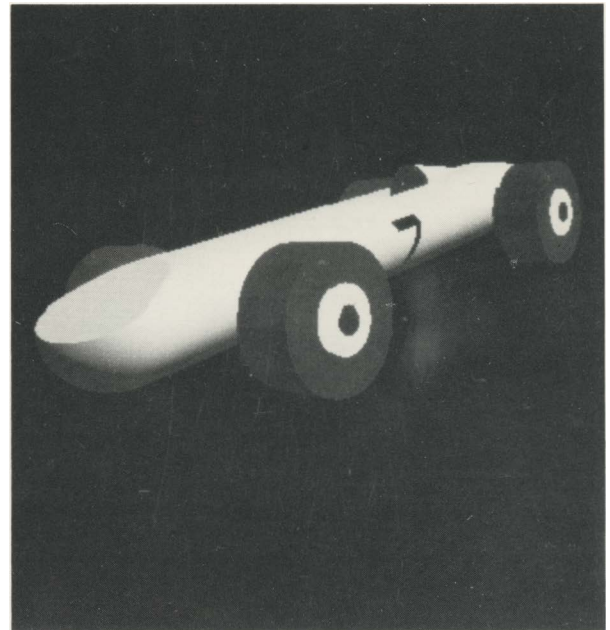
TECHNICAL ASSISTANCE

Neal Handly
Robert E. Holzman

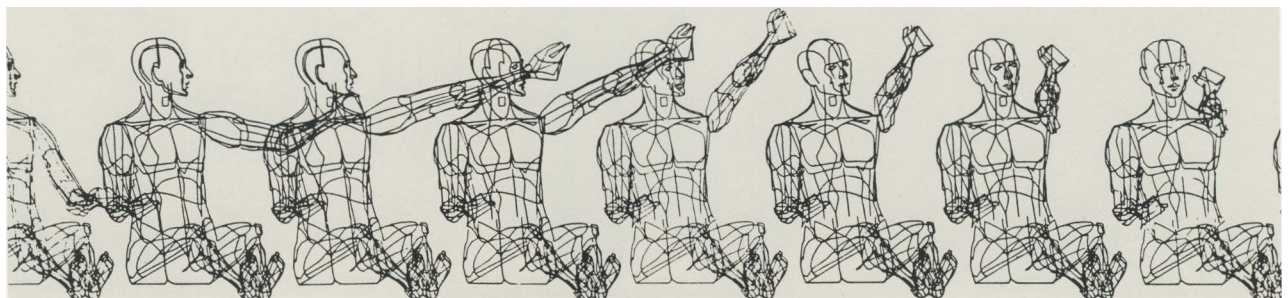


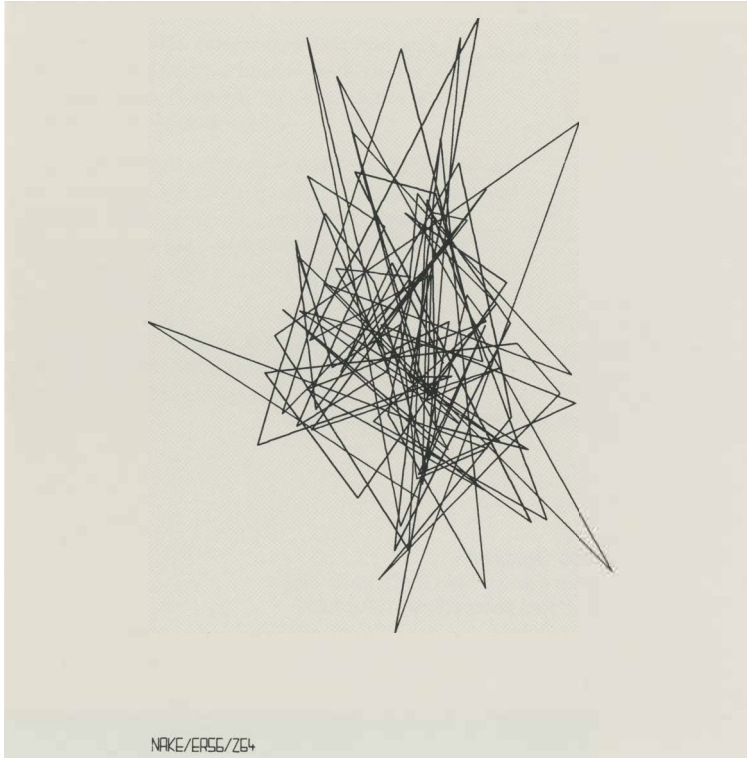
Ben Laposky
Oscillon 40 1952
 Photograph of analog screen 11 x 14"

Bob Goldstein
Race Car for MAGI film circa 1968
 Polaroid photograph 3.25 x 4.25"

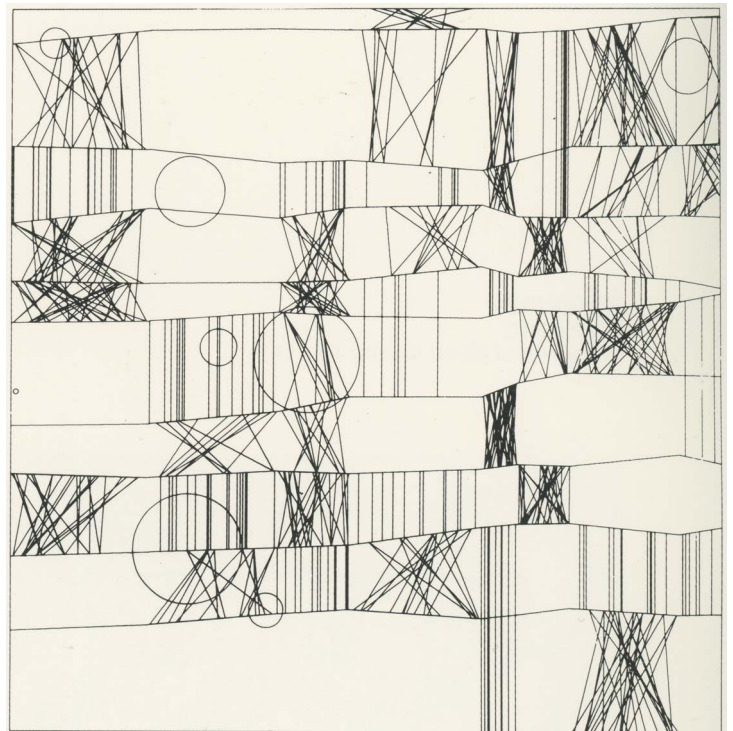


William Fetter
H32569 1962
 Photograph of plotter drawing 8.5 x 11"

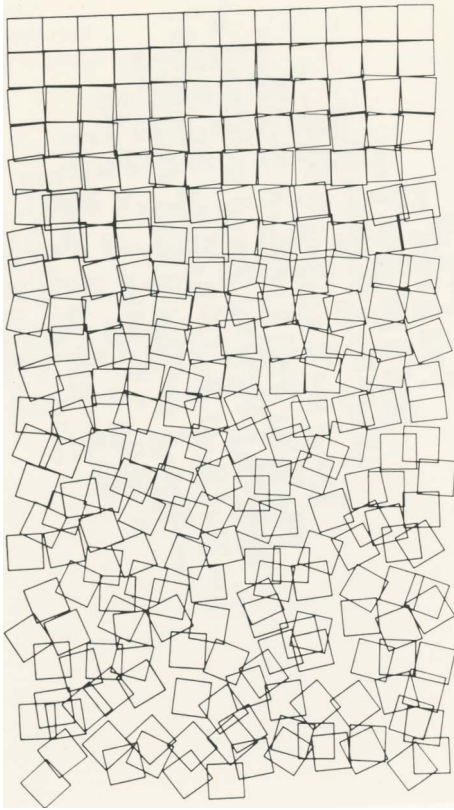




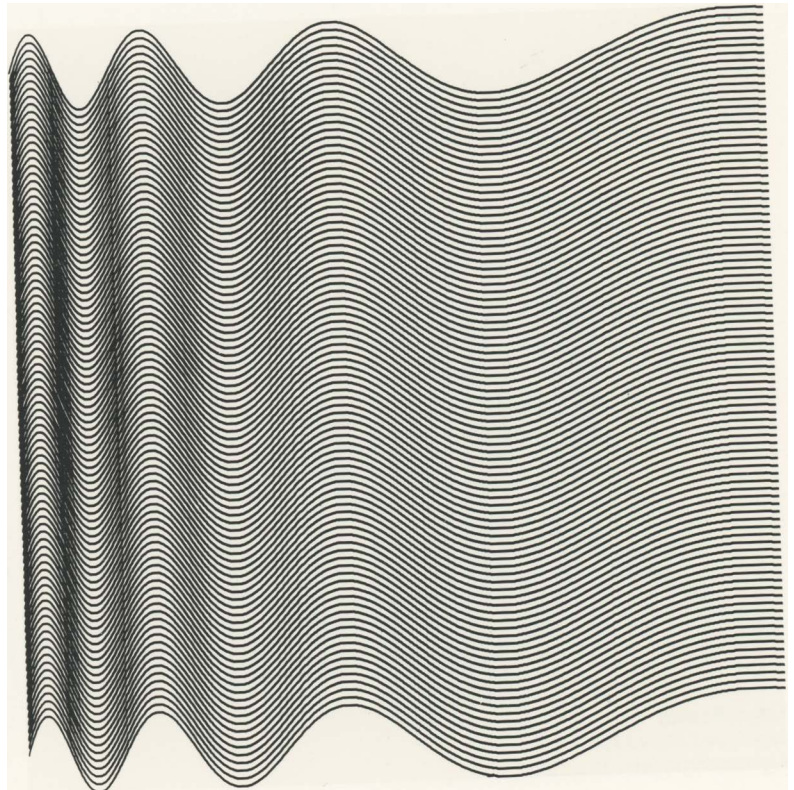
Frieder Nake
Random Polygon 1963
 Photograph of plotter drawing 8 x 6"



Frieder Nake
Hommage to Paul Klee 1965
 Serigraph 20 x 20"



Georg Nees
Gravel Stones 1966
 Serigraph 39 x 28"

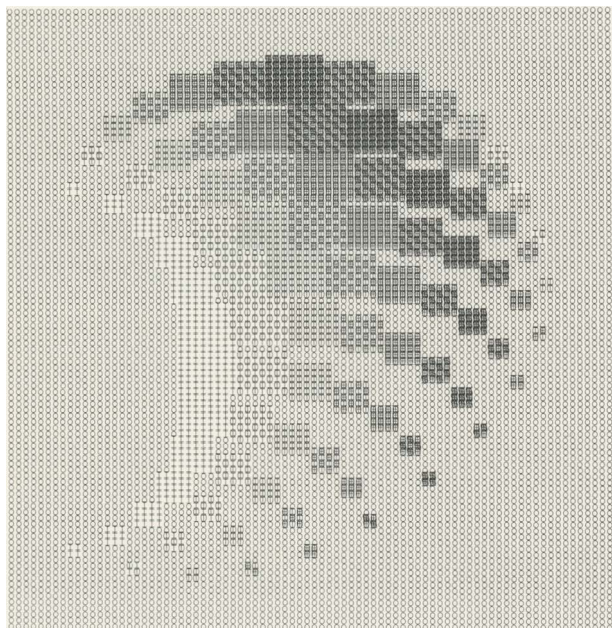
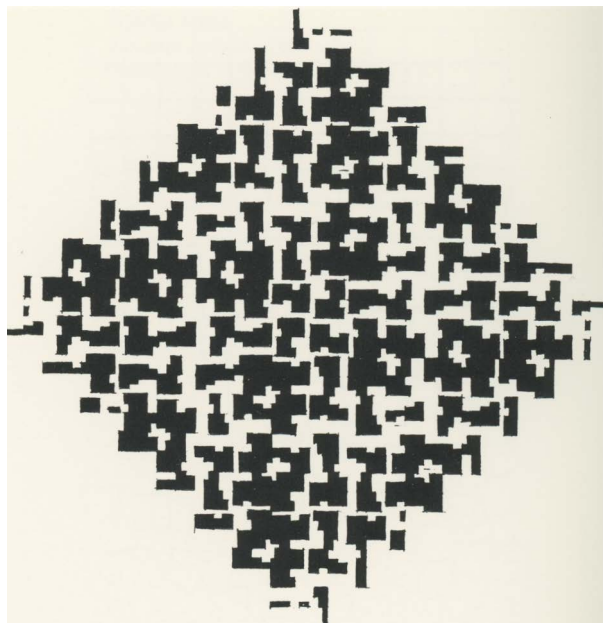


A. Michael Noll
*Ninety computer-generated sinusoids with
 linearly increasing period* 1965
 Photograph of plotter drawing 8.5 x 11"

Klaus Basset

*Symmetrische Durchdringung gerader und
ungerader Reihen* 1963

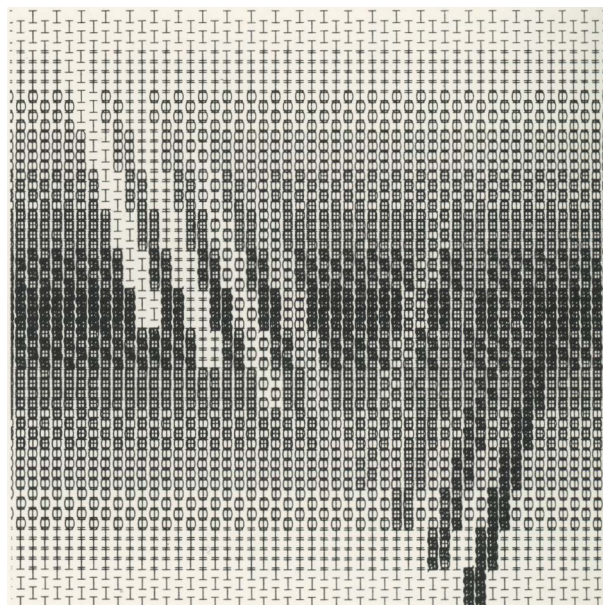
Drawing 6 x 6"



Klaus Basset

Osliper Fächer 1981

Alphanumeric print 12 x 12"

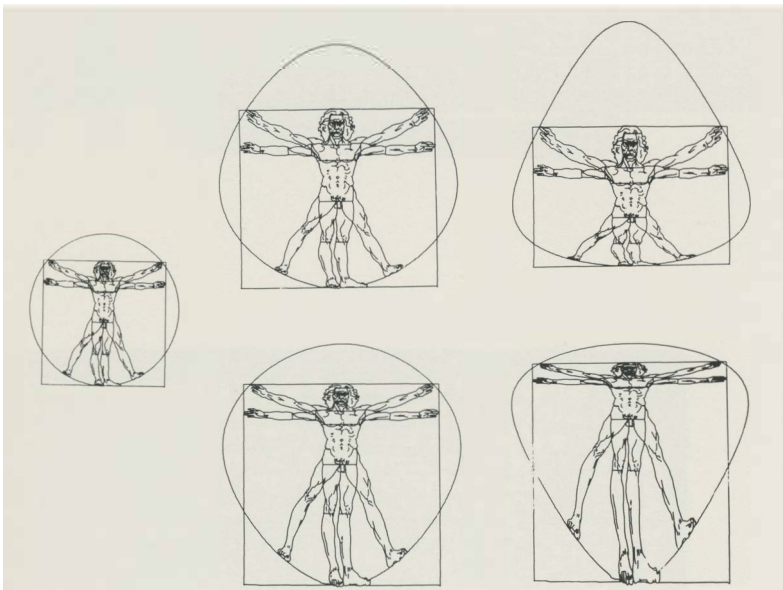
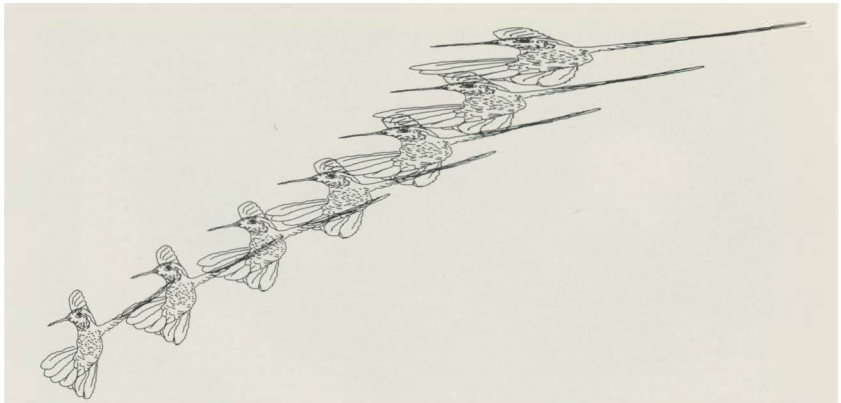


Klaus Basset

Layers and Steps I 1985

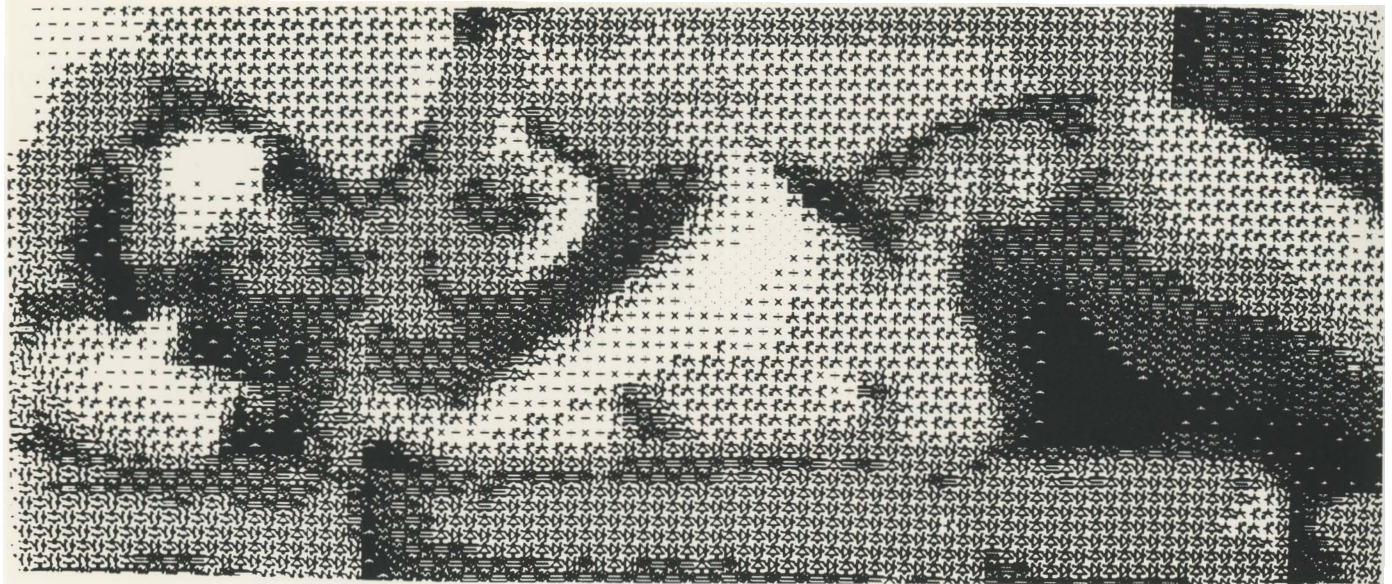
Alphanumeric print 12 x 12"

Charles Csuri
Hummingbirds 1966
 Photograph of plotter drawing 8.5 x 11"



Charles Csuri
Leonardo Man 1966
 Photograph of plotter drawing 8.5 x 11"

Charles Csuri
Sine Curve Man 1966
 Photograph of plotter drawing 8.5 x 11"



Kenneth Knowlton, Leon Harmon
Nude (Study in Perception) 1966
 Alphanumeric print (original 30 x 144")

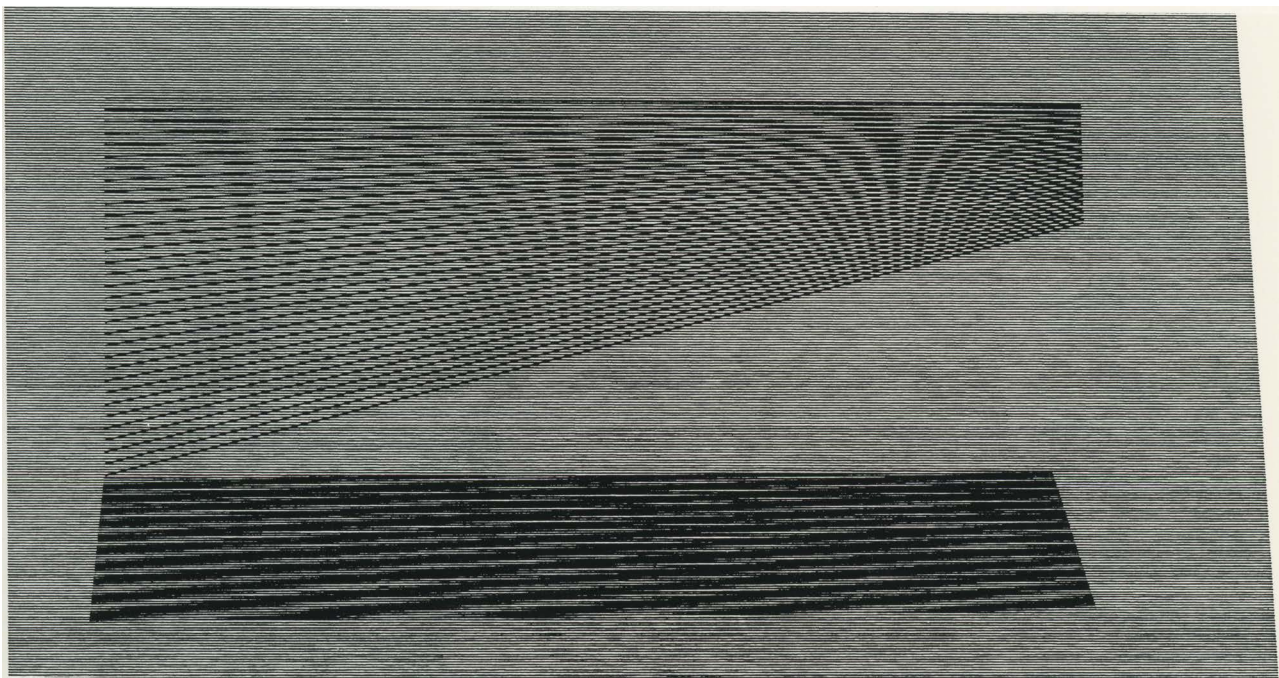


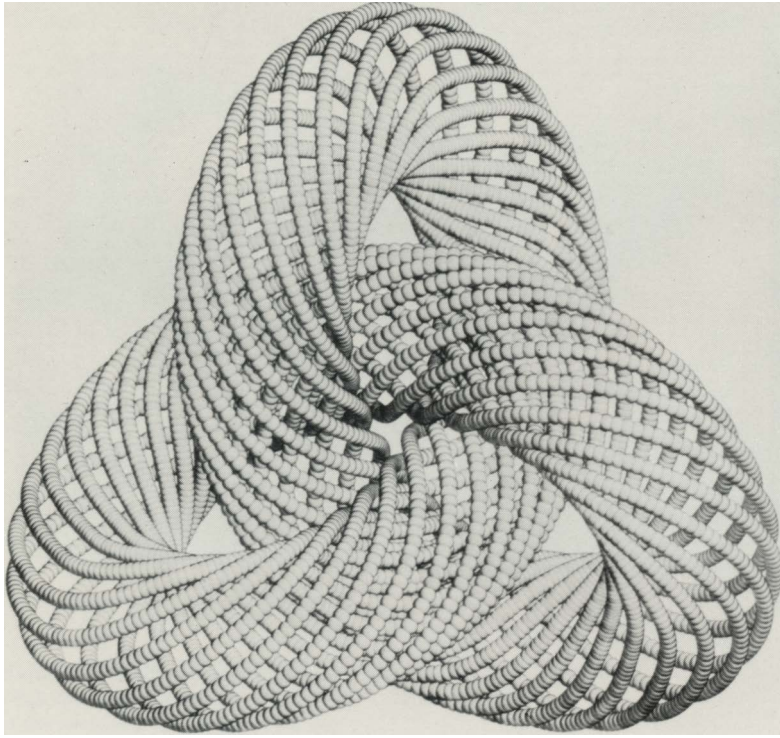
Kenneth Knowlton
Statue of Liberty 1986
 Laserprint 20 x 16"



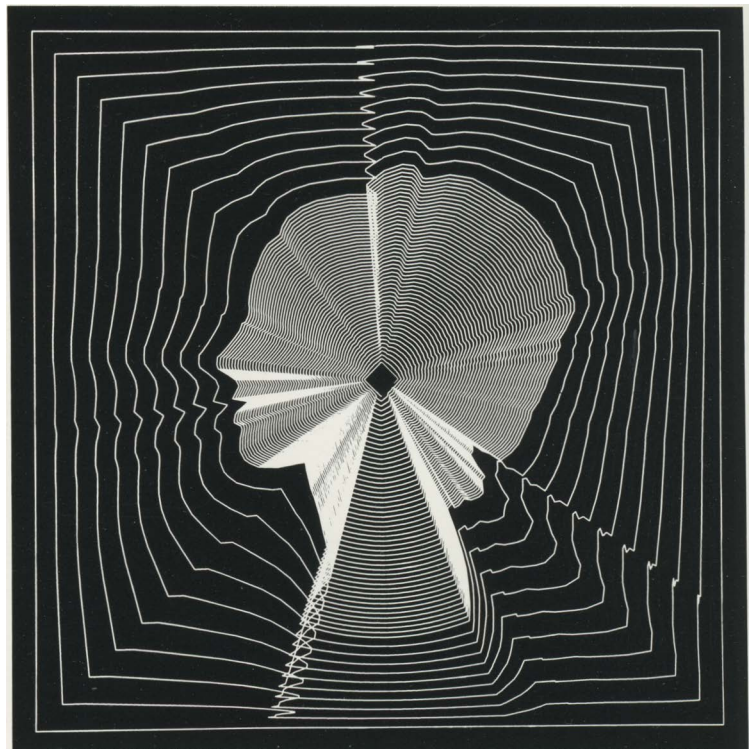
Manuel Barbadillo
 Photograph of painting 1975

Eudice Feder
Separation 1980
 Plotter drawing 16 x 23"

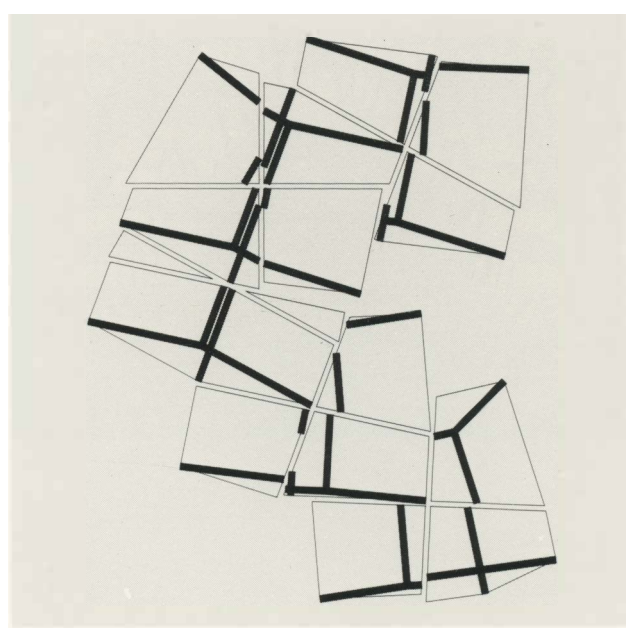
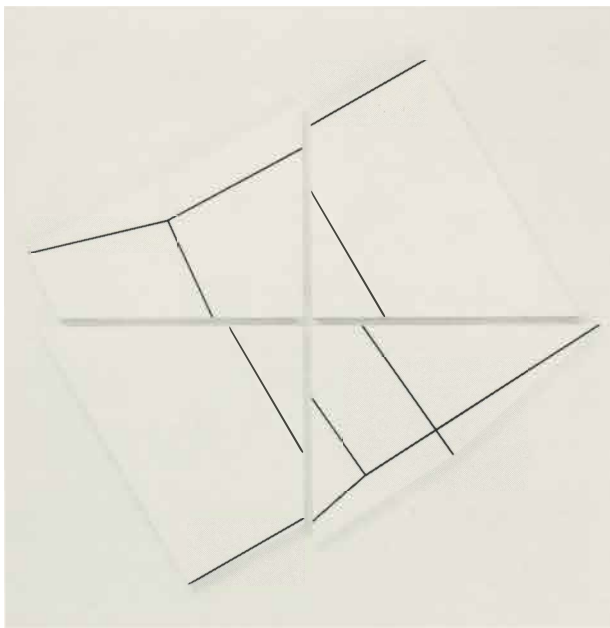
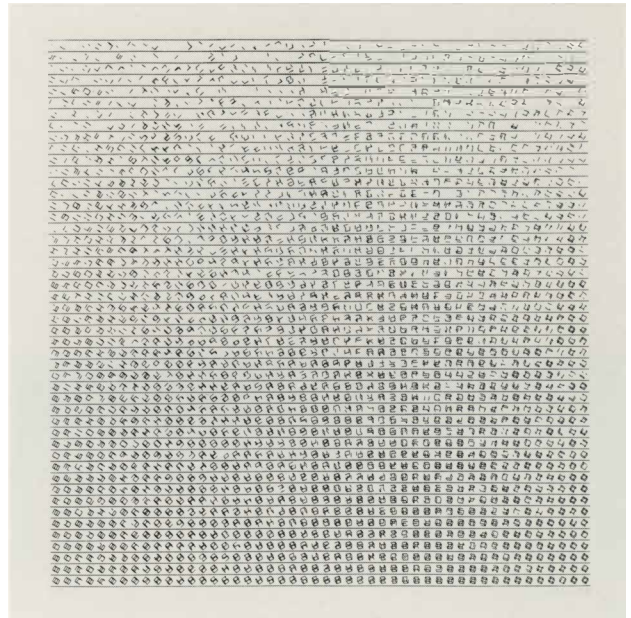
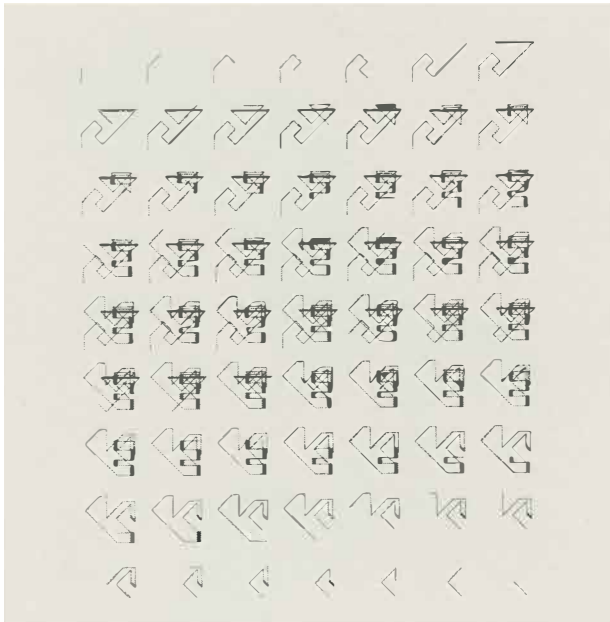




Joseph Heller
Eternal Braid 1983
 Plotter drawing 40 x 28"



Masao Komura, Kunio Yamanaka
Return to a Square (b) 1968
 Serigraph 20 x 17"



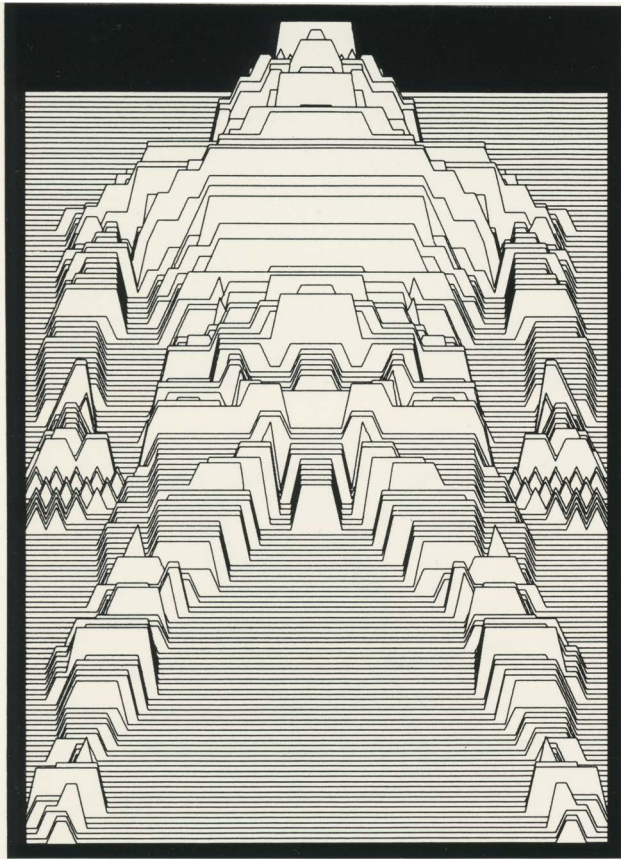
Manfred Mohr
P-26/2 Inversion Logique 1969
 Plotter drawing 22 x 18.5"

Manfred Mohr
P-155 Cubic Limit 1974-6
 Serigraph 27.5 x 27.5"

Manfred Mohr
P-306 Divisibility I 1980-3
 Acrylic on canvas and wood 40 x 44"

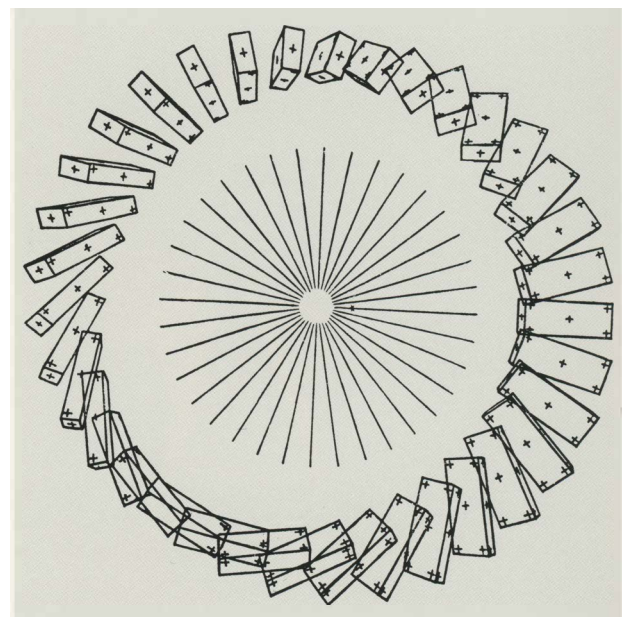
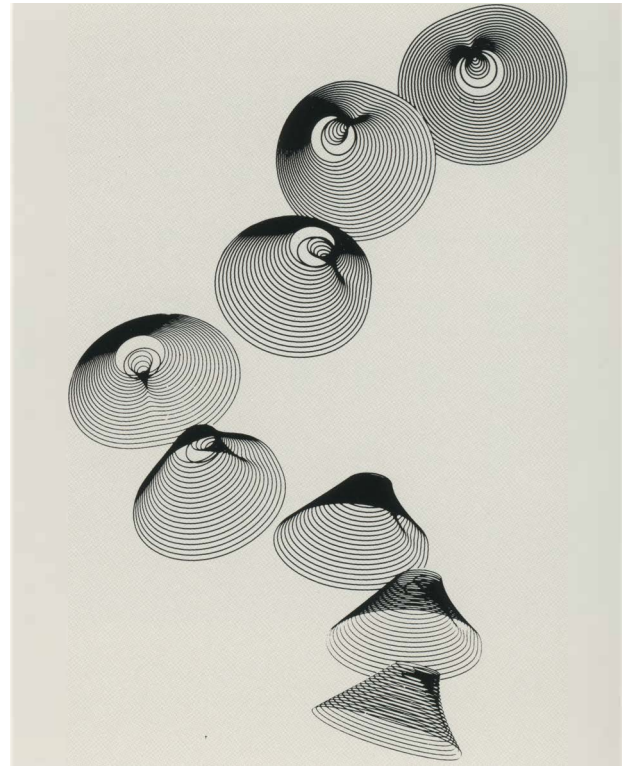
Manfred Mohr
P-370-P Divisibility II 1985
 Plotter drawing 24 x 24"

Hideki Mitsui
CG 1972-1 1972
 Photograph of plotter drawing 10 x 12"

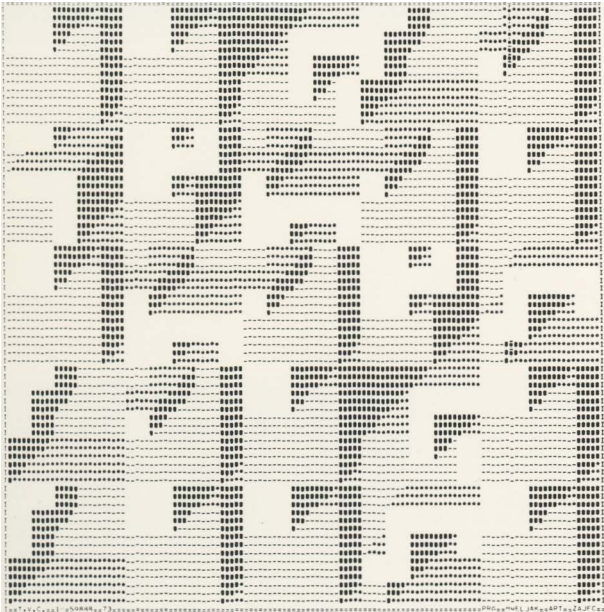
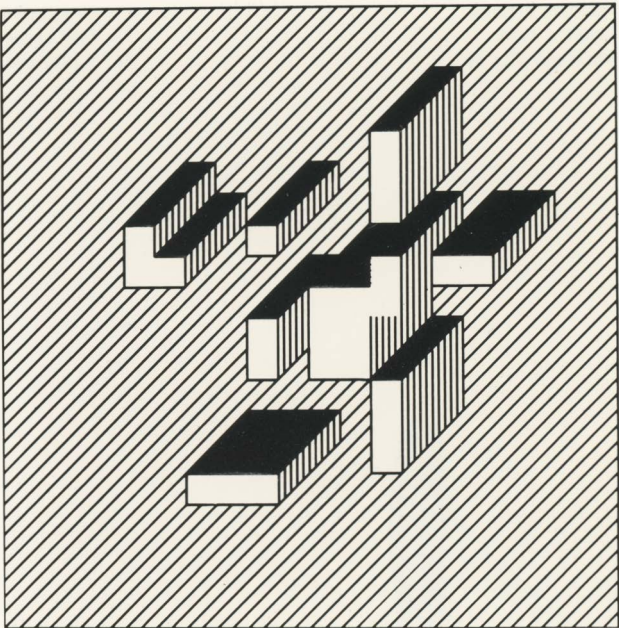


Stan Vanderbeek
Disappearing Man 1979
 Plotter drawing 60 x 29.5"

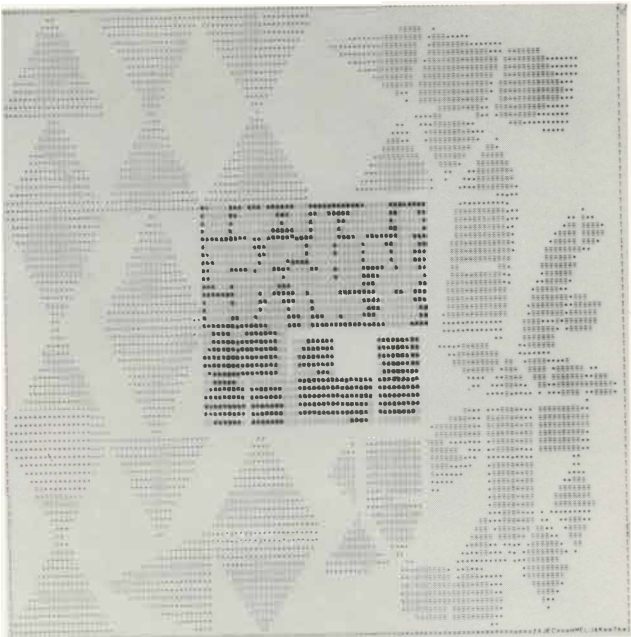
Edward E. Zajac
 Still from *Simulation of a Two-Gyro Gravity-Gradient Attitude Control System* 1961
 16mm film 3¼ minutes



Edward Zajec, Matjaz Hmeljak
The Cube: Theme and Variations
TVC 3271 1971
Plotter drawing 12 x 12"

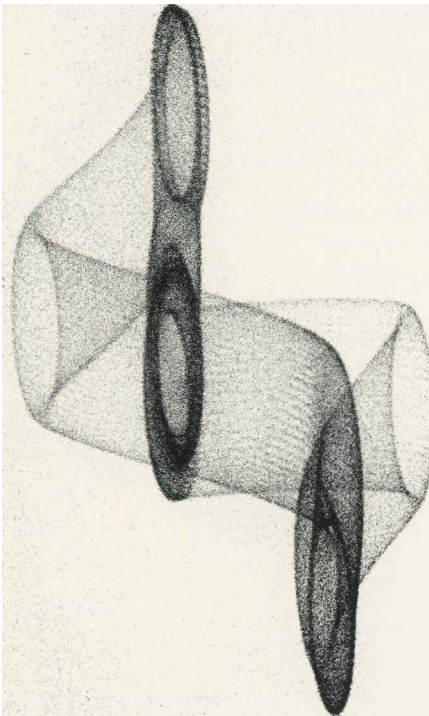


Edward Zajec, Matjaz Hmeljak
The Cube: Theme and Variations
TVC 59888 1973
Plotter drawing 15 x 15"



Edward Zajec, Matjaz Hmeljak
Logic Moments in Color
LMC 3002086 1976
Alphanumeric print 14.5 x 16"

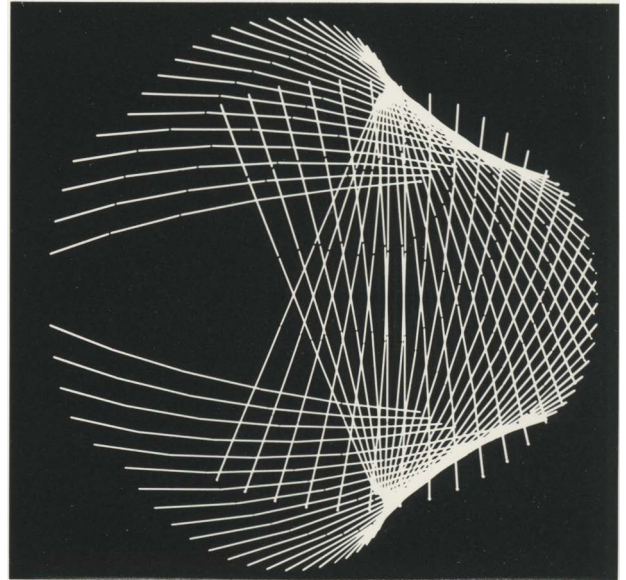
Herbert Franke
Grafik I 1956
 Serigraph 17 x 11"

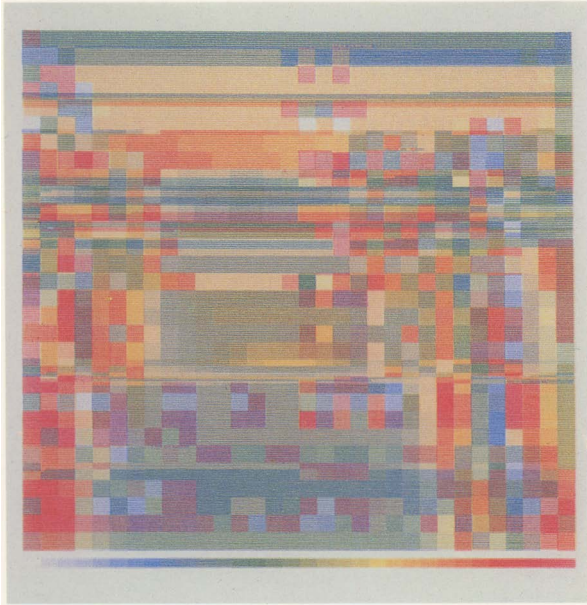


Herbert Franke
Serie 1961/62 e'd'a' 1961-2
 Serigraph 27.5 x 20"

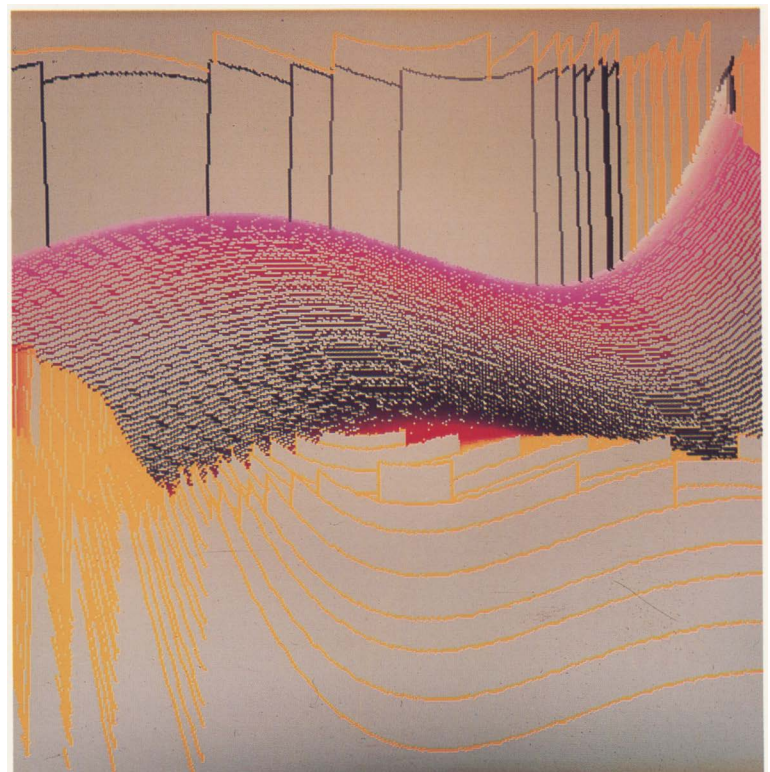


Herbert Franke, Peter Henne
Serie Algebraische Kurven ed'a 1969
 Serigraph 28 x 20"

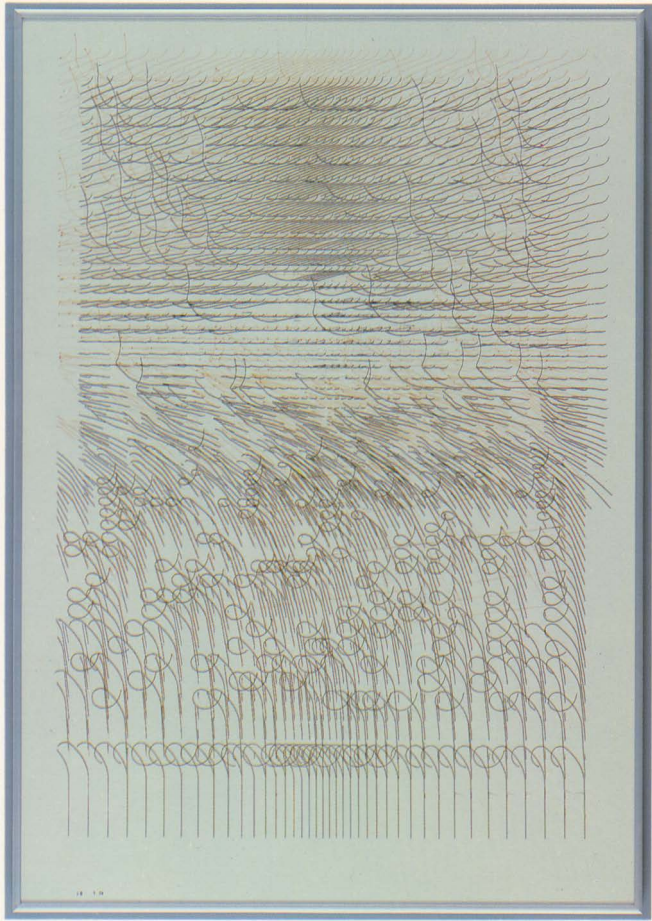




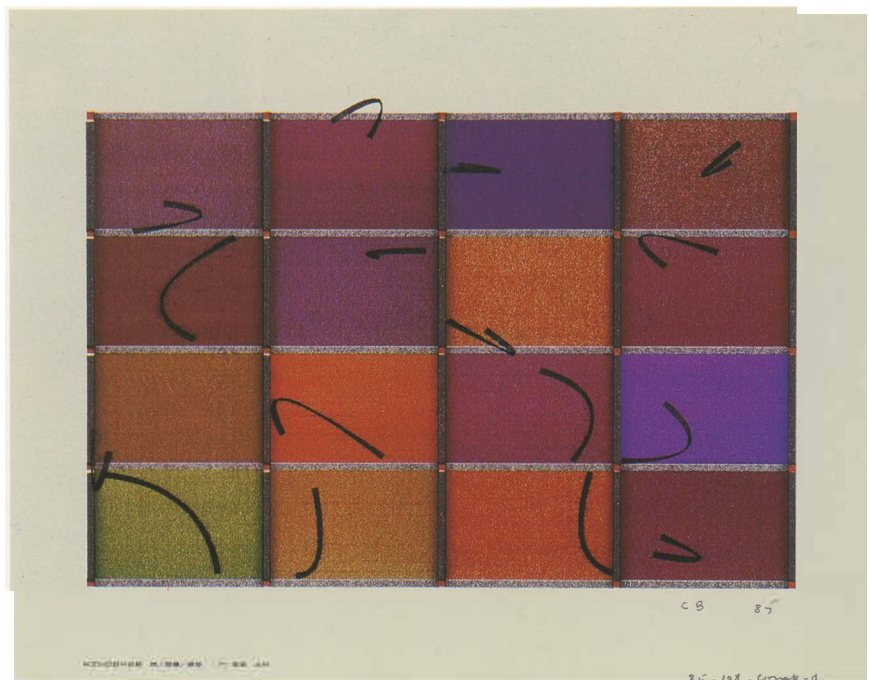
Herbert Franke
Farbraster 42 1975
 Inkjet print 16.5 x 14"



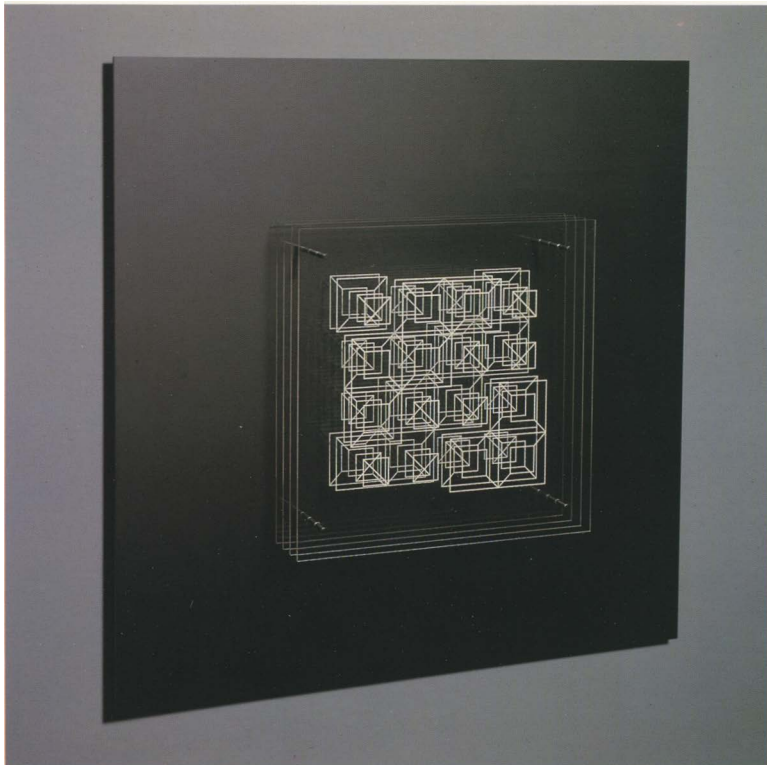
Herbert Franke, Horst Helbig
Mathematische Landschaft 1984
 Cibachrome of raster image 20 x 20"



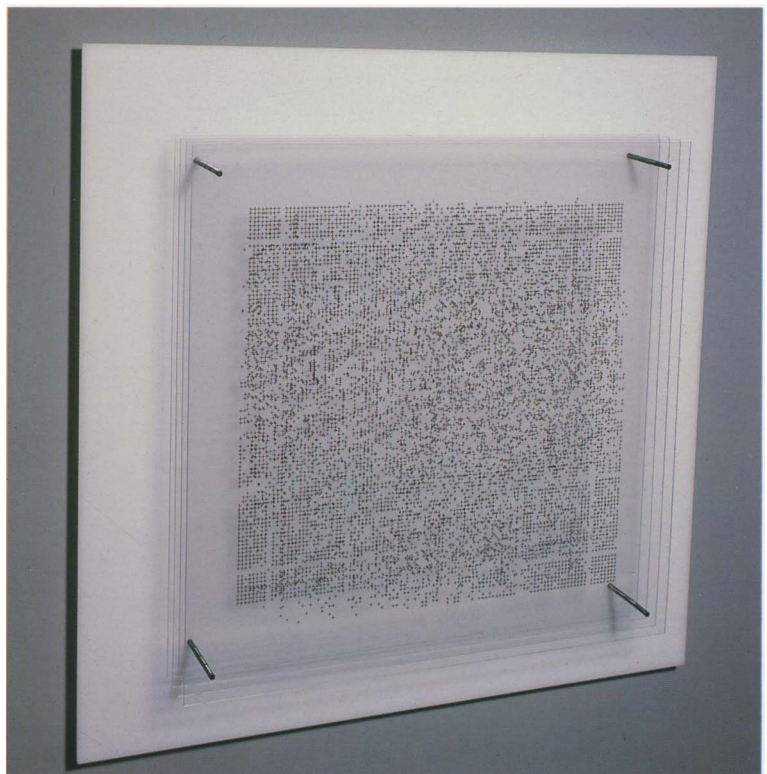
Colette Bangert, Charles Bangert
Large Landscape: Ochre & Black 1970
 Plotter drawing 32 x 23"



Colette Bangert, Charles Bangert
Circe's Window 1985
 Plotter drawing 8.5 x 11"



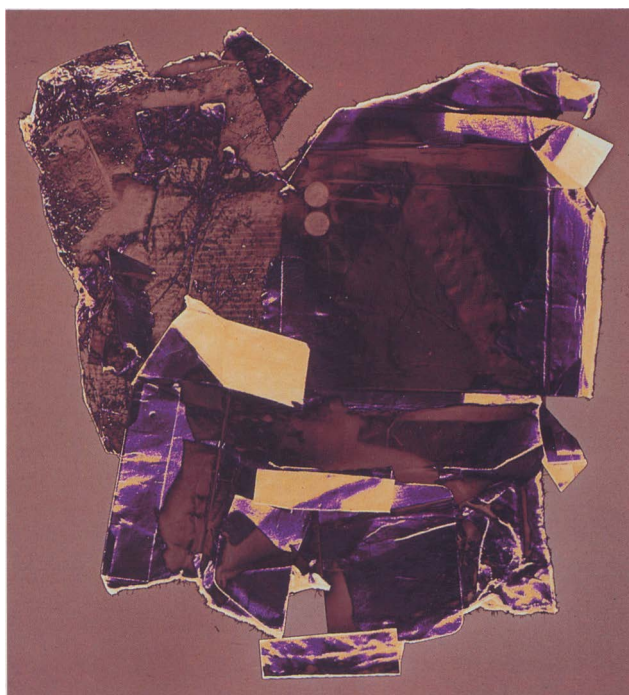
Tony Longson
Group Theory Grid 1968
 Plexiglass 24 x 24 x 4"



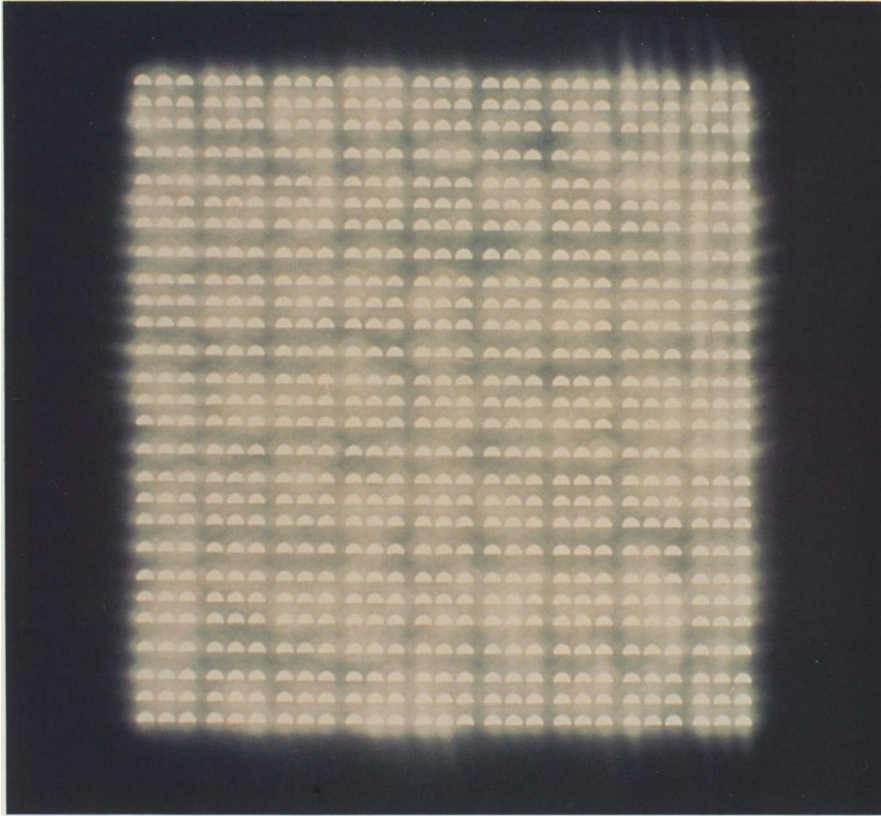
Tony Longson
Square Tonal Drawing #2 1980
 Plexiglass 30 x 30 x 4"



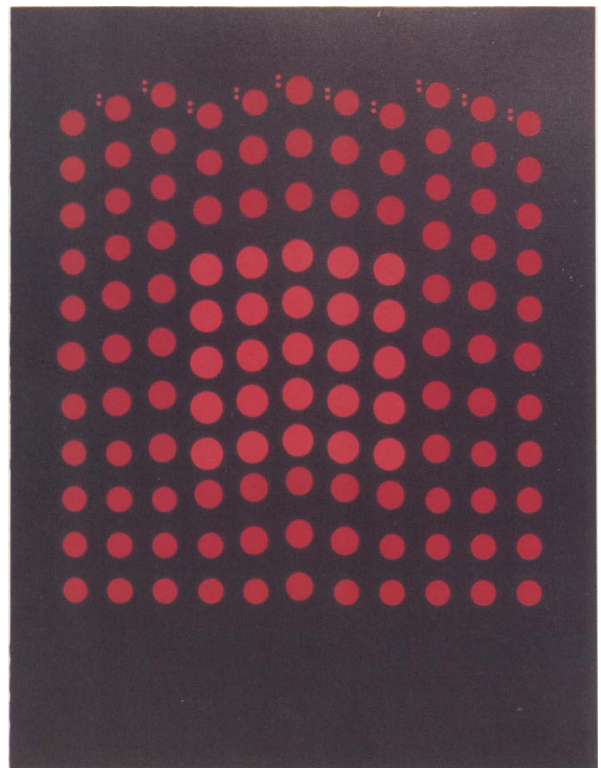
Robert Mallery
Quad III 1968
 Laminated veneer 86 x 16 x 16"



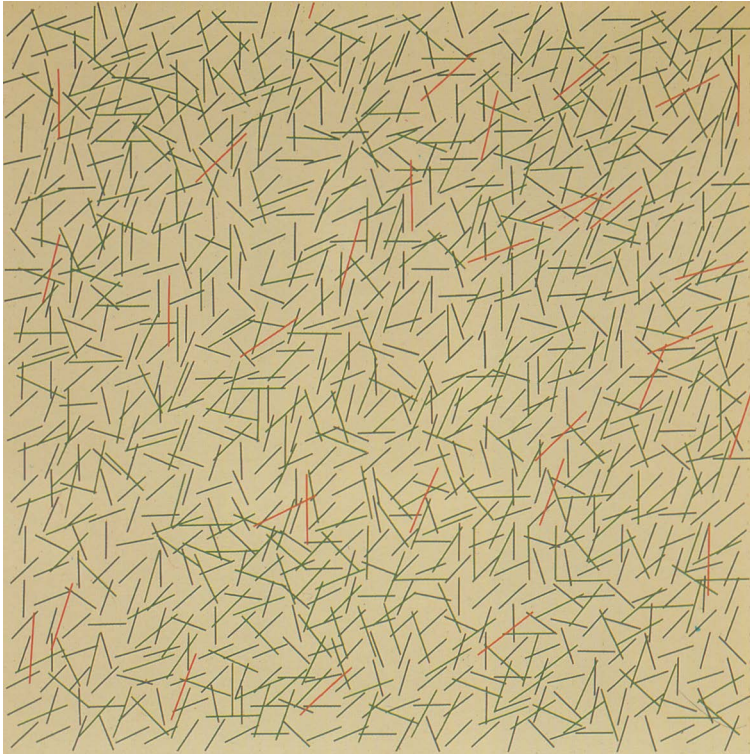
Robert Mallery
Collage 1985
 Cibachrome of raster image 8.5 x 10.5"



Aaron Marcus
Lightbuttons: Rising Suns 1967
 Photograph of vector image 30 x 30"



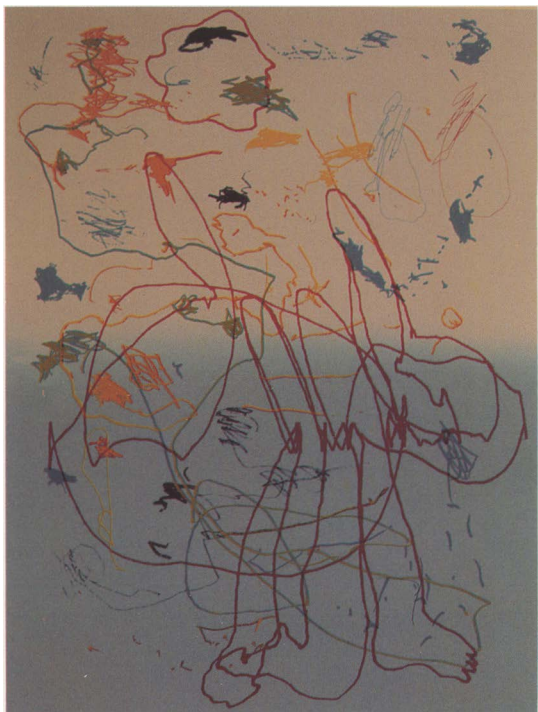
Aaron Marcus
Radioactive Jukebox 1972-4
 Serigraph 18 x 15"



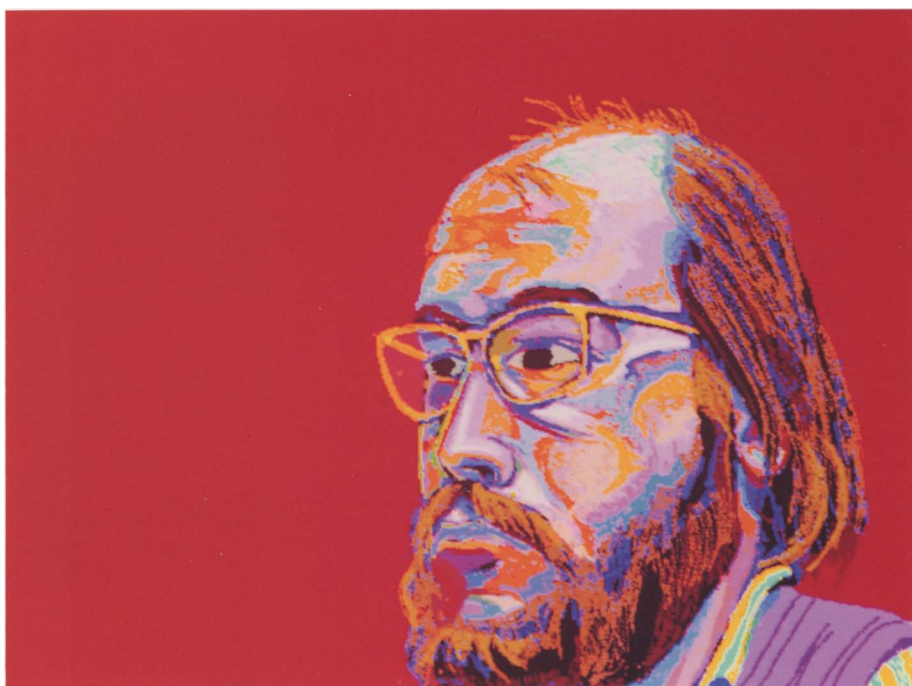
Vera Molnar
Interruptions -20 1969
 Plotter drawing 17.5 x 13.5"

Vera Molnar
Hypertransformations 1973-6
 Serigraph 25.5 x 19.5"



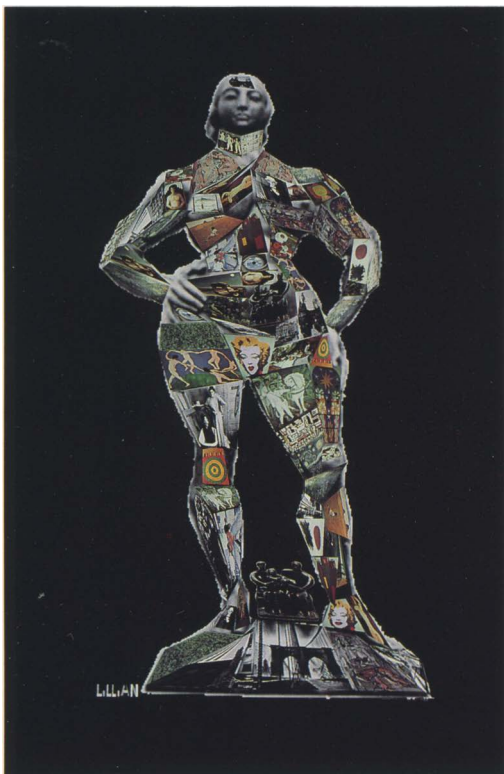
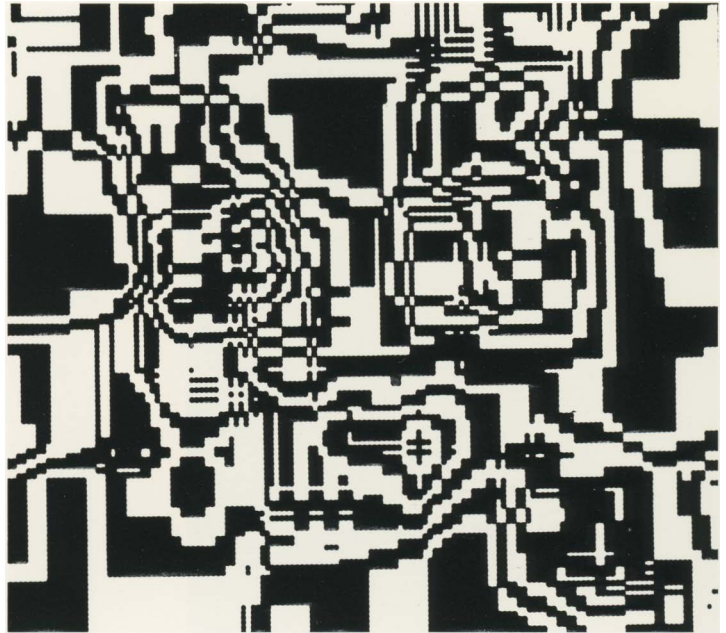


Jozef Jankovič, Imrich Bertok
Computer, My Daughter and I 1980
 Serigraph 25.5 x 19.5"

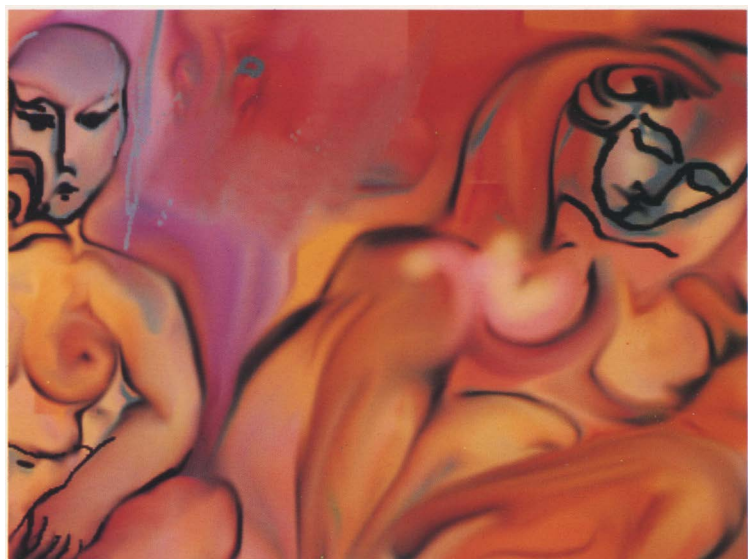


Duane Palyka
Self-Portrait 1975
 Photograph of raster image 16 x 20"

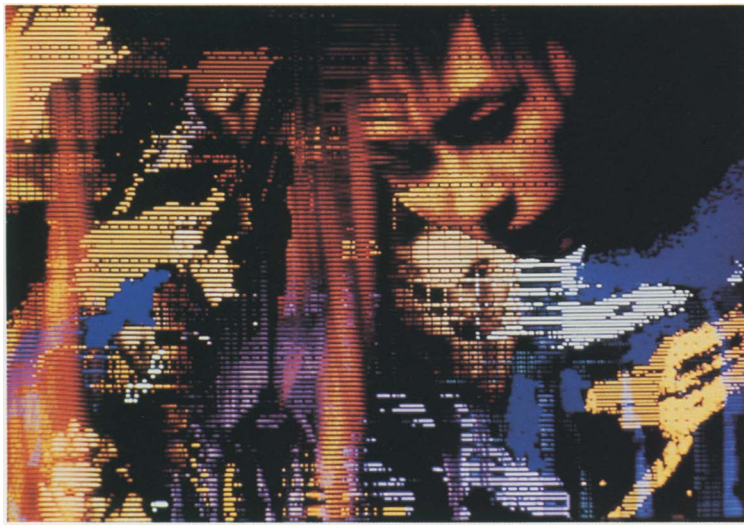
Lillian Schwartz, Kenneth Knowlton
 Still from *Pixillation* 1970
 16mm film 4 minutes



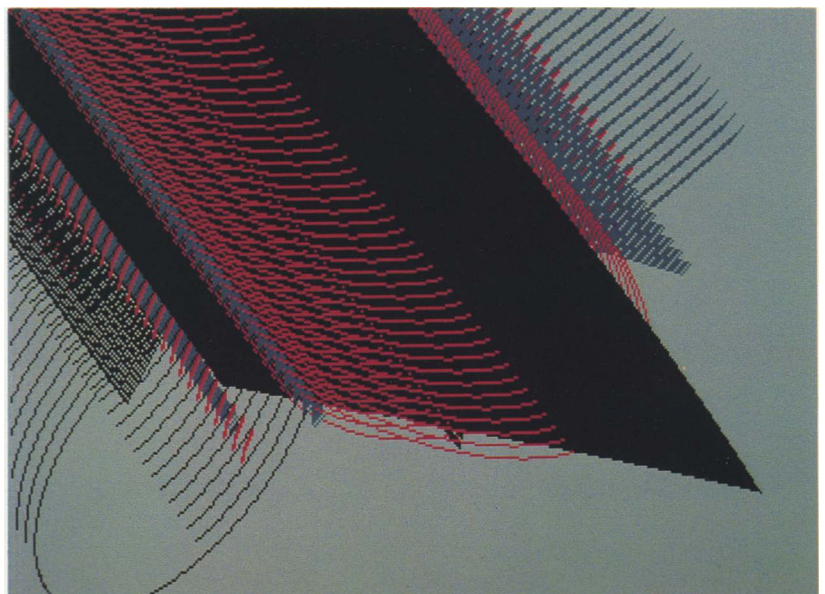
Lillian Schwartz
Big MOMA 1984
 Lithograph 8 x 4'



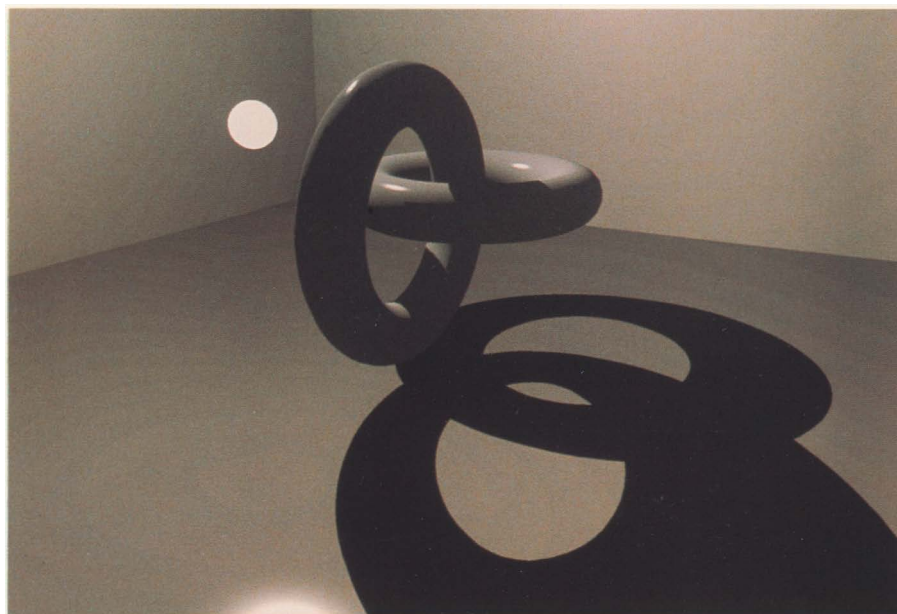
Lillian Schwartz
Symbolic Homage to Picasso 1986
 Cibachrome of raster image 4 x 4'



Carlos Argüello
Mary 1985
 Photograph of raster image



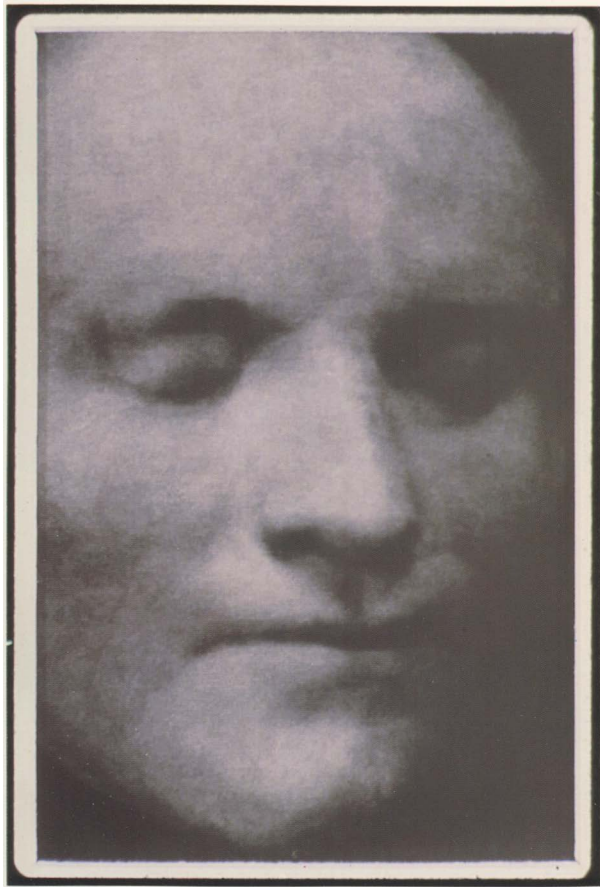
Terry Blum
Ellipse Series #1 1985
 Photograph of raster image



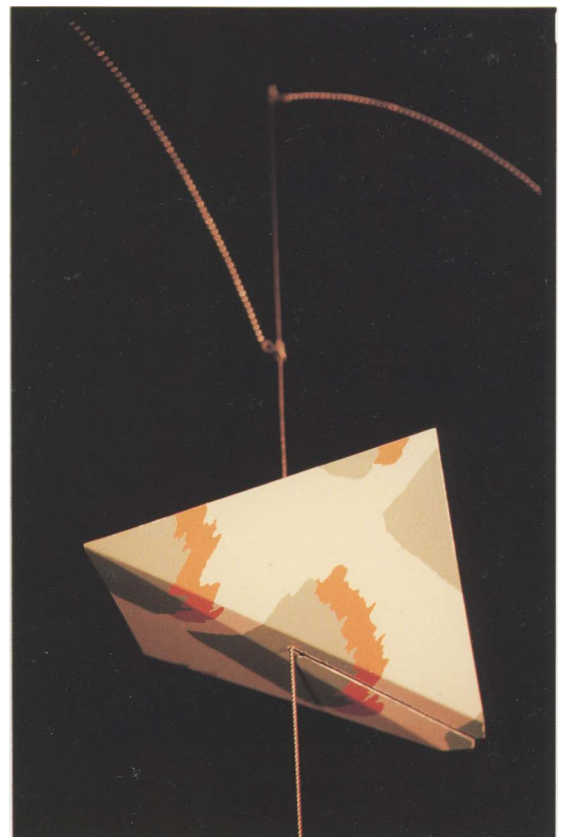
Paul Brown
Sculpture Simulation 1983
 Photograph of raster image



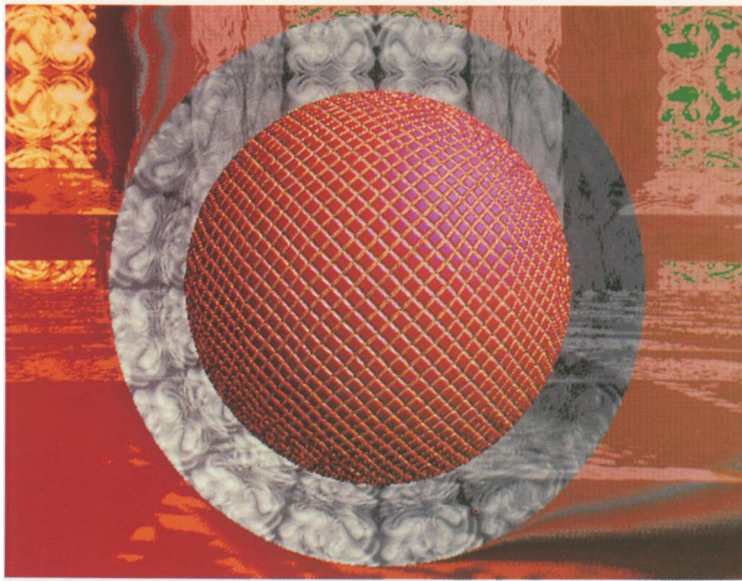
Susan Brown
Stretch 1985
 Plotter drawing 28 x 30"



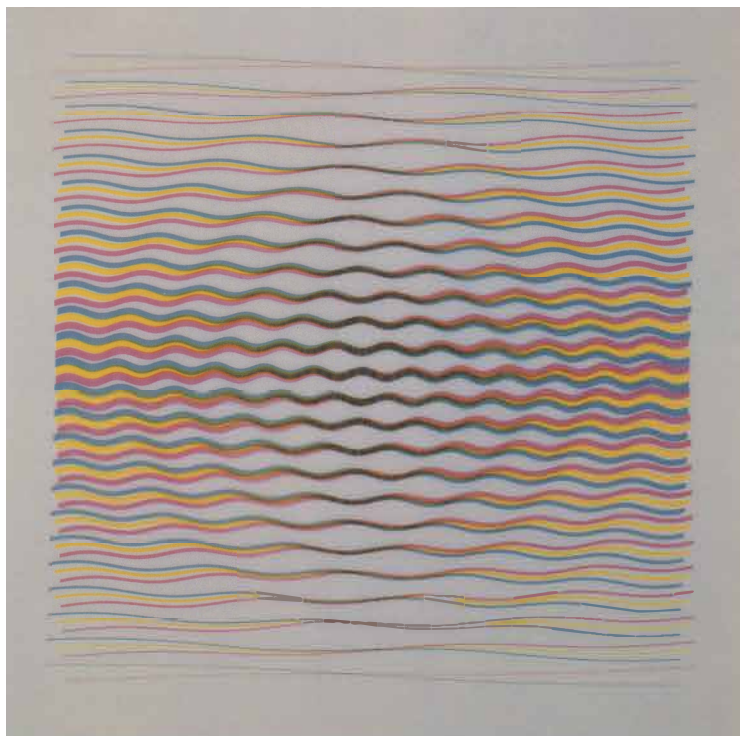
**Nancy Burson, Richard Carling,
David Kramlich**
The Dead 1984
Composite silver print



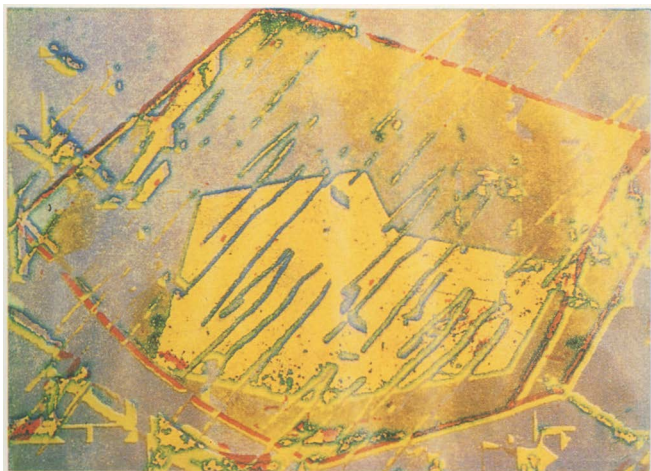
Rob Fisher, Ray Masters
Skyharp (detail) 1986
Stainless steel, aluminum 16 x 16 x 6'



David Em
Redbal 1980
 Cibachrome of raster image 6 x 8'



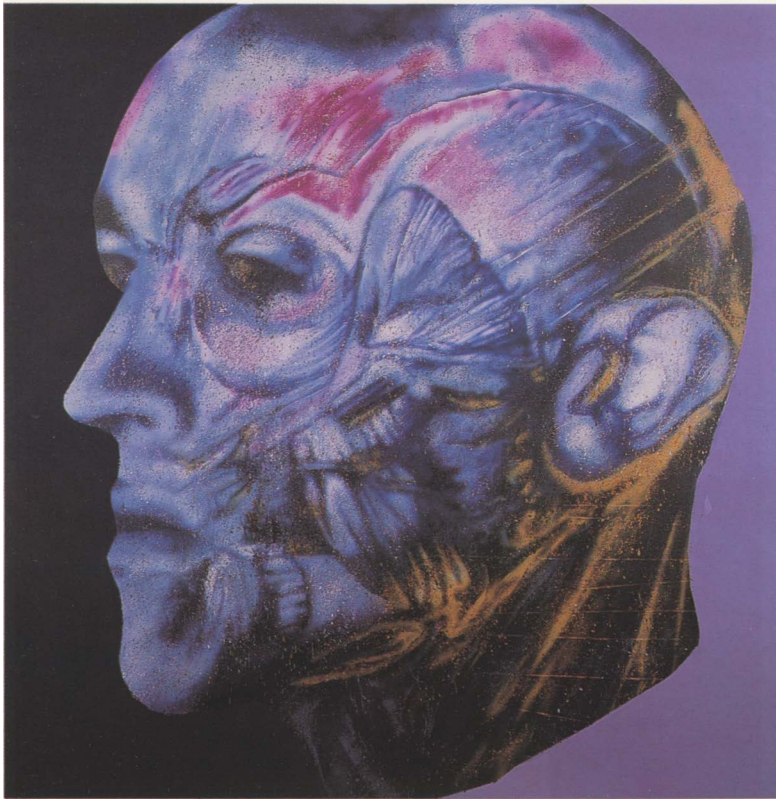
Jürgen Lit Fischer
Obertöne-spektral 1984
 Serigraph 40 x 40"



Darcy Gerbarg
DVI Series I #1 1979
 Etching 10 x 12"



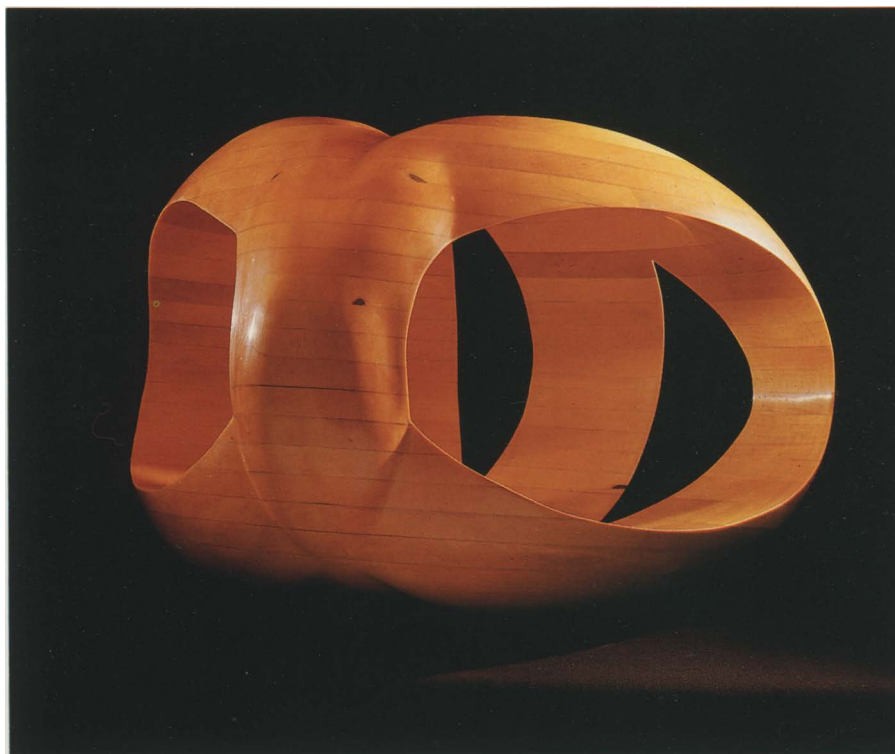
Darcy Gerbarg
Plain 1985
 Acrylic on canvas 63 x 87"



Jeremy Gardiner
Self-portrait 1985
 Acrylic on canvas 60 x 60"



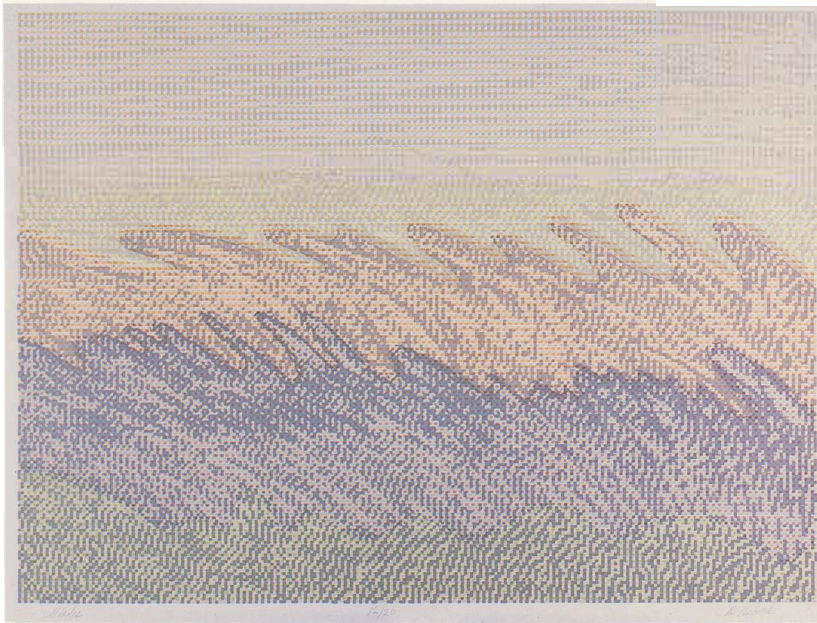
Laurence M. Gartel
Deciphering Archetypes of Human Form
 1985
 Polaroid collage 37 x 33"



Bruce Hamilton, Susan Hamilton
Tetrad 1984
Wood 16 x 27 x 23"



Josepha Haveman
Stillife 8 1985
Inkjet print 10 x 12"



Richard Helmick
Glades 1983
 Screenprint 22 x 30"

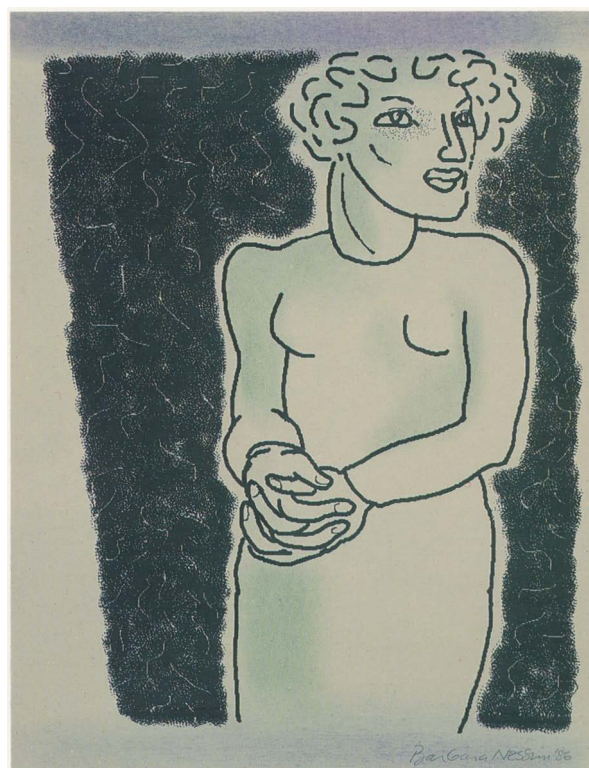
Hervé Huitric, Monique Nahas
Hommage à Georgette La feuille 1985
 Photograph of raster image

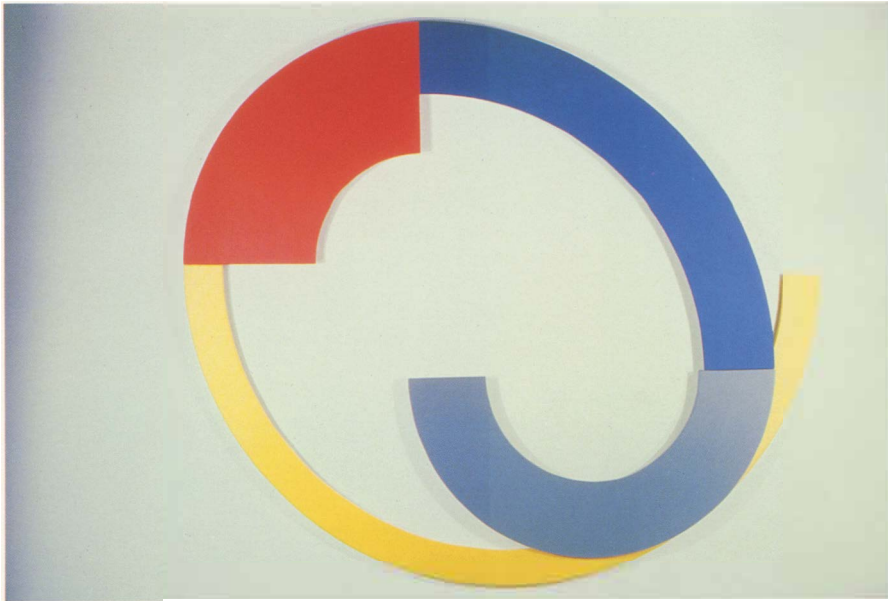




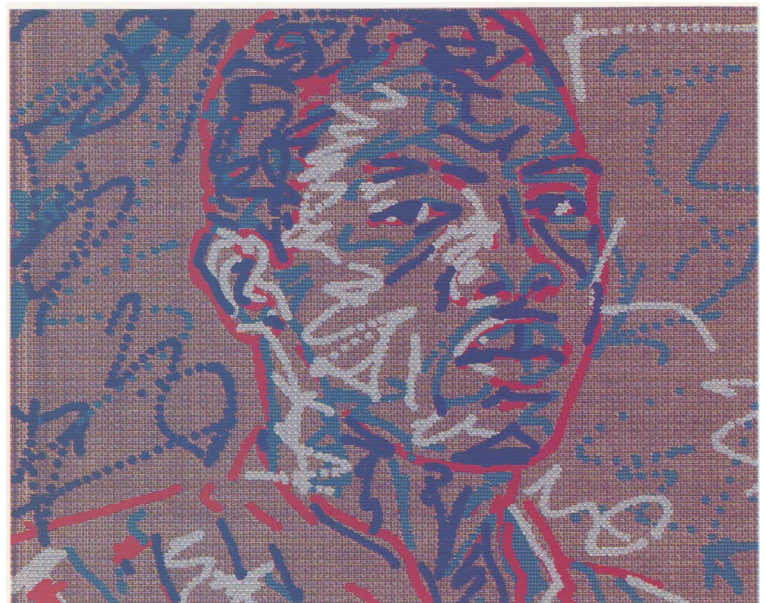
Alyce Kaprow
Fazes 1983
 Photograph 16 x 20"

Barbara Nessim
Diana I 1986
 Printer and mixed media 11 x 8.5"

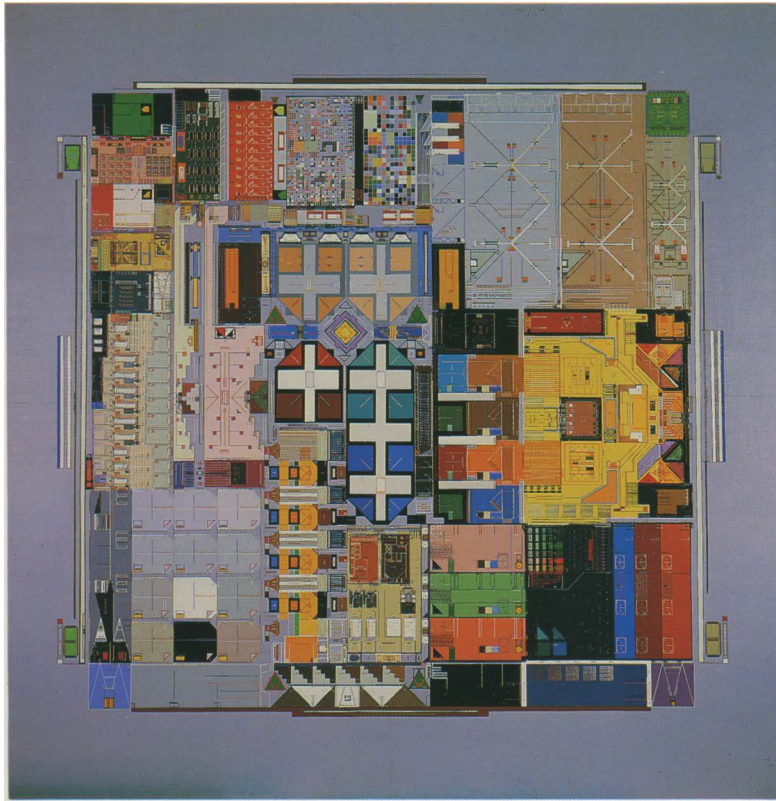




John Pearson
Remembrances #5 1986
 Acrylic on shaped canvas 74 x 93"



Gregg Smith, Kathy Neely
Delano 1985
 Inkjet print 12 x 16"



Mark Wilson
Untitled 1975
 Acrylic on linen 72 x 72"

Mark Wilson
Long Skew B 1985
 Plotter drawing 20 x 96"



COMPUTER GRAPHICS AS ARTISTIC EXPRESSION

Herbert W. Franke

(translated from the German)

Computer graphics has been in existence for more than twenty years. From the beginning, people experimented on ways to use the new medium — in addition to scientific, technical and commercial application — for artistic goals. Around 1965, Germans Frieder Nake and Georg Nees and the American, A. Michael Noll, strove for that goal; they were followed by individuals such as Kenneth Knowlton, the team of Charles Csuri and James Shaffer in America, and the Japanese Computer-Technique Group. All of them were represented in the large exhibition “Cybernetic Serendipity” in 1968 in London.

In the following years, in addition to mathematicians and programmers, more and more professional artists adopted the methods of computer graphics. This became an international activity, but was little known to the general public. The situation changed a few years ago, not so much because of a breakthrough in the field of art, but as a result of the production of spectacular computer-produced special effects for science fiction films and advertising commercials.

As a technical method, computer graphics no more is involved with art than pencil and color. It becomes interesting only after it is applied to creative goals, and even then it needs the creative human being to achieve high quality, aesthetic results. In view of the short time that computer graphics tools have been at our disposal, each computer graphics work of art should be looked upon as an experiment to test the medium for its suitability as a means of artistic expression. We have here the unique case of an art “*in statu nascendi*,” the extraordinarily interesting initial state of an art which eludes all classical fields of observation, to be observed in its emergence. This is a special opportunity which, strangely enough, scarcely has been exploited up to now by relevant scientists.

One noteworthy observation in the evolution of computer art is its development from playful experiments to commercialization. Another is the formation of different styles and criteria of valuation, a phase not yet concluded so far. This article will concentrate on yet another aspect of this discipline — the interaction between technical instrumentation and artistic expression.

In the fifties, the mechanical “plotter” was the only drawing apparatus in use. According to a program, the plotter controlled the movement of ink, pen and pencil, over flat paper or paper stretched over a roll. This method limited artistic experiments with computer graphics to line drawings, initial production of block diagrams, wiring diagrams, maps, etc.

Software, as well as hardware, affected these artistic experiments in design. The first programming languages were particularly well-suited to describe mathematical and logical associations. The first computer artists used these existing routines, so it is not surprising that many of the things produced then originated from the rich store of forms in technique and science.

From the view of artistic trends, these works are formally related to constructivism, especially concerning the precision of presentation and the limitation to simple form elements, which were then still necessary. While representatives of classical constructivism had to make do with a ruler and compass, thus being limited to straight lines and circles, it is easy for the computer user to insert precise and complicated curves. This is possible either by the process of interpolation or by the program evaluating mathematical formulas and transforming the resulting numbers into graphic presentation.

Another expansion of form and style, accessible with programming languages, concerns the transfer from order to chaos. With the help of a random number generator, one can get essentially orderless rows of numbers which can be used as reference numbers for graphics presentations. The use of the chance effect, common in the early days of computer graphics, also found expression in manually produced constructivist works, such as those by Herman de Vries. Some constructivists, like Peter Struycken, Zdenek Sykora and Gerhard von Graevenitz, used the computer to realize their picture ideas.

Different effects were achieved by using methods of image processing, that is, the graphic processing of data. Originally this technology was used by scientists to enhance pictures obtained photographically. With digital electronics, a considerable widening of this field of activity was possible, such as being able to correct distortions of pictures or eliminate “noise.” Distinguished from computer graphics, image processing works with pictures of real objects and scenes, which are thus open to artistic treatment. Again, already written computer programs are available to artists, who use them to distort pictures rather than to improve them. This can lead to attractive graphic effects.

The beginnings of image processing go back to the time of printers and plotters, but the real impetus is connected with television. This technical innovation, with the appearance of the picture tube as a presentation tool for computer graphics, initiates a significant change. With color screen limits of more than one hundred million hues, the number of available colors is greater than the number of colors the human eye can distinguish.

Contrary to the plotter presentations, the construction of which often took more than an hour, a picture is now created within fractions of a second. This permits interactive work — there is essentially no waiting time — and the producer immediately can see the results of his graphics applications and improve upon them until the effects are optimal. This also eases the capture of movements over time. With bigger systems, sequences of thirty pictures per second can be created in real time. For the first time, the visual artist has a means to create graphics sequences freely.

Whereas the limited possibilities of the plotter favored a trend toward mathematical constructive presentations, the monitor picture gives the artist relative freedom. Today, computer graphics is not bound to a certain style but depends on the views of the artist. If he wants to use the so-called paint systems, which allow for simulation of hand-drawn objects, he achieves a flexibility hardly imagined before: he can mix and change paints at will, turn parts of the picture, move, manipulate or erase; he can withdraw objects and enlarge details which are then zoomed back into the picture, etc. Pictures produced in this way do not differ significantly from those achieved with conventional methods.

Some artists have discovered the wider possibilities in style and expression that can be realized with computer graphics, unknown in classical painting. Mathematical formulas, used since the early days of computer graphics, have been applied more rigorously to current work. A significant difference results. With conservative working methods you go point-by-point, meaning that in a picture, the exact spot you touch is changed. Computer graphics also permits changing the picture in its entirety.

In this field of mathematical techniques belong transformations. When applied to images, these transformations yield manifold changes. In simple cases, a transformation can cause an exchange of colors, a physical structure, or the accentuation of contours. With more complicated transformations, new picture structures can emerge that do not resemble the original. A picture can be formed by applying different transformations, or by modifying form and color manually. A mathematical law says that, in this way, any picture may emerge. Both methods are also complementary.

An even more remarkable computer technique available to artists is the ability to create three-dimensional perspective presentations. Just as line-drawings of plans and maps influenced computer art in the beginning, today's computer-aided design applications are influencing 3-D art. In place of physical models of machine parts or buildings, there are pictures that can be observed from all sides; a change of the viewing angle can be achieved from the control panel. A 3-D representation of the object is stored in the computer. Software computes the desired views and displays them on the screen.

With the help of special programs, 3-D objects and scenes can be made to look real. Once the user specifies the number and locations of light sources, software removes hidden lines and hidden surfaces, and adds shadowing and highlights according to the laws of optics. Last, computer graphics programmers developed algorithms for realistic generation of mountains, clouds, water, living beings, etc. Some of the effects are so astonishing that they are taken for works of art in themselves. At previous exhibitions of the annual SIGGRAPH conference, artistic works were displayed alongside images showcasing technical achievements and creative programming.

And yet, it would be a mistake to deny this medium's artistic potential. The development of programs has proven to be the necessary basis without which no artistic achievement in this field is possible. It is the realm of photorealism, the style dominant in art circles some time ago, which demanded the rendering of scenes from everyday life as realistically as a photograph. Although the results of this style are not distinguishable from painted works, there still is a considerable difference. In the application of 3-D routines, the artist is concerned with more than the surface of things — quite another approach from the reproduction of perspective projection. It is evident that we have here a real expansion in presentation, as the objects presented in this way can be observed from all sides, as well as through time. If we deal with moving things, e.g. an animal, then the dialogue between the artist and his object goes further still. He may think about the interplay of skeleton and muscles, the degrees of freedom of movement, and finally, create a film of the creature in motion. Here again, the effect alone is not sufficient to make the presentation into a work of art, but the availability of the method presents an enormous challenge to the artist who now has means of expression hitherto unavailable to him.

The experiences with the first picture sequences created this way show that realism is relatively uninteresting. As has been confirmed in other fields of art, an exact copy of reality is not what counts. An entirely new dimension opens for the artist when he moves from realism to surrealism, just as with image processing, which serves not only to "improve" pictures, but also to make them abstract and interesting. For the first time, he has the possibility of building scenes of his fantasy in three-dimensional form, to give shape to worlds that do not exist in reality and, perhaps, cannot exist.

The hardware and software needed to create real and surreal pictures are still extremely expensive and limited in number. For the artist who wants to use these systems, it is difficult to find and gain access. But at those rare happenings where highly developed technique and artistic talent come together, there originate examples of surreal forms with the potential to initiate a new epoch.

Among the few pioneers of this trend are David Em, an American, and Yoichiro Kawaguchi from Japan. Today, their art might still appear exclusive, just because the method applied is at the disposal of only a few. But we can see already that hardware and software for computer graphics presentations are developing and spreading quickly. What is still a pioneer achievement may, in ten or twenty years, belong to the ordinary fields of artistic activity.

TV NEEDS MTV LIKE MTV NEEDS COMPUTERS

pattern potentials for music-with-art

John Whitney

J. S. Bach's last unfinished work, *THE ART OF THE FUGUE*, is a magnificent network of simple theme and variations that are interwoven, transposed, inverted, and retrogressed. Some believe that Bach's counterpoint, which consists of a *complementarity* of voice-parts, exhibits an affinity with algorithmic computer-program instructions and procedures.* I agree, and I believe that a *video counterpoint* offers a special complementarity between its own musical and its visual voice-parts.

Will computers allow a new art on TV as pure and popular as Bach's music? With suitable talent in place, I believe so. Formal principles can be composed into algorithmic software. But more to the point of this essay, composers can invent algorithms with which to process both musical and graphic rules and aesthetics. In short, there are new *pattern potentials for music-with-art*.

Color and music have more potential for fusion than imaginative composers, poets and artists believed possible. From Aristotle to Scriabin and Wassily Kandinsky, visionaries repeatedly invoked the mind's poetic image of intertwining color with music. Inadvertently, this dream devolved into a kind of collective vision which, after these many centuries, is near to actual realization, hence the spread of TV's present "stylish" pop MTV.

Yet, MTV needs substantiality to realize that ancient collective vision. Computers can contribute substance by expanding music's art of time. The computer's clock allows compositions in time which can be as sensitive as real-time performance. In fact, we've acquired high-resolution numerical control of time itself. Solid-state instant replay, expanded memory plus greater speed and bandwidth sharpen the creative potentials. Graphic geometry, infused with the vitality of color and motion, gains the full emotive power of music. Systems architecture of this decade has produced music and graphic generating capabilities all in one computer instrument. This has become the artist's first *universal machine*.

Founded on a universal-machine concept, my own study of color-in-motion began in 1965 as a search for aesthetic roots while developing software and interim instrumentation. This exploration of computational "digital harmony" gradually substantiated the point of my reasoning. Differential functions within various geometric algorithms generated order-disorder graphics (harmony). Mathematical expressions, plotted frame for frame on film or video, produced subtle clues that helped me to clarify this hypothesis, with each new film.

Eventually, it came to my deeper understanding that a differential arithmetic of resonance actually *embodies* the architecture of music. This arithmetic productively complements a graphic differential geometry. Visual patterns, derived from simple periodic geometry, produce order/disorder resonances in actions which complement the consonances and the dissonances, the tensional dynamics and the universal emotive power of musical rhythm and harmony. These were summary conclusions I was able to draw from my study and films [1,2].

Thus I was able to accept as an operable fact that the basic, quantifiable units of construction for this computer art are: (a) the pixel points of color, and (b) the pure audio sine wave. These two root components enable one to compose periodic and polyphonic artworks in graphics and audio, as if these elements were building blocks with which to construct a generative graphics and a new musical scale. These elements provided a complementarity between sight and sound, and they suggested the foundation for an aural-visual art.

We may compare the implications of two terms often associated with computer music: *synthesis* and *genesis*. My studies suggested that composing music by computer should stress algorithmic or generative processes of genesis. Basic elements, pixel and sine wave, can be generated from "ground up," so to speak, into visual patterns as well as melodic patterns of specific timbres, all by algorithmic rules invented by the composer. This proved to be a departure from most improvisatorial composing procedures of synthesis, for example, often accomplished on real-time keyboard synthesizers.

It seems to me that much creative effort is misguided because of an insensitivity to this major issue of synthesis vs. genesis. The arbitrary wave-form envelopes of all tone synthesizers, keyboard improvisation, and even of present day Expert Systems applications to music synthesis, create a world which is just that: *synthetic*.

Our experience will finally teach us that a computer instrument offers a genuine potential for audio-visual art that is *not* synthetic and *not* a synthesis or an imitation of the creations associated with either the gallery or concert hall. Computer art belongs elsewhere in a different cultural community. Television needs music-television just as much as MTV needs good computer-graphics and computer-music. Here, we might employ Expert Systems more wisely than merely to imitate a grand piano.

The very concept of genesis prompted my ideas about *pattern potentials for music with art*. Filmmaking demonstrated to me that all twelve-tone methods and traditions, requiring fixed tunings, notation and instruments, could be replaced by acoustic algorithms in association with graphic algorithms. Here was new methodology for digital harmony. I had uncovered the harmonic basis for composing music in interactive interplay with color design and action. Located outside instrumental/vocal traditions yet retaining a valid harmonic foundation, digital harmony may (or may not) be a new and different approach for an evolving species of composer/artist.

My guess is: a powerful appeal lies within the natural interlace and active coordination of eye to ear, and ear to eye, at the integrated level of digital aural-visual harmony. But who's to foresee the expressive power of these relationships until they're brought to life in many, many successful works of art? Some have doubts about the power of *harmonic pattern*, but we must not forget what is already well known. Examine the twenty or so fugues in Bach's last work to see how harmonic pattern, *constructed from a mere twelve tones*, probes the depths of human feeling.

A computer's expanded, heterosensuous opportunities for art were never before understood; without digital systems, they weren't even subject to exploration. Now, overnight, the methodology is at hand. Long ago the refinement of the Baroque family of musical instruments opened floodgates, permitting certain music that has been popular now for some three hundred years. Just so, we may expect that the perfection of realtime audio-graphic computer instrumentation (including a feasible interface with TV) promises an avalanche of popular work among those *pattern potentials for music-with-art*.

Art's relation to its instrumentation is the ongoing subject of interest; my own experience shall provide this concluding anecdote:

It was with a homemade device, a simple sinusoidal pendulum array and optical-printer instrument, that my brother and I composed our first *international success* in the rarified avant-garde of '40's-style MTV. This early triumph implanted in our minds an urgent lifelong drive to gain access to a perfected facility that would provide music and graphic capabilities unified within one instrument. This was at least thirty years before computer technology would make that instrument a reality.

Out of the strength of our convictions regarding this instrument, we conceived an *indelible dream of auralvisuality* within a brand new artform. Thereafter, reflectively, for years I envied Domenico Scarlatti and Antonio Solar, who, by royal or Papal largess, were provided the instrument and the patronage with which to compose hundreds of simple essays exploring a keyboard artform that was mostly of their own invention. Would that brother James and I had had such a "gift" of instrumentation. And yet, it's here!

*The manuscript of the *ART OF THE FUGUE* might be described as an algorithm used to translate the notes into real tones every time instrumentalists elect to perform Bach's musical composition.

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WHY IT ISN'T ART YET

Kenneth Knowlton

For twenty plus years, I have participated in “computer art” as a developer/experimenter/inventor of languages/interfaces/techniques, as a collaborator/teacher/writer, and as a “computer artist.” As a result of all this, I finally feel like an established practitioner in an enterprise that doesn’t (at least not yet) exist. Here’s why:

1. A work of *art* must answer at least some of these questions: For what technical or emotional problem is this an answer or a demonstration of a search? Of what monologue is this a continuation, of what dialogue a contribution? What does this work state, demonstrate, or ask? From what personal attitude and/or social culture does it come? By what syntax am I to parse it, by what semantics does it mean something?
2. Though not every work of traditional art is laden with deep human emotion, every traditional medium makes possible an occasional expression of, for example, anxiety, remorse, tenderness, or nostalgia. In contrast to this, the most evocative quality of computer art to date seems, to me, to be antiseptic otherworldliness.
3. Any given graphics system has a rather strong flavor because of what’s permitted or excluded, and what’s easy vs. hard. Even though many systems could be adapted to a specific person or to a particular artistic intent (because you “only” need to change the software), this typically isn’t done because the artist doesn’t know how or doesn’t have the appropriate help or resources. A tool that is potentially very flexible is usually used in terribly unimaginative ways.
4. Art/technology collaborations seldom result in art, but rather in experimental designs, demonstrations, and in the education of the principals. There are exceptions to this statement (e.g., “words-and-music”) in areas where the participants rather thoroughly understand, respect, and utilize each other’s special roles and talents. But an artistic statement is not easily produced by a committee. It is hard enough for a right brain to express itself through its left neighbor — much harder through someone else’s. Furthermore, the production of art involves simultaneous command of the processes — of all types and on all levels — that are involved, including a full intellectual and intuitive grasp of alternatives. The worth or excellence of a work of art comes largely from the vastness of the realm of possibilities that were (even unconsciously) discarded in the process of choosing a sequence/combination/method that is special.

5. Typical person-machine interfaces are grotesquely constraining channels of expression (imagine playing a violin through a keyboard or painting a picture by means of a robot). And to the degree that the interfaces permit human expression, few people have spent anywhere near the amount of time developing facility-with-tools that artists normally do with brushes, or that pianists do with keyboards, etc.

Conclusion: We are not yet beyond the gee-whiz stage of cuteness, of stunts, and of novelty for its own sake. In order for the artist to get into serious art, he/she must have a more nearly complete command of the tools, including the understanding and ability to build, redefine and/or augment them. Similarly, because of the awkwardness of interfaces, the artist should have control over the mapping of human actions into directives to the underlying operations. These are not new ideas — in a computer environment such features and behavior are understood implicitly and expected. How to do the same for artists is not quite so clear because artists have somewhat different temperaments, methods and purposes.

At this point, it does not make much sense to me to be trying to produce better computer art. The more appropriate challenge is to create better environments for the development of art-making tools.

VISIONS OF MIND

Frank Dietrich

*"I was interested in ideas — not merely in visual products.
I wanted to put painting once again at the service of the mind.
Painting should not be exclusively retinal or visual;
it should have to do with the grey matter, with our urge for understanding"*
— Marcel Duchamp

Computer art is unfolding on the basis of scientific and engineering achievements of pioneering personalities, whose vision suggested that it should be possible to wrest something other than calculation speed and numeric precision from those crude and clumsy computers; something that could be turned into meaningful images. They set out to build dedicated machines to interpret an intuitive stroke with a pen or a snapshot taken through the lens of a camera. They designed displays that show more colors and change images faster than the human eye can distinguish. They devised software to generate pictures that appear just like photographs of reality. All of this has been accomplished within the short timespan of two or three decades. The history of computer graphics reads like a tremendous technical success story.

Conceptually, the way had been paved by Alan Turing's contributions even before the first computer had actually been built. Turing had reasoned about the ability of a computer to act intelligently. He realized that all a machine needs to perform are read and write operations on sequences of symbols. These symbols can represent anything, obviously numbers, but similarly, letters, or as we commonly know today, colors, geometries and other visual features. Symbols can be arranged in larger complexes to stand as tokens for aspects of reality or fictional models. The computer serves as a dynamic symbol processor by altering any given symbol in any order. Turing compared the machine's functions to humans' use of language. He argued that both activities share the processing of symbols — the only mental phenomenon from which results are directly observable. Thus, he concluded, the computer can exhibit the same intelligence we attribute to human beings. In principle, a general purpose computing machine was conceived. In one of its incarnations, it can act as a universal image generator [1].

Turing's inferences remain hotly disputed, since they bluntly grant intellectual powers, widely believed to be the exclusive possession of humans, to machines. Opponents argue that even if a machine could conduct limited rational reasoning it could never exhibit genuine creativity. They define creativity as the production of something original, something without precedent. Creativity implies the capacity to break those rules voluntarily that are slavishly executed by logical deduction, and consequently is considered integral to artistic pursuits. Modern art, in general, disregards existing value systems and continually posits completely novel conditions. Academic codifications of art have been undermined and extended by an ongoing succession of new art movements, manifestos, and methods.

By severing its ties to the social context of religious and political rituals, art became the essence of truly personal experience that is condensed into special forms of individual expression. Because each piece of art is unique as a symbolic manifestation of the spiritual potency and handicraft skills of its creator, it is considered to be precious both in immaterial and marketable terms. This foundation of art was never questioned until Marcel Duchamp invented his "readymades," which were utilitarian, prefabricated mass products that he chose to elevate into the domain of art, simply by declaring them to be art. Duchamp's surprising gesture of placing an ordinary, industrially manufactured urinal as a piece of art into the sacred halls of a museum shocked even the liberal consensus of the avant garde. This "readymade" had not been ennobled by the creative hand and spirit of the artist, and to make matters worse, it directly confronted the public with issues that were suppressed because they were considered obscene. A scandal was inevitable [2].

With one innovative stroke Duchamp shattered the endless cycle of discussions about validity and virtue of this or that "ism" and radically probed into the very foundation of art. His ironic questions remain unresolved but continue to influence the contemporary understanding of art. Duchamp's "readymade" was the result of his sharp reasoning about the impact of industrialization on art. It was fashioned to ridicule the closed circuits of a narrow-minded art world. The "readymade," with a Gödelian "jump-out-of-the-loop," discarded all prevalent aesthetic criteria for judging art [3]. It seems to me that our time is ripe for an equally strong and convincing statement that reflects on the dramatic changes inflicted by the computerization of factory, office, home, and of course, art. In analogy, such an artifact would take the very subject it covers into account and proudly proclaim itself "machinemade."

The outstanding and farsighted work of both Turing and Duchamp delineates the intersection of contemporary art and computer science. At times like these when new territories are being staked out, proven methods and yesterday's guidelines are bound to fail. Not only practicing artists are thrown back upon their personal judgment, but critics and audiences alike should seize the opportunity to scrutinize closely and discuss frankly the repercussions and extensions that computer technology is bringing to the arts.

The majority of artists use computers today to further cultivate their expressive vocabulary and to take advantage of the digital dynamics within the production process. In essence, they are either replacing traditional tools with sophisticated computer simulations or integrating computer imaging techniques by applying them alongside conventional methods. In the latter case, multi-media pieces are often collaged out of different image sources and materials. This approach helps to turn the highly malleable but intangible computer image into

a durable work of art. Other artists follow routes that experiment more directly with the procedural character of imaging technology. They address topics such as change, chance, and chaos, and visualize them in unusual formats such as combinatorial clusters of a complete picture space or multiple exposures of a gradual evolution.

Computer art provides exciting visual “thought experiments,” that would not be possible in other domains of human endeavor. A far-out example is the depiction of the internal memory of a computer. Patterns of behavior and organic growth processes are modeled in challenging and formidable attempts. Even Turing’s far-reaching philosophical suggestions are being implemented in automatic drawing systems that simulate visual cognition. Computer environments represent the changing states of mind of an artificial “time entity.” Finally, Duchamp’s dictum, “It’s the onlooker who has the last word,” gains fresh meaning vis-à-vis the participatory potential of interactive computer installations that invite the audience to realize a very personal version of one particular piece of computer art.

In my own view, good computer art, like any good art, goes far beyond the thin skin of its physical surface. At its best it is smart art that can stimulate via visual symbols a rich variety of retinal as well as mental activities. These symbolic artifacts vividly trigger our perception and lead successively to deeper levels of cognition. Symbols are like shadows cast by the internal state of an organism, shadows that can be registered meaningfully by the counterpart in a dialogue. How are we to tell whether the originating organism is a human being or a machine? What matters in the end is that only through the eye of the beholder is an image activated and able to serve as the evocative agent that touches mind, heart, and soul.

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COMPUTER AESTHETICS:

New Art Experience, or The Seduction of the Masses

Patric D. Prince

In the early twentieth century, Modern artists, notably Suprematists, Cubo-Futurists and Constructivists, rejected scientific perspective and descriptive art [1]. Although this dismissal of the world of appearances in art was never accepted by the general public, Modernism evolved from that rejection.

Computer art in the 1980s is, in turn, a rejection of Modernism. The interactivity of computer art is tied to the revolutionary art of the early twentieth century; computer art in general, however, uses the dynamic dimensions of space rejected at that time.

Computer artists are replacing Modern Art concepts with new aesthetic qualities which include not just three but four dimensions, the fourth dimension being that of time. The aesthetic experience associated with interactive computer art is one of the most noteworthy discoveries of the "masses." Computer generated images were embraced by the general public in electronic games early in the 1970s and now through the use of home computers. When amateur artists are drawn to the computer to make images, I call the production of their creative efforts "Volksart." I differentiate between the term "folk art," which commonly refers to primitive art, unassociated with industrialized technology, and Volksart, which is the production of artwork by computer artists without formal training in aesthetics.

Probably because computer art intrigues the masses, it is slow to be recognized by the "art world." One hears the comment that computer-aided art has no intrinsic worth, no discernable aesthetic qualities, and is acritical [2]. Aesthetics is usually defined as the study of beauty. Contemporary usage of the term aesthetics implies a study of the design elements that make up any artistic endeavor, in this case, computer art.

The design elements that contribute to the aesthetics of computer art have developed as computer technology expanded and responded to visual needs. There are eight readily recognizable design elements that relate to how computers function to produce images that make up the computer aesthetic [3]. They are

1. Repetition of forms
2. Randomness
3. Variable viewpoints
4. Modeling of the real world
5. Texture mapping
6. Color changes
7. Interactivity
8. The program as a design element

Artists use the computer as a tool, designing works of art which they then execute in other forms, for example, plotter drawings and paintings.

Artists use the complete computer system as a medium in order to paint in light. The translucent quality of colored light as produced on the monitor is unmatched by any other artform.

Artists use the computer as subject for their visual research. Since art represents the era in which it was produced, some artists provide us with a view of the complexities of the Information Age and the impact of computers on our society.

The history of computers in art parallels the history of Western contemporary art. In the Sixties, computer artists produced Hard Edge and Op-art. In the Seventies, artists attempted to engage the audience in participation; this has its counterpart in the development of interactive animation. In the Eighties, artists returned to figurative imagery. It is the return to the descriptive that draws people to computer art. Artists and the masses have chosen to use the computer to create artworks in order to express our age, the Information Age.

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ANIMATION

Duane Palyka

Oh! Oh! More Craziness! 1986
3 minutes (artist's excerpt from *Living Above the Mouse's Ear*)

Pixar

The Adventures of André and Wally B. 1984
2 minutes

Tony Pritchett

The Flexipede 1968
2 minutes

Melvin Prueitt

Pixel 1984
4½ minutes
Crystal Dove 1985
¾ minute

Ron Resch

The Cube's Transformations 1984
6½ minutes

Judson Rosebush

Space‡ 1974
3 minutes

Dan Sandin, Tom DeFanti, Mimi Shevitz

Spiral 5 1981
6¾ minutes

Lillian Schwartz

Pictures in a Gallery 1975
7 minutes
MOMA 1984
½ minute

Lillian Schwartz, Kenneth Knowlton

Pixillation 1970
4 minutes
Olympiad 1971
3½ minutes

Michael Sciulli, James Arvo, Melissa White

Quest: A Long Ray's Journey into Light
1985
3½ minutes

Seibu Production Network

Mandala 1983
2¾ minutes

Richard Shoup

for **Xerox**
Superpaint 1973-5
4 minutes (excerpt)

Mark Snitily

Peak 1981
1½ minutes

Vibeke Sorensen

Temple 1975
4¼ minutes
Solstice 1986
3 minutes

Peter Struycken

Shift 31 1982
1 minute (excerpt)

Toyo Links

Bio-Sensor 1983
5 minutes

Susan Van Baerle

The Uneven Bars 1983
1 minute

Susan Van Baerle, Douglas E. Kingsburg

Snoot and Muttly 1984
3½ minutes

Stan Vanderbeek, Kenneth Knowlton

Man and His World 1967
1 minute
Poem Field #7 1968
4½ minutes

Stan Vanderbeek, Richard Weinberg

Euclidean Illusions 1979
9¼ minutes

Jane Veeder

Montana 1982
3¾ minutes

Chris Wedge

Tuber's Two Step 1985
1¼ minutes

Barry Wessler

SST vs Capitol 1972
3¾ minutes

James Whitney

Lapis 1962-6
8¾ minutes

John Whitney

Permutations 1968
7½ minutes
Arabesque 1975
6¾ minutes

Turner Whitted

The Compleat Angler 1980
1 minute

Dean Winkler, John Sanborn

Renaissance 1984
5¾ minutes

Edward E. Zajac

Simulation of a Two-Gyro Gravity-Gradient Attitude Control System 1961
3¾ minutes

David Zeltzer

The Skeleton Animation System 1984
1¼ minutes

TECHNICAL GALLERY

These images demonstrate the development of technical achievement in computer graphics. The technical gallery includes work by:

Kevin Bjorke
James Blinn
Phong Bui-Tuong
Loren Carpenter
Ed Catmull
Hank Christiansen
Jim Clarke
Frank Crow
A. Erdahl
David Evans
William Fetter
Henri Gourand
Ben Laposky
Carl Machover
Benoit Mandelbrot
Nelson Max
Martin Newell
A. Michael Noll
Fred Parke
William Reeves
Gordon Romney
Alvy Ray Smith
Ivan Sutherland
Richard Voss
John Warnock
Gary Watkins
Turner Whitted
C. Wylie
Bob Young
Edward E. Zajac

INSIDE BACK COVER CREDIT

1. **Frieder Nake**
Matrizenmultiplikation serie 40 1968
Plotter drawing with felt pen 20 x 20"
2. **Peter Beyls**
Handkolorierte Computerzeichnungen 1984
Hand-colored plotter drawing
3. **Masao Komura**
Leap! 1973
Offset lithograph and serigraph 24 x 24"
4. **Yolchiro Kawaguchi**
Untitled 1986
Photograph of raster image

BACK COVER CREDIT

1. **Tom DeWitt**
Vassar 1985
Photograph of raster image
©Tom DeWitt at RPI Image Processing Lab
2. **Edward Zajec**
Logic Moments in Color LMC 2701041 1976
Inlaid paper 17 x 17"
3. **Gerald Hushlak, Larry Sinkey**
The CEO Apologizing to her CRT from a Mount in Marlboro Country 1982-86
Ink on paper 30 x 40"
4. **Joan Truckenbrod**
. . . . on becoming 1984
Photograph of raster image
5. **James Whitney**
Still from *Lapis* 1962-6
16mm film 8¾ minutes
6. **Duane Palyka**
Picasso 2 1979
Photograph of raster image 16 x 20"

ANIMATION

Abel Image Research

Bill Kovacs, art director

Chicago — Skidmore, Owings, and Merrill
1981
2 minutes

Kenny Mirman, Randy Roberts, art directors

TRW Series 1981-5
2½ minutes

Randy Roberts, art director

Brilliance 1985
1 minute

Adage Graphics

LEM film 1967
1¼ minutes

Rebecca Allen

Swimmer 1981
¼ minute

Catherine Wheel 1982

2¼ minutes (artist's excerpt)

Steps 1982

2½ minutes (artist's excerpt)

Laurie Anderson, Dean Winkler

Sharkey's Day 1984
4¼ minutes

James Blinn

The Evolution of Blobby Man 1982
1 minute

for NASA

Voyager 2 Encounters Jupiter 1978-9
3¼ minutes

Loren Carpenter

Vol Libre 1980
2 minutes

Ed Catmull, Henry Christiansen,

Jim Clarke, Frank Crow,

Fred Parke, Phong Bui Tuong

Examples of Current Computer Graphics
Technology circa 1974

5¾ minutes (excerpt, restored)

Doris Chase

Dance Tén 1977
8 minutes

Charles Csuri

Hummingbird 1966
1¼ minutes

Cranston / Csuri Productions

TRW series 1984-5
1 minute

Gears 1986

½ minute

Cranston / Csuri Productions,

Ohio State University CGRG

George Playing Pool 1982
¾ minute

Larry Cuba

Two Space 1979
7½ minutes

Calculated Movements 1985

6½ minutes

Tom DeFanti, Mark Gillenson,

Manfred Knemeyer,

Gerry Moersdorff, Charles Csuri

Grass 1971-2

1 minute (excerpt)

Gary Demos

Rainbow Pass 1974
4¾ minutes

Digital Productions

2010: Jupiter Sequence 1984
¾ minute (excerpt)

Hitachi 3D Movie 1985

¼ minute (excerpt)

for Lorimar / Universal

The Last Starfighter 1984
3 minutes (excerpt)

Sonja Ellingson

A Brief Visual History of Computer
Graphics 1963-72

4¼ minutes

David Em

Egg White and the Seven Pixels 1983
3¾ minutes

Ed Emshwiller

Thermogenesis 1972

3½ minutes (artist's excerpt)

Sunstone 1979

3 minutes

Skin Matrix S 1984

4¼ minutes (artist's excerpt)

Bill Etra, Louise Etra, Lou Katz

Ms. Muffett 1975

3 minutes

Peter Foldes

La Faim (Hunger) 1974
11½ minutes

Ford Motor Co.

Surface Generation by Computer 1965

2½ minutes

Geoffrey Gardner

Beethoven's Sixth in CIG 1981
5½ minutes

Copper Giloth

Popcorn 1980

¾ minute

Skippy Peanut Butter Jars 1980

3¾ minutes

Ronald Hackathorn, Rick Parent,

Al Meyers, Charles Csuri

Anima 2 1976

2¾ minutes

Ron Hays

Canon 1979

6 minutes

Information International Inc.

Demo 1981

9¼ minutes

H. Jürgens, H.-O. Peitgen, M. Prüfer,

P. H. Richter, D. Saupe

Frontiers of Chaos 1985

6¼ minutes (excerpt)

Yoichiro Kawaguchi

Growth I — *Mysterious Galaxy* 1983

6¼ minutes

Growth II — *Morphogenesis* 1984

4¼ minutes

Growth III — *Origin* 1985

4½ minutes

Manfred Knemeyer, James Shaffer,

Charles Csuri

Real-time Art System 1969

1¾ minutes (excerpt)

Pierre LaChapelle, Philippe Bergeron, Pierre Robidoux, Daniel Langlois

Tony de Peltrie 1985

8 minutes

Doug Lerner

Molecular Dynamics 1985

2¾ minutes

Doug Lerner, Dan Asimov

Sudanese Möbius Band 1984

2 minutes

Limelight Productions

for Dire Straits

Money for Nothing 1985

4¾ minutes

Ken Loss-Cutler

Geometric Perspectives 1985

5 minutes

Lucasfilm

for Paramount Pictures

Star Trek II: Genesis Sequence 1982

1½ minutes

MAGI

Bob Goldstein

Demonstration of the MAGI Process for
Computer Generated Films circa 1968

2 minutes (excerpt)

MAGI / Synthavision

Demo 1972

6 minutes

for Disney Studios

TRON: Light Cycles and Tanks 1982

4½ minutes

Wild Thing 1982

¾ minute

Benoit Mandelbrot

The First Fractal Island 1974

½ minute

David Margolis, Hüseyin Koçak,

David Laidlaw, Thomas Banchoff

Tori in the Hypersphere 1985

3 minutes

Nelson Max

DNA with Ethidium 1978

4¼ minutes

Carla's Island 1981

4½ minutes

New York Institute of Technology

Computer Graphics Laboratory

3DV 1983

10 minutes (includes excerpts from *The Works*)

A. Michael Noll

A Computer Generated Ballet circa 1964

2½ minutes

Rotating Four-Dimensional Hyperobject

circa 1964

1 minute (excerpt)

Arthur Olsen

Tomato Bushy Stunt Virus 1981

3¾ minutes (excerpt)

Pacific Data Images

T. Beier, A. Chin, R. Chuang, R. Cohen,

G. Entis, S. Folz, R. Gould, J. Palrang,

C. Rosendahl, D. Venhaus, J. Ward

Assorted Animation Pieces 1983-5

4½ minutes

INSTALLATIONS

Lance Williams

Serpent 1985
Shore 1986
Photographs of raster images

Richard Wright

1, 2, 3, 0; 0; 5, 2, 8, 4, 2, 4, 1, 4
1, 2, 3, 0; 0; 3, 2, 8, 4, 1, 2, 7, 4 1986
Photograph of raster image

Shigeki Yamamoto

Luminous Wind 1986
Inkjet print

Shinya Yusa

Computer Tube 1985
Computer Bugle 1985
Serigraphs

THE UNIVERSAL SPHERES 1986

The Universal Spheres reflect technical advances in computer graphics as expressed in spherical objects. Unless otherwise noted, all the Spheres are photographic reproductions of raster images. Numbers refer to the order in which images are shown.

Al Barr

15. Untitled (Rings of Spheres) 1982
53. Untitled (Crystal Tinkertoys) 1982

James F. Blinn

22. *Blobby DNA Molecules* 1981
30. *Io Closest Approach* 1979
32. *Venus Surface Map* 1982
32. *Saturn Rings* 1982

David E. Breen

60. *Terrain* 1986

Bruce Brown

12. *Re-entry Vehicle Simulation* 1979

Stan Cohen, Todd Rodgers

10. Untitled (Spheres) 1984

Michael Colleary

26. Untitled (Textured Shapes) 1982

Robert Conley

54. *Refractions* 1982

Frank Crow

44. Untitled (Peppermint wineglass and green glass ball) 1982

Frank Dietrich

23. Untitled (Blobby) 1984

David Difrancisco

73. *Chrome Hedge* 1981

Kathleen M. Dolberg

8. *Shadows (LAUR85-2918)* 1985

David Em

39. *Crimson King* 1979
40. *Kapong* 1979

David Geshwind

63. Untitled (Bug Eyes) 1980

Roy Hall

55. Untitled (Still Life with Candy Dish) 1984
71. *The Gallery* 1983

Hsuen-Chung Ho

57. Untitled (Pink and Green Balls, Chrome Reflections) 1983

Kirk Hoaglund

13. Untitled (Spheres and Machine Part) 1984

Jim Hoffman

36. Untitled (Poly-patterned Planet) 1981

Kevin Hunter

41. Untitled (Translucency Illusion) 1982

Tony Johnson

6. *Bubble Girl* 1982

Bruce Jones, Mark Sylvester,

John Grower
76. *Wavefront's Exclamation Point* 1985

Richard Katz

11. *In The Beginning* 1983

Yoichiro Kawaguchi

24. Untitled (Splash) 1982
45. *Crystal Space* 1982
46. Untitled (Sphere with Reflection) 1982

D. B. Kirk

51. Untitled (Primary Light Spheres) 1985
79. Untitled (Green Sphere on Water) 1985

Ken Knowlton

3. Untitled (Blue and Green) 1979

Chuck Kozak

1. *Nuke the Cablecars* 1982

David Laidlaw, Hüseyin Koçak

77. *Tubes Within Tubes* 1986

D. Leich

69. Untitled (Floating Spheres) 1983

David Lister

47. *Bouncing Balls* 1983

Dick Lundin

68. Untitled (Ant and Crab from *The Works*) 1982

Mike Marshall

5. *Beam and Bubbles* 1981

Nelson Max

20. *Two Base Pairs of DNA; double exposure* 1979
18. *Twenty Base Pairs of DNA; No Shadows* 1980
19. *Ball-and-Stick DNA; open form* 1981

Nelson Max, Fred Wooten

16. *Antimony Sulfur Iodide Crystal* 1979

Nelson Max, John Blanden, John Watchmaker

21. Untitled (Translucent DNA) 1982

G. Myers

27. *Shiva First 20 Beam Shot* 1979

L. Nackman

35. Untitled (Polygon Fantastic Planet) 1982

Suma Noji

25. *Stone* 1985

Arthur Olson, Nelson Max

17. *Tomato Bushy Stunt Virus* 1980

Michael Potmesil

14. Untitled (Sphere Towers) 1980
38. Untitled (Painted Spheres) 1980
48. Untitled (Recursive Sphere and Cube) 1980
50. Untitled (Mandril Sphere) 1980

Melvin Prueitt

58. *The Rising* 1985
59. *Sparkling Molecule* 1985

John Ridgeway

2. Untitled (Full Moon) 1984

Christa Schubert

4. *Untitled* (Plotted Circles) 1984
Photoreproduced collage of plotter drawing

Michael Sciulli, James Arvo

56. *Orange* 1985

Patricia Search

74. *Mystrigue* 1986
75. *Spirit Two* 1984

Richard Shoup

28. *Planet Composition Chart* 1980
29. *Orbiter Trajectory Chart* 1979

D. Stredney

62. *Old Cowboys Never Die* 1982

S. Todd

67. Untitled (Modular Structure with Spheres) 1985

Joanne Tolkoff

7. *Cactupus* 1985

George Tsakas

78. *Pool Balls* 1986

Richard Voss, Benoit Mandelbrot

33. *Fractal Planetrise According to Benoit Mandelbrot* 1982

P. Watterberg

49. *SIGGRAPH '83* (Mandrill Title Slide) 1983
72. Untitled (Crystal Ball Pyramid Lake) 1985

Turner Whitted

52. Untitled (Ray Traced Spheres) 1982

Lance Williams

9. *Giaconda* 1982
65. *Untitled* 1979
66. *Casting Curved Shadows on Curved Surfaces* 1979

Lance Williams, Alvy Ray Smith

64. *Untitled* 1979

artists unknown:

from Paramount Pictures

34. *Genesis Planet* 1982

from Information International Inc.

43. *Computer* 1979
61. Untitled (Still Life With Orange) 1979
70. Untitled (Interior Scene) 1981

from Information International Inc. for Disney

37. *TRON Solar Sailor* 1982

from Lexidata Corp.

42. Untitled (Translucent Ball Bearing) 1983

Images seen in *The Universal Spheres* may be found in SIGGRAPH slide sets from previous years.

INSTALLATIONS

Linda Gottfried

Betsy IV 1986
Betsy V 1986
Betsy VI 1986
Gyro-Glyphics 1985
Photographs of raster images

Henry Grebe

Statue of Liberty (3 × 3) 1986
Photograph of raster image

Eric Haines

Homo Ludens 1984
Photograph of raster image

Sharon Hendry

Artist's Studio 1985
In the Heights — Houston, Texas 1985
Portrait of a Spy 1985
Photographs of raster images

Trish Henry

Don 1985
Don 2 1985
Photographs of raster images

Colin Hui

Ugman 1986
Porcelain Doll 1986
Photographs of raster images

Colin Hui, Tom Nadas, Alain Fournier, Avi Naiman, John Amanatides

In Drag 1985
Photograph of raster image

Hervé Huitric, Monique Nahas

Hommage à Georgette La feuille 1985
Nature 1985
Eva 1986
Caprice 1986
Photographs of raster images

Masa Inakage

Dream Cloud 1985
Photograph of raster image

Christian Janicot

Dido & Aeneas 1985
La Table Rouge 1985
Photographs of raster images

Lauretta Jones

Drawing Life, Drawing Blood 1985
Mixed media collage

Alyce Kaprow

Two__Foto 8A 1984
Two__Bignums 1984
Photographs of raster images

Alex Kempkens

Haider 1984
W. F. a 1984
W. F. b 1984
W. F. c 1984
Photographs of raster images

Mi Kyung Kim

Still Life with Cat 1986
Photograph of raster image

Hareesh Lalvani

Islamic Pattern Q2.P4.Q8.P3 1982
Islamic Pattern Q9.Q5.P4.Q8.Q2.R1 1982
Islamic Pattern P3.P4.P2.Q2.Q8.P6.P4.Q5.Q9.R12.Q6.Q1.R1 1982
Plotter drawings

Xavier Lee

Embers (Tribute to Gerima) 1985
Photograph of raster image

Ruedy W. Leeman

Sexuality Body 1985
Photograph of raster image

Sharmen Liao

Untitled 1986
Photograph of raster image

Don MacKay

Shirt 1-1 1985
Shirt 1-5 1985
Shirt 1-6 1985
Photographs of raster images

Gregory MacNicol

Four Threads 1985
Photograph of raster image

Ferdinand Maisel

Rch.in 1985
Photograph of raster image

Ferdinand Maisel, John Chadwick

Touchdown 1985
Photographs of raster images

Steven L. Mayes

Crossroads 1985
Photoetching monoprint

Karen McInnis

Cal and Cort Poolside 1985
Sea Shack 1985
Pep and Mugs 1985
Photographs of raster images

Gavin S. P. Miller, Jon Hunwick

Boris the Spider (Hanging by a Thread) 1985
Photograph of raster image

John Jay Miller

srobb.2 1984
qfix.861 1986
Photographs of raster images

Mary Lynn Morrow

Green Chair Parade 1986
Chair Parade in the Church 1986
Photographs of raster images

Charles B. Murphy

Dog Dreams 1985
Photograph of raster image

Herbert Paston

Domo Sushi 1985
Photograph of raster image

Edie Paul

Cityman Takes a Walk 1985
Photograph of raster image

Steve Pietzsch

Rembyte 1985
Self Portrait 1985
Photographs of raster images

Marilynne Ramsey

Tsunami Waterbed 1983
Printer drawing

Micha Riss

Vision 1985
Photograph of raster image

Elizabeth Rosenzweig

Beresheet 1983
Syzygy 1984
When 1984
Photographs of raster images

Christa Schubert

Untitled (B) 1985
Collaged plotter drawing

Christa Schubert, Roy Montibon

Untitled (D) 1985
Collaged plotter drawing

Ilene Schuster

Communication Spheres 1985
Spacescope 1985
Photographs of raster images

Leslie Schuster

Femme Robuste 1984
Electralily 1985
Madonnae 1986
Photographs of raster images

Anne Seidman, William Kolomyjec, John Donkin

Ghoti 1985
Photograph of raster image

Takeshi Shibamoto, Yumi Shibata

Koömote 1982
Photograph of raster image

Joel A. Slayton

JSDD2 1982
JS2537 1982
Photograph of raster image

Dan Spence

Metal Limpet 1985
Photograph of raster image

René Steichen

Blue Runner 1985
Motion 1985
Photographs of raster images

Gwen Sylvan

Journey 1985
Santorini 1985
Photographs of raster images

Naoko Tosa

Visual Buddha 1985
Photograph of raster image

Joan Truckenbrod

. . . . on becoming 1984
relativistic observer 1985
resonance 1985
Photographs of raster images
Lattice Vibrations 1985
Printed canvas tapestry

Sotera Tschetter

Late Night Stop 1986
Photograph of raster image

Frances Valesco

Birdcall #3 1986
Mixed media print

Tom Vasko

Chess Game 1985
Manipulated photograph of raster image

Michael J. Voelkl

Newland VII 1985
Inkjet print

Keith Waters

Eiffel Tower 1984
Plotter drawing

Greta Weekley

Seven Curved Chords, Version III 1985
Plotter drawing

Jerry Weil

Money for Nothing 1986
Irony 1986
Photographs of raster images

INSTALLATIONS

Denis Bolohan

Untitled 1985
Mylar mirrors 500 sq. ft.

Peter Broadwell, Rob Myers, Robin Schaufler

Plasm: A Fish Sample 1986
Environment with Iris workstation

D. L. Deas, Jeanne Mara

Let's just call it 'Untitled' 1986
Mixed media 60 x 48 x 18.5"

Tom DeWitt, Alan Jackson

Pantomation 1986
Laser projector 8 x 8 x 20'

Alejandro Ferdman, Mark Holzbach, David Chen

Airborne 1985
Hologram 8 x 8"
His Master's Song 1986
Hologram 8 x 8"

Audrey Fleisher

Kimono 1985
Mixed media, 41 x 50"

Jim Gibson

Inexplicable Synthetic Persona 1986
Dangerous Illusions 1986
Voodoo Mojo 1986
Amiga microcomputer

Jo Ann Gillerman, James Gillerman

Orchid 1986
Aurora computer graphics system

Copper Giloth

The Conversation #1 1986
Amiga microcomputer and wood

Margot Lovejoy

Azimuth XX Series 1986
Projection 12 x 16'

Sharon McCormick

Time Man 1986
Hologram
Texas / SIGGRAPH 1986
Hologram

Barbara Nessim

Untitled 1986
Macintosh microcomputer and five
printer drawings

Philip Pearlstein

Philip Pearlstein Draws the Artist's Model
Videotape 86min
Legs and Linoleum 1984
Watercolor on paper 30 x 41½"

Edward R. Pope

Doctor Artist 1985
Apple IIe microcomputer

Thomas Porett

Victims 1985
Macintosh+ microcomputer and printer
drawings

Michael Sciulli, Melissa White, James Arvo et.al.

Arcade 1985
Dome Temple 1985
Temple__2.land 1985
Rainbow 1985
A Spectrum of Graphic Solutions 1986
Apollo computer

Vibeke Sorensen

Abstraction 1975
Krinklebox 1984
Untitled 1986
Stereoscopic studies

Jacques Stroweis

Untangible 1986
Mutoscope image

PAINTING IN LIGHT 1986

the following works are included in this
installation:

Pat Alexander

Carnival 1985
Photograph of raster image

Carlos Argüello

Mary 1985
Poul + Mary 1985
Photographs of raster images

Daniela Bak

Haricots verts 1986
Photograph of raster image

Amy Bassin

A Battle of Nude Men #2 1985
Photograph of raster image

John Ashley Bellamy

Comet Impregnation of the Star Man 1985
*Image Shattering Re-entry of the
Star Man* 1985
Cosmic Metamorphosis 1985
Photographs of raster images

Alain Bergeran

Singing 1986
Photograph of raster image

Peter Beyls

Handkoloriete Computerzeichnungen 1984
Hand-colored plotter drawing

Terry Blum

Folded Structure 1983
Ellipse Series #1 1985
Photographs of raster images

Chiara Boeri

Love Love Love 1985
Décor pour Don Juan 1985
Erotica 1 1985
Photographs of raster images

Jeff Brice

Burden of Memory 1985
Photograph of raster image

Paul Brown

Drawing 1974
Plotter drawing
Sculpture Simulation 1983
Photograph of raster image

Luz Bueno

China Doll 1983
Woman Running Under the Moon 1983
Photographs of raster images

Nancy Burson, Richard Carling,

David Kramlich
Androgyny 1982
The Dead 1984
Composite silver prints

Martha Cansler

Paintbox/ADO Demo 1985
Photograph of raster image

Christian Cavadia, Jean-Pierre Lihou

Bouquet fleché 1981
Plotter drawing

Christian Cavadia,

Jean-Charles Troutot
Hommage à Escher 1983
Plotter drawing

Miguel Chevalier

+ F . . . a touch of red & pink 1986
Red Lips 1986
following the tracks 1986
Photographs of raster images
following the tracks 1986
Altered transparency

Jp Culver

Dancer 1986
Cancelled Life 1986
Photographs of laser images

Mary A. Daemen

Journey 1985
Three Graces Plus One 1985
Self-portrait III 1985
Photographs of raster images

Mark A. Dearing

A Little Bird Told Me 1985
The Young Officer 1985
Photographs of raster images

Ryoichiro Debuchi

Biomechanoids #1 1986
Biomechanoids #2 1986
Photographs of raster images

Amber Denker

Blowout 1984
Isolation/Inspiration 1984
Untitled 1985
Photographs of raster images

Tom DeWitt

Vassar 1985
Photograph of raster image

Frank Dietrich

C-Mix (a) 1984
C-Mix (b) 1984
Antarctica 1984
Photographs of raster images

Frank Dietrich, Greg Turk

Softy 1983
Photographs of raster images

Matt Elson

Poster Image 1985
Helga Smoking 1985
Phil in the Desert 1985
Photographs of raster images

Audrey E. Fleisher

Skywarp 1986
Photograph of raster image

Donald Gambino

Does He, or Doesn't He? 1986
Flexing for Her 1986
Photographs of raster images

Rachel Gellman

Dance Variations 3 1985
Composite photograph
Abstract Conversations 1985
City/Texture 1985
Photographs of raster images

Michael Golden

Quality Foil 1 1985
Quality Foil 2 1985
Quality Foil 3 1985
Photographs of raster images

Deborah M. Gorchos

Mr. Lizard Snakeskin Sheds It 1985
Heat transfer on fabric

TWO DIMENSIONAL / THREE DIMENSIONAL WORKS

Masao Komura

Leap! 1973
Offset lithograph and serigraph 24 x 24"

Masao Komura, Kunio Yamanaka

Return to a Square (b) 1968
Serigraph 20 x 17"

Masao Komura, Kouji Fujino

Running Cola Is Africa! 1968
Serigraph 40 x 40"

Ben F. Laposky

Oscillon 40 1952
Photograph of analog screen 11 x 14"
Oscillon 1049 1960
Photograph of analog screen 11 x 14"

Tony Longson

Group Theory Grid 1968
Plexiglass 24 x 24 x 4"
Square Tonal Drawing #2 1980
Plexiglass 30 x 30 x 4"
After Mondrian 1986
Plexiglass 30 x 30 x 4"
Fragmented Anamorph 1986
Aluminum rod and image 30 x 30 x 10"

Robert Mallary

Quad III 1968
Laminated veneer 86 x 16 x 16"
Collage 1985
Cibachrome of raster image 8.5 x 10.5"
A Group of Four 1986
Cibachrome of raster image 30 x 12"

Robert Mallary, Douglas Cox

Three Arrays 1978-9
Mixed Media, 80 x 60 x 52"

Aaron Marcus

Lightbuttons: Rising Suns 1967
Photograph of vector image 30 x 30"
Radioactive Jukebox 1972-4
Serigraph 18 x 15"
Hieroglyphs 1978
Plotter drawing 12 x 12"

Hideki Mitsui

CG 1972-I 1972
Photograph of plotter drawing 10 x 12"
Cosmic Image: Transmigration 1985
Acrylic on canvas 36 x 36"

Manfred Mohr

P-21 Band-Structures 1969
Plotter drawing 22 x 22"
P-26/2 Inversion Logique 1969
Plotter drawing 22 x 18.5"
P-52 Quark-Lines 1970
Plotter drawing 22 x 22"
P-161 Cubic Limit 1973
Plotter drawing 38.5 x 153"
P-155 Cubic Limit 1974-6
Serigraph 27.5 x 27.5"
P-200 /2009 /2015 /2016 /2020
Cubic Limit II (series) 1977-80
Plotter drawings 12.25 x 12.25" each
P-306 Divisibility I 1980-3
Acrylic on canvas and wood 40 x 44"
P-370-P Divisibility II 1985
Plotter drawings 24 x 24"

Vera Molnar

Interruptions -20 1969
Plotter drawing 17.5 x 13.5"
Interruptions -72 1969
Plotter drawing 15 x 13.5"
Hypertransformations 1973-6
Plotter drawings 15 x 13"
Hypertransformations 1973-6
Serigraph 25.5 x 19.5"
Fissions -5 1985
Serigraph 22 x 22"

David Morris

Spirit 1986
Aluminum 2 x 3 x 3'

Frieder Nake

Random Polygon 1963
Photograph of plotter drawing 8 x 6"
Random Polygon, Controlled Randomness
1965
Serigraph 20 x 20"
Hommage to Paul Klee 1965
Serigraph 20 x 20"
Random Walk Through Raster,
series 2.1-4 1966
Serigraph 18 x 18"
Matrizenmultiplikation serie 40 1968
Plotter drawing with felt pen 20 x 20"
Matrizenmultiplikation serie 42 1968
Plotter drawing with felt pen 20 x 20"
Contribution to Ars ex Machina 1972
Serigraph 20 x 15"

Georg Nees

Corridor 1966
Serigraph 39 x 28"
Gravel Stones 1966
Serigraph 39 x 28"

Duane M. Palyka

Computer Art 1967
Printer drawing 28 x 20"
Centered Bubbles 1974
Photograph of raster image 20 x 16"
Self-Portrait 1975
Photograph of raster image 16 x 20"
Picasso 2 1979
Photograph of raster image 16 x 20"

John Pearson

O H B Proposal #1 1984-5
Acrylic on board 22 x 36 x 3"
Fresnel Proposition (five plots) 1986
Plotter drawings 11 x 8.5" each
Remembrances #5 1986
Acrylic on shaped canvas 74 x 93"

Lillian Schwartz

Big MOMA 1984
Lithograph 8 x 4'
Symbolic Homage to Picasso 1986
Cibachrome of raster image 4 x 4'

Chihaya Shimomura

Work #4 circa 1979
Photograph of plotter drawing 8.5 x 11"
Work #10 circa 1979
Photograph of plotter drawing 8.5 x 11"
Work #16 circa 1979
Photograph of plotter drawing 6 x 8"

Gregg Smith, Kathy Neely

Colin Wilson — Distorted in Triangles 1985
Inkjet print 11.5 x 15"
Delano 1985
Inkjet print 12 x 16"

Vibeke Sorensen

Three Ring Circuit 1986
Electronics and plexiglass 8 x 8 x 4"

Kerry Strand

Crest 1972
Serigraph 16 x 21"

Stan Vanderbeek

Cosmos Series 29.1 / 29.2 1967
Etchings 24 x 24" each
Love / Hate (4) 1974-5
Etchings 18 x 40" each
Disappearing Man 1979
Plotter drawing 60 x 29.5"
Disappearing man 1979
Preliminary sketch 77 x 22"

Mark Wilson

Untitled 1975
Acrylic on linen 72 x 72"
Long Skew B 1985
Plotter drawing 20 x 96"

Edward Zajec

Proster V. 8. I 1968-70
Plotter drawing 18 x 18"
Spatial Metaphors 1970-3
Serigraph 22.5 x 22.5"
Prismance 1122 1978-81
Plotter drawing 16 x 16"

Edward Zajec, Matjaz Hmeljak

The Cube: Theme and Variations
TVC 3271 1971
Plotter drawing 12 x 12"
TVC 57302 1971
Plotter drawing 15 x 15"
TVC 59888 1973
Plotter drawing 15 x 15"
Logic Moments in Color
LMC 3002086 1976
Inlaid paper 17 x 17"
LMC 3002086 1976
Alphanumeric print 14.5 x 16"
LMC 5160680(011) 1976
Alphanumeric print 14.5 x 16"
LMC 5160680FTT 1976
Inlaid paper 17 x 17"

TWO DIMENSIONAL / THREE DIMENSIONAL WORKS

Colette Bangert, Charles Bangert

Large Landscape: Ochre & Black 1970
Plotter drawing 32 x 23"

Landlace 1976

Acrylic on cotton duck 52 x 52"

Structure Study II: Yellow, Red, Brown, Black 1977

Plotter drawing 10 x 16"

Grass: Series I 1979

Plotter drawing 11 x 13.5"

Circe's Window 1985

Plotter drawing 8.5 x 11"

Manuel Barbadoillo

Cuadro Numero 192, 168 circa 1969
Alphanumeric prints, 11 x 15" each

Aneila 1974 — Aneya 1974 — Aneda 1975

Photographs of studies for paintings,
7 x 7" each

Metaplasmos, 6M5 1985

Plotter drawing 22 x 9.5"

Klaus Basset

Symmetrische Durchdringung gerader und ungerader Reihen 1963

Drawing 6 x 6"

Gegenläufiger Rhythmus mit einem Zeichen in 8 verschiedenen Längen 1967

Tempera on paper 5.5 x 19.5"

Osliper Fächer 1981

Alphanumeric print 12 x 12"

Layers and Steps I (1 of 10) 1984-5

Alphanumeric print 12 x 12"

Klaus Basset, W. Plochl

Linz (series) 1979

Alphanumeric prints 12 x 22"

Susan Brown

Stretch 1985

Plotter drawing 28 x 30"

Violin 6 1985

Plotter drawing 20 x 25"

Daniel Cooper

Luma-I 1984

Serigraph 18 x 26"

Charles Csuri

Hummingbird 1966

Photograph of plotter drawing 8.5 x 11"

Hummingbird Transformations 1966

Photograph of plotter drawing 8.5 x 11"

Leonardo Man 1966

Photograph of plotter drawing 8.5 x 11"

Sine Curve Man 1966

Photograph of plotter drawing 8.5 x 11"

Marilyn Eitzen Jones

Reflections 1985

Mixed media on acrylic 3.5 x 3.5"

David Em

Redbal 1980

Cibachrome of raster image 6 x 8"

Sunrise 1985

Cibachrome of raster image 16 x 20"

Zotz 1985

Cibachrome of raster image 16 x 20"

Chernobyl 1986

Cibachrome of raster image 40 x 40"

Eudice Feder

Permutations 1980

Plotter drawing 8.5 x 11"

Separation 1980

Plotter drawing 16 x 23"

Divided Sea 1983

Plotter drawing 12.5 x 15"

Southern Lights 1985

Plotter drawing 16 x 23"

Jürgen Lit Fischer

Obertöne-spektral 1984

Serigraph 40 x 40"

Intervals / Intervalle 1985

Serigraph 19 x 19"

Light-Piece / Laser-Peace 1986

Plexiglass 40 x 40 x 0.8"

Rob Fisher, Ray Masters

Skyharp 1986

Stainless steel, aluminum 16 x 16 x 6"

Herbert Franke

Grafik I 1956

Serigraph 11 x 17"

Grafik 6 1956

Serigraph 11 x 17"

Serie 1956 1956

Serigraph 28 x 20"

Serie 1956 ed'a 1956

Serigraph 28 x 20"

Serie 1961/62 e'd'a' 1961-2

Serigraph 27.5 x 20"

Drakula 1972

Serigraph from calendar 21 x 16"

Farbraster 42 1975

Inkjet print 16.5 x 14"

Farbraster 75 1975

Inkjet print 16.5 x 14"

Herbert Franke, Peter Henne

Algebraische Kurven, ed'a 1969

Serigraph 28 x 20"

Herbert Franke, Horst Helbig

Mathematische Landschaft 1984

Cibachrome of raster image 20 x 20"

Jeremy Gardiner

Self-portrait 1985

Acrylic on canvas 60 x 60"

X-Ray 1985

Acrylic on canvas 60 x 60"

Laurence M. Gartel

Deciphering Archetypes of Human Form 1985

Polaroid collage 37 x 33"

Darcy Gerbarg

DVI Series I #1 1979

Etching 10 x 12"

Q space 1982

Serigraph 50 x 40"

Plain 1985

Acrylic on canvas 63 x 87"

Sandy 1986

Acrylic on canvas 63 x 89"

Julian Guest

CC/400/P Series (3) 1977

Plotter drawing 11 x 11" each

Bruce Hamilton, Susan Hamilton

Tetrad 1984

Wood 16 x 27 x 23"

Josepha Haveman

Stillife 8 1985

Inkjet print 10 x 12"

Martin J. Heller

Eternal Braid 1983

Plotter drawing 40 x 28"

Richard Helmick

Hills 1980

Screenprint 20 x 21"

Glades 1983

Screenprint 22 x 30"

Janet Hoskins

Boomer Bytes 1985

Fabric 21 x 36"

Gerald Hushlak

Chernozem Fields Forever 1977

Ink on paper 18 x 18"

Rubber Stamping the Lonely Angels of Reality 1982

Ink on paper 30 x 40"

Gerald Hushlak, Larry Sinkey

Ain't No Navel Forces in Dis'Dress 1982

Ink on paper 30 x 40"

Intuitive Ordering of Aqueous Humor Into a Likeness of Mount Rushmore 1982

Ink on paper 30 x 40"

The CEO Apologizing to her CRT from a Mount in Marlboro Country 1982

Ink on paper 30 x 40"

Suguru Ishizaki

Organic Image 1986

Serigraph 32 x 32"

Jozef Jankovič, Imrich Bertok

The Place Above 1979

Serigraph 32 x 21.5"

Computer, My Daughter and I 1980

Serigraph 25.5 x 19"

The Group Exercise 1983

Serigraph 26.5 x 33"

Alyce Kaprow

Fazes 1983

Photograph 16 x 20"

Matthew 3 1984

Photograph 16 x 20"

Kenneth Knowlton

Daybreak 1966

Serigraph 16 x 20"

American Gothic Pair 1984

Dominoes 26 x 24 each

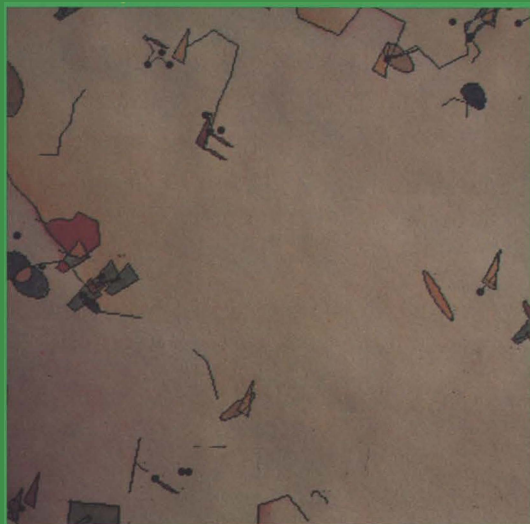
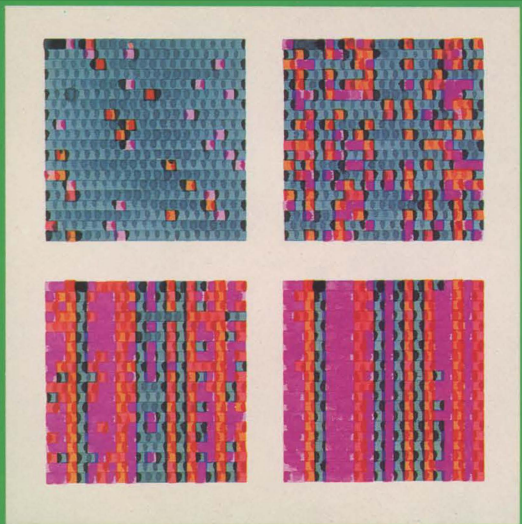
Statue of Liberty 1986

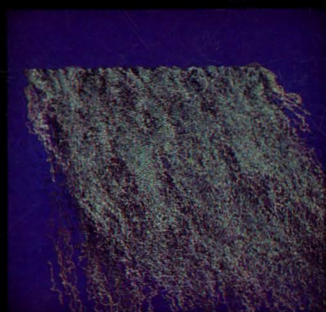
Laserprint 20 x 16"

Kenneth Knowlton, Leon Harmon

Nude (Study in Perception) 1966

Alphanumeric print (original 30 x 144")





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