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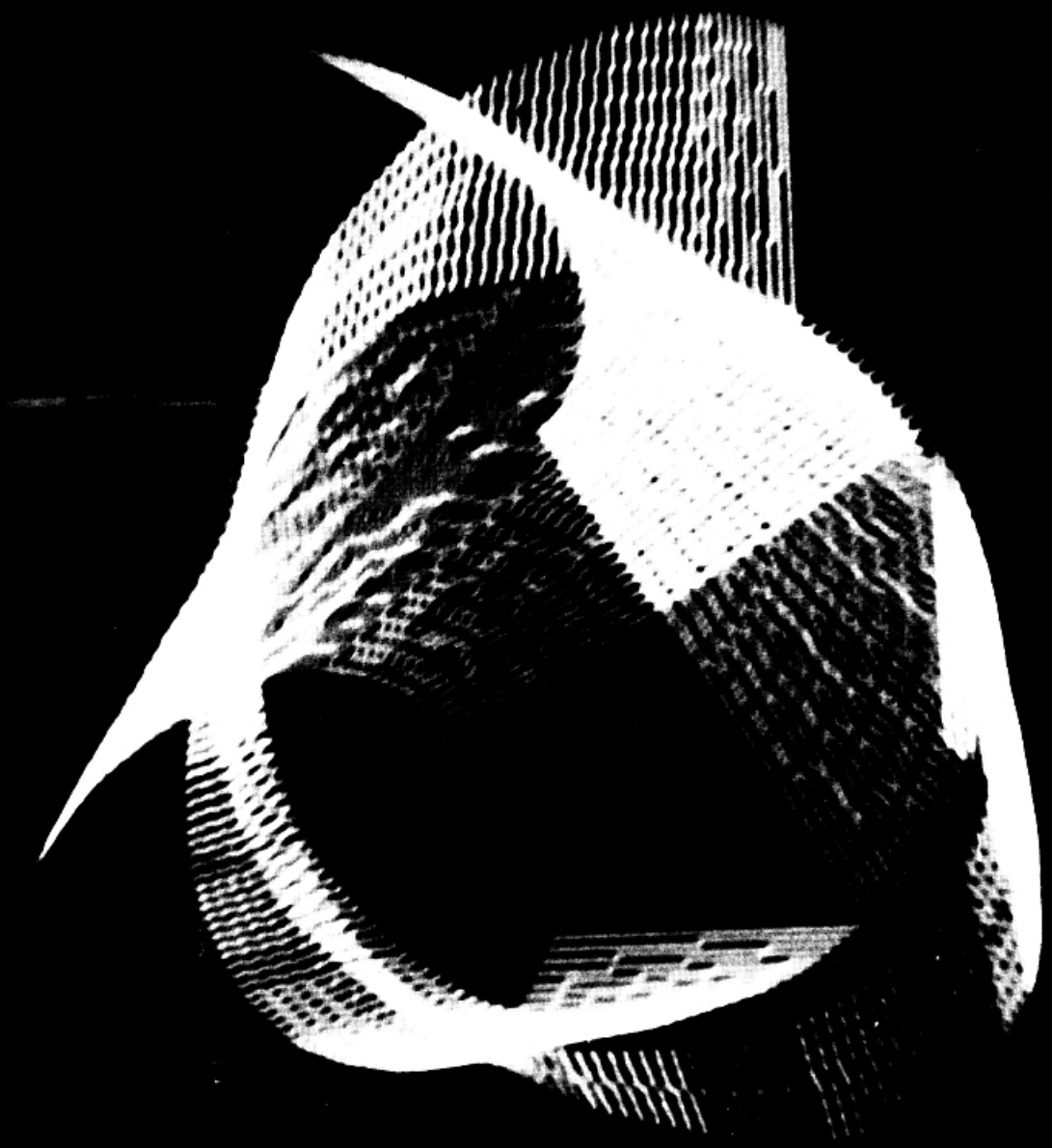

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PHOTOGRAPHY, LAYOUT DESIGN, Grace C. Hertlein

THE MAGAZINE OF INTERDISCIPLINARY COMPUTER GRAPHICS FOR PROFESSIONAL GRAPHICS PEOPLE AND COMPUTER ARTISTS

EDITORIAL

MAKE DO WITH WHAT YOU HAVE

Recently several incidents have recalled the idea of "making do with what you have." Too often there is the mistaken idea that one must have very expensive hardware and software to achieve innovative graphics. Here are some examples:

THE NEEDS OF SMALL INSTITUTIONS

I was preparing an invitational paper for a computer conference of small colleges. The conference leader asked me to suggest ideas that these small institutions could afford to achieve graphics. The idea came readily to mind: "Make do with what you have. Don't wish for the moon."

THE NEED FOR AWARENESS BY STUDENTS

I was lecturing and demonstrating art graphics to a group of students in an advanced software class. They were bemoaning the lack of complex animation equipment. In discussing their current research, I found that many of them were re-inventing the wheel, repeating experiments that were already available on our campus. They had failed to assess what was available. When they were told that such routines were already in existence, they replied, "Oh, I was interested in the theory. It doesn't matter if I repeat what someone else has already done."

However, if more students were aware of what has been done, they could use their fine talents to take previous research and add improvements, to render these systems available for new users, etc.

THE NEED FOR INTEGRATION OF FACILITIES, SOFTWARE

It is becoming increasingly common for institutions to hire a special coordinator for instructional computing. Some common needs are: teaching teachers how to compute; coordinating programs that are available; securing needed software; planning new hardware, etc.

I talked with such a coordinator a few weeks ago. He enthusiastically expounded on grand plans for expensive new hardware. I listened for some time, and then said:

- Do you know what we already have available?
- Have we ascertained that existing materials and facilities are being fully used?
- Are we making use of knowledgeable people on our own campus?
- Have we ascertained what programs we can get free of charge from our own system?
- Have we investigated to find out what we can obtain from our regional computer consortium?
- Have we researched what is available from national organizations, as EDUCOM and CONDUIT?
- Have we planned specific workshops for special groups of people?

RE-INVENTION OF THE WHEEL

Repeatedly at national and international conferences we see research that is identical with previous discoveries. Professors are not the only persons who fail to review the literature. Intermediate and advanced students are too often guilty of the same practice.

There is something more important here than ignorance, ego, or immaturity. It is the lack of objective study and thinking about the work of others. Too often we accept authorities as minor gods, and do not question openly what has been accomplished -- and do not appreciate sufficiently what has been done. This is intellectual immaturity.

KNOW WHAT IS AVAILABLE

The valuable resources of many institutions are wasted because systems are locked up (for the privileged use of specific users). Making full use of facilities is mandatory for any institution.

Information on facilities and available software is not openly advertised for potential users. Information is often poorly organized for varied types of users.

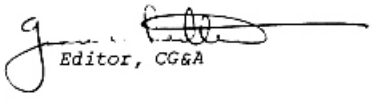
GOING BEYOND WHAT YOU HAVE

After making sure that what is available is well used, there is an innovative place, where one can get hardware and software to do things beyond their original intent or scope. For example, many institutions do "pseudo" animation on storage tube CRTs. Many small schools only have printer graphic capabilities. Many groups do not have plotters and utilize hard copy units from CRTs until they can afford to buy other hardware.

After innovatively using what is available, it is sensible to have expansion plans, wisely knowing what is affordable, and what works, particularly in a student environment, where equipment must be "student proof". Often it is necessary to learn to write good feasibility studies, in order to get the new hardware and software.

Computer graphics is like the art of great cooking. A superb cook can make a marvelous meal from almost nothing. A mediocre cook requires only expensive, rare ingredients.

It will be some time before microfilm and frame buffer systems are affordable by many institutions. In the meantime, we can achieve innovative works with what we have, what we can afford, and what we can procure -- in the near future.



Editor, CG&A

INTERACTIVE, DYNAMIC, COMPUTER ART

by Professors Dick Land and Dan Cohen
Division of Engineering and Applied Physics
Engineering Sciences Laboratory
Harvard University
40 Oxford Street
Cambridge, Massachusetts 02128

BACKGROUND

Graphic computer output from its beginnings has attracted attention to the possibilities of computer art. Like so much development associated with computers, specialists having sophisticated understanding of the computer began exploring an alien field, rather like a child discovering the crayon. However, artists discovering technology don't do so well either; i.e., E.A.T. (Experiments in Art and Technology, Incorporated).

THE QUESTION OF ART -- OR TASTE

Implicit in art is the question of taste -- a peculiar and unique human judgment -- that lacks clear definition, and most certainly, lacks any uniformity of development.

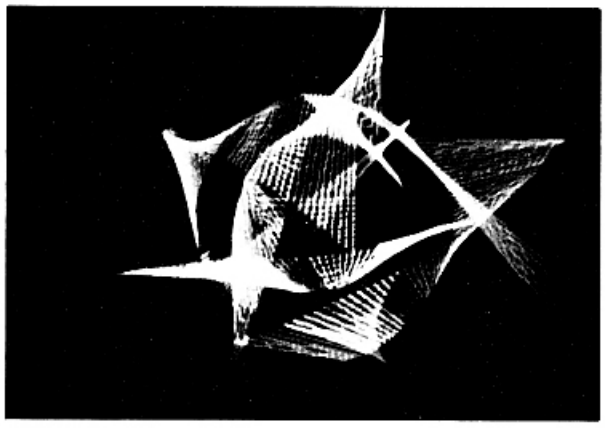
Entry into the "art field" is more open than most, for definitions and limits are poorly defined. Critics, scholars, galleries, and museums establish standards to be challenged by the unpredictable tastes and fickle judgments which make things popular and inspire fads.

As a human endeavor, art seems tied to the equally ill-defined concept of pleasure, "I like that!" While we all use pencils, we do not all produce art; yet the artist with a pencil may produce an extraordinary work exercising his talent through the use of ordinary tools.

THE POTENTIAL OF COMPUTER ART VS. THE REALITY

The computer can provide fantastic diversity and power of technique with almost unimaginable flexibility.

BELOW: A double-exposure from the "Flowers" program.



ABOVE: A second illustration by Dick Land and Dan Cohen. Illustrations shown here were made from colored transparencies by the authors, with black and white illustrations (slides) by Mel Fisher. Printing of the black and white graphics, including double-exposures of works by G. Hertlein, editor of CG&A.

Output hardware is the only major limitation to the graphic style, sculptural effect, or luminal* dynamics.

Most output referred to as computer art has been merely designs, patterns, and sterile decoration, pleasing in many cases, but hardly evocative. Schillinger anticipated such activity in his work, "Mathematical Basis of the Arts" thirty years ago. /1/

Recently while watching random dots produce variations on circles, deformations and transformations in pleasing color as a movie short, /2/ a young adult audience hissed several times -- the hisses outnumbering the applause at the end -- a reaction, perhaps, to the computerized nature of the forms, which lacked humanity.

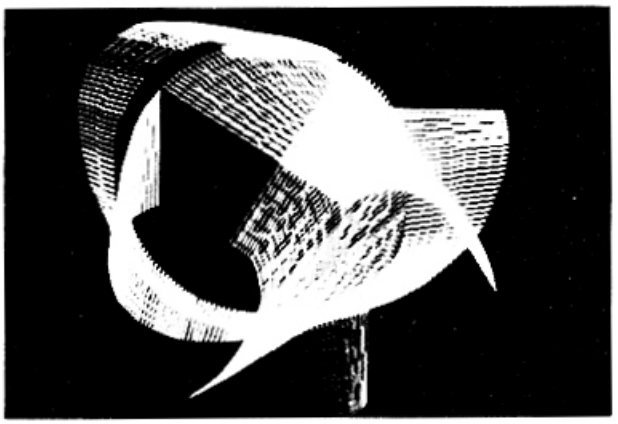
The abstract structure and intent for computer produced material must come from human qualities which may be greatly assisted by the machine providing detail and execution. Perhaps it is the remoteness of the general public from the medium, still strange in its first decade of availability, that fails to capture an enthusiastic audience.

INTERACTIVE COMPUTER USAGE

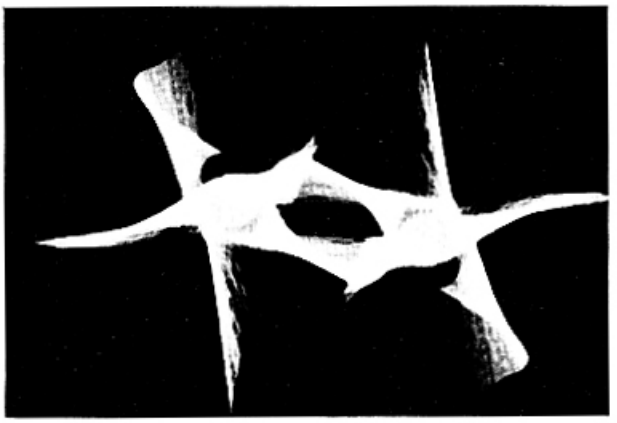
There are computer installations where an observer or "operator" at the machine is continuously aware of what is being processed and can interact with the program in progress, by adjusting switches and analog devices. This interactive computer usage with its sophisticated flexibility should provide an optimum environment for artistic expression.

*Lumia, the name given by T. Wilfred for artistic painting with light.

NOTE: This work was supported, in part, by the Advanced Research Projects Agency (ARPA) Under Contract #F 19628-68-C-0379.



ABOVE: The cover illustration by Dick Land and Dan Cohen is shown here in reduced form.



ABOVE: A double-exposure of a form resembling winged birds in flight, from "Flowers".

TWO APPROACHES OR CATEGORIES OF COMPUTER USAGE

There seem to be two general categories of achieving artistic results with computers. The most prevalent is to make the computer a slave, doing completely specified work, making transformations and elaborations from exact instructions. In this category, the computer merely details a picture already complete in the mind of the programmer-operator.

The other option is to provide depth and sophistication to the computer program, such that essentially unpredictable images appear. An operator may now learn to interact as critic and selector, determining the broad style in which the computer improvises -- or at the extreme, a random number generator provides source direction for previously established flexibilities.

Within these approaches is the potential for producing either static works or dynamic outputs, dependent upon available hardware and operator intent.

THE FLOWER PROGRAM

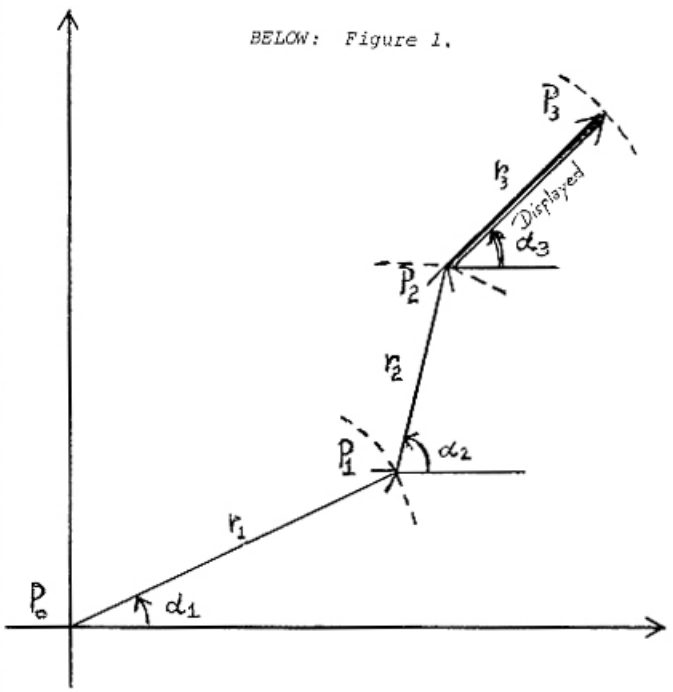
An example of dynamic interactive computer use which has enjoyed considerable artistic appreciation is the "flower" program. /3/ This program is a demonstration of how complexity can be achieved using simple basic operations.

The flower program generates an unpredictable dynamic pattern whose nature depends upon operator interaction. The operator or user can interact to modify the pattern according to his or her taste.

The operator's exact influence on the pattern generation remains unknown to him (because of program complexities), which introduces an element of "mystery" in the operation. While the operator does does not have complete control over the displayed pattern, he (or she) can influence the nature of the image dynamics.

The program displays on CRT's (TV-like consoles) a selected number of lines as a function of time using simple relations, essentially circle generators. (See Figure 1.) The functional relationships actually define three lines, yet only the third line is displayed (line P_2P_3).

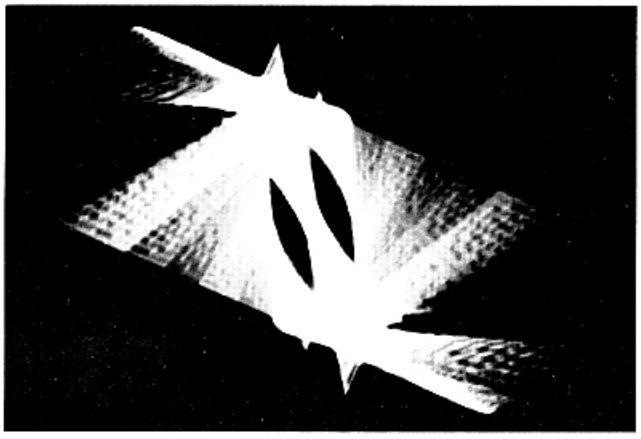
BELOW: Figure 1.



$$\Delta \alpha_1 = w_1 \cdot \Delta t$$
$$\Delta \alpha_2 = w_2 \cdot \Delta t$$
$$\Delta \alpha_3 = w_3 \cdot \Delta t$$

$$\Delta r_1 = f_1(w_4) \cdot \Delta t$$
$$\Delta r_2 = f_2(w_4) \cdot \Delta t$$
$$\Delta r_3 = f_3(w_4) \cdot \Delta t$$

NOTE: W_1, W_2, W_3, and W_4 are entered by adjusting knobs.



ABOVE: Double-exposure of graphic from "Flowers".

Aside from choosing initial values, the operator has control over four parameters (W_i) as the program continuously generates new sets of lines (switch command may stop generator or freeze the display at any time, giving an image with fixed lines).

Each new set of lines uses the final values of the previous set as initial conditions, so the pattern evolves, or has a sense of history. Intentionally, an arithmetic overflow is disregarded, introducing an unpredictable, complicating event.

ACHIEVING COLOR IN THE FLOWER PROGRAM

Color is introduced in real-time by a method similar to the old CBS-TV technique, as suggested by Ivan Sutherland. /4/ A synchronous motor-driven filter wheel with six sectors (in opposing sectors, red, green, and blue) is held in front of the eyes. Adjustment of the display repeat rate brings some lines into view only through the red sectors of the filter -- thus they look red. Where lines appear in both red and green, they look yellow, etc.

Synchronism is achieved either by using a specific clock in the computer and phase adjustment, or by merely establishing parameters of the flower program, such that approximate synchronism is attained with the basic computer time cycle acting as a clock and program length determining composite effects. For this color system to work, the phosphor of the display scope must be faster than the aperture time of the color filter wheel.

In our system, the eye views through a single color for 8 milliseconds; the P-4 phosphor is reported to have a decay time of less than 100 microseconds.

The other important criterion is the spectral character of the phosphor, which must be essentially white. In the P-4 case, it is red deficient; hence the illumination instruction for lines desired in red is increased one step above lines to be green or blue. This is, of course, adjusted to the choice of color filters, visual response, or photographic response, yielding the overall color rendering for the system. The dynamic view on a P-7 phosphor is also pleasant, where the bright blue fast response and the slow yellow-green response give a blue and yellow color to the display that can only be appreciated by watching the program in motion.

As yet, television and motion picture illumination thresholds are too high to capture the dynamic nature of these displays, although new TV cameras recently developed may permit such recording in the near future.

PHOTOGRAPHING THE FLOWER PROGRAM

Still color photo recording of the "flowers" uses a slightly telephoto lens viewing through one of the eye holes of the filter wheel. The line generation is stopped, and the display is carefully adjusted for synchronism with phase adjusted for correct color. Best results have been achieved with four to eight second exposures on EHB-135 film through an f/2.8 87mm lens about 1 meter from the display. Black and white photographs and plotted outputs are also easily obtained.

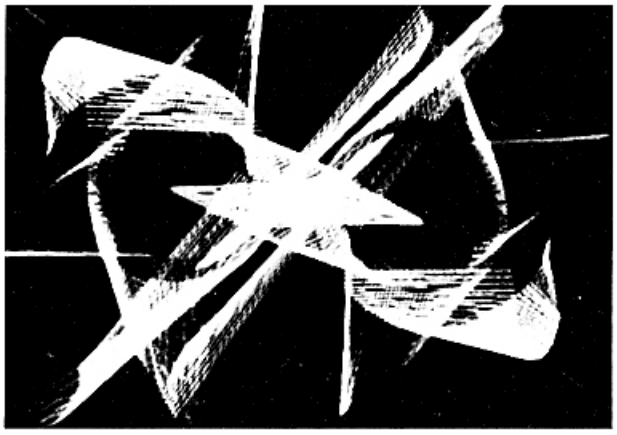
Whatever the recording techniques, none appears to do justice to the joyous nature of seeing the dynamic display as it is produced. There may be a special enjoyment of interacting with the program in a "suggestive" way that greatly enhances the viewer's appreciation of the patterns that just cannot be captured in timeless form.

THE TEMPORAL ESTHETIC NATURE OF THE FLOWER SYSTEM

The temporal nature of the "flowers" may be their most handsome feature. Generally, the choice of parameters will determine a non-repetitive succession of line drawings which seem to evolve, with succeeding line sets having similar character but subtle differences. One may assume most parameter sets will produce asymmetrical cycles, assuring a suspenseful quality which draws one's attention by the sense that the pattern will never be the same again; once missed, it is lost forever. The interactive quality assures uniqueness; for the time that a parameter change is made is as important as the actual change itself -- and it would be rare indeed that one would make the same change at the same time accurate to a millisecond!

For the operator the obscure relation of control parameters to the resulting display provides an element of mystery in the man-machine coupling. The question of the operator's taste comes into play while viewing and making a decision to intervene with new parameter selections. The human element continues to be significant in selecting certain patterns for photography, and in the selection among successful photos.

BELOW: Triple-exposure of a pattern by Dick Land and Dan Cohen.



ABOVE: A more complex double exposure from the "Flower" series, patterns by Dick Land and Dan Cohen.

THE MATURATION OF COMPUTER ART

Abstract art, minimal art, mathematical art, and the like have been around without computer assistance. The maturation of computer art will come from discovery of expressive use of the techniques being explored at present. Whether the artist chooses to use the power of the machine as an exacting slave to instructions, prefers random selections, or allows for interaction in varying degrees -- will be part of the tasteful design.

The last word will be had by the audience -- if they stay to look, a measure of satisfaction has been achieved, and if they walk away, perhaps those of us who enjoy playing with computers can continue to enjoy these expressions as special "insider" divertissements. It seems that a degree of computer understanding enhances appreciation of the art currently produced. To what extent artists will wish to initiate processes and interact in some controllable way with subtly unpredictable results is unexplored, for the opportunity is new. Our very limited experience shows considerable enthusiasm by the artists who have played with the "flowers".

Yet the history of discovery of new media has always seen experimentation and observation of unpredictable results.

In the future, it may be the viewer, artist, or both who engage the computer interactively, providing a humanizing element in the quest for relevance and involvement in the machine process producing computer art.

REFERENCES AND NOTES

/1/ Joseph Schillinger. The Mathematical Basis of the Arts. New York: Philosophical Library, 1948.

/2/ John Whitney & IBM, Untitled Movie Short, Computer Produced (ten minutes) viewed in New York City at Cinema I, June 22, 1969 with "The Last Summer".

/3/ A real-time (interactive results available in operator's time scale) program originated by Dan Cohen, spring, 1968 for PDP-1 and Type 340 CRT Display, using 4 operator adjustable knobs.

/4/ R. I. Land and I. E. Sutherland, "Real-Time, Color, Stereo, Computer Displays", Applied Optics, Vol. 8:3, pp. 721-723, March, 1969.

STATEMENT FOR EXHIBIT (ART OF THE SPACE ERA)

Wide acceptance and broad impact on artistic expression resulting from developments of the "space era" remain in the future. Perhaps the films "2001" and "Star Wars" are exceptions. But for the individual artistic works, there are many employing "space era" technology. Often these efforts appear to remain exploratory and disappointingly unexpressive. The works generally fall into the category of Kinetic Art, and such efforts while they may offer pleasing design, fall short of the sophistication necessary to truly evoke lasting responses by the majority of the audience.

In particular, opto-electronic and micro-electronic developments of the "space era" may be expected to provide fabulous new techniques and media for the artist. One of these being explored during the past fifteen years has been "Computer Art" (still looking for a better name!).

NOTE: The following comments are excerpts from an article by Richard Land from Leonardo, 1969. /1/ These comments have been specifically chosen to complete the author's philosophical statements -- and they are as relevant today.

...Computers draw, paint, make music, sculpt and do almost anything man can do! Rubbish. Computers do what men tell them to do and nothing more. The instructions may be sophisticated and the results rather distantly related to the initial data but there is nothing inside the "black-box" of the computer which has taste. That is the prerogative of man.

...The designation "computer art" seems destined to remain attached to those art forms produced by a machine originally designed for other purposes -- the machine becomes an instrument of extra-logical expression only as the result of the operator's intention.

...The fact that we have in this century devised a machine of almost unimaginable complexity and versatility merely taxes man's mentality in finding ways to put it to use and evaluate its results.

CONCLUSION

Perhaps the computer is more than a new medium. It is a challenge to artists in all media to learn the characteristics of this powerful tool and the ways in which it may give wider scope to their talent. Talent, taste and intuition must be brought to the computer by man, it has technique to spare.

/1/ Land, Richard I, "Computer Art: Color Stereo Displays," Leonardo, Vol. 2, 1969, pp. 335-344.

ART OF THE SPACE ERA

EXCERPTS FROM THE EXHIBITION CATALOG

by Thomas A. Bowles III and
Carolyn Wood, Curator
Huntsville Museum of Art
700 Monroe Street, S.W.
Huntsville, Alabama 35801

Here are brief excerpts from Part I, by the Director of the Huntsville Museum of Art, Thomas A. Bowles III, and the Curator, Carolyn H. Wood.

ART OF THE SPACE ERA - January 16 - July 30, 1978

This exhibition was planned with the aid of a grant from the National Endowment for the Humanities. The exhibition commemorates the 20th anniversary of America's first satellite, Explorer I.

INTRODUCTION by Thomas A. Bowles III

The launching of the Explorer I satellite in 1958 officially signalled the beginning of America's entry into an era of space exploration. The twentieth anniversary of that event is being commemorated by the Huntsville Museum of Art with the exhibition, "Art of the Space Era."

Our era of space exploration, a new age of discovery, has brought with it such a rapid expansion of knowledge and such a quantity of computer data to study that there has been little time to understand and to assimilate on a human scale its significance. Yet the assimilation process on an affective level must take place: we shall soon find ourselves, with the space shuttle program, living with space travel as a daily occurrence -- not just exploring for the future, but living in that world of tomorrow so long predicted in works of science fiction.

...Perhaps no other era has been so stimulating to artists. Each artist has reacted in his own way...The artists have begun to digest the events which left most of us mute for want of terms adequate to parallel our emotions.

ART OF THE SPACE ERA by Carolyn H. Wood

Art of the Space Era is an attempt to explore through the visual arts the question of man's relationship to himself and the earth he inhabits -- a question which has taken on entirely new connotations in the twenty years of America's space program.

TECHNOLOGY AS MEDIUM

...Rather than employ the technological developments of past eras, such as oil paint, bronze or photography, these technologically-oriented artists employ computers, video machines, fiber optics, strobe lights, sophisticated motors and electronic equipment as their medium of expression.

COLLABORATION

...Perhaps the most distinctive characteristic of the technological artists represented in Art of the Space Era is their emphasis of the principles of collaboration and integration. Artists associated with the art and technology movement have realized that they cannot afford to be introverted or antisocial but must often collaborate with specialists -- engineers, scientists or computer programmers -- to achieve their aims.

COMMUNICATION

...If there is one common thread connecting all of these technological artists and their works it is perhaps best expressed by Otto Piene: "Technology has most to do with increasing and intensifying communication."

SUMMARY

In spite of the emphasis on collaboration, participation by the viewer, social commitment and communication, artists who utilize contemporary technology as a means of expression have not forsaken their personal vision and sense of beauty. ...Technology is subordinated to aesthetic statement.

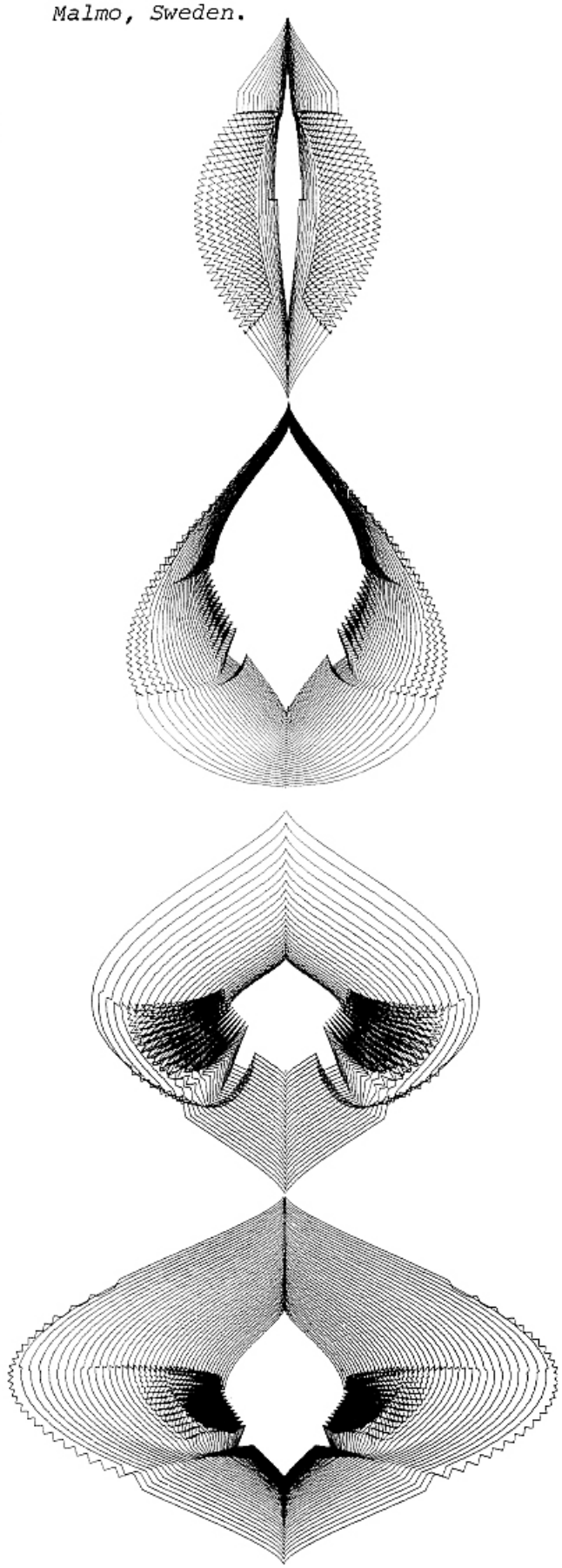
...A fitting symbol of the union of this sense of beauty and the need for human interaction to produce or even to survive here on earth is NASA's photograph of our home planet seen for the first time as a tiny, fragile jewel floating in a void. Technological artists have perceived a new consciousness of the interdependence of all things: "We are all riders on spaceship earth," as R. Buckminster Fuller has said.

The integration of art and technology, artists and engineers or scientists is thus not as strange as it might seem. Both artists and scientists explore and experiment to discover solutions to problems; both are seeking the truth in regard to the nature of reality; both are seeking to improve the human condition. The spirit in both scientific and artistic inquiries is eminently humane.

(EDITOR'S NOTE: Part I of the Art of the Space Era Exhibition opened on January 14, 1978 at the Von Braun Civic Center of the Huntsville Museum of Art, Huntsville, Alabama. Works in this portion of the show are primarily kinetic, technological works of art.

Part II, the Invitational International Computer Art Show, will open on May 5 at the museum. A catalog is being assembled at the present writing. Excerpts from this catalog will be printed in the August issue of CG&A, along with new illustrations.)

BELOW: Untitled Transformation by Sture Johannesson and Sten Kallin, Malmo, Sweden.



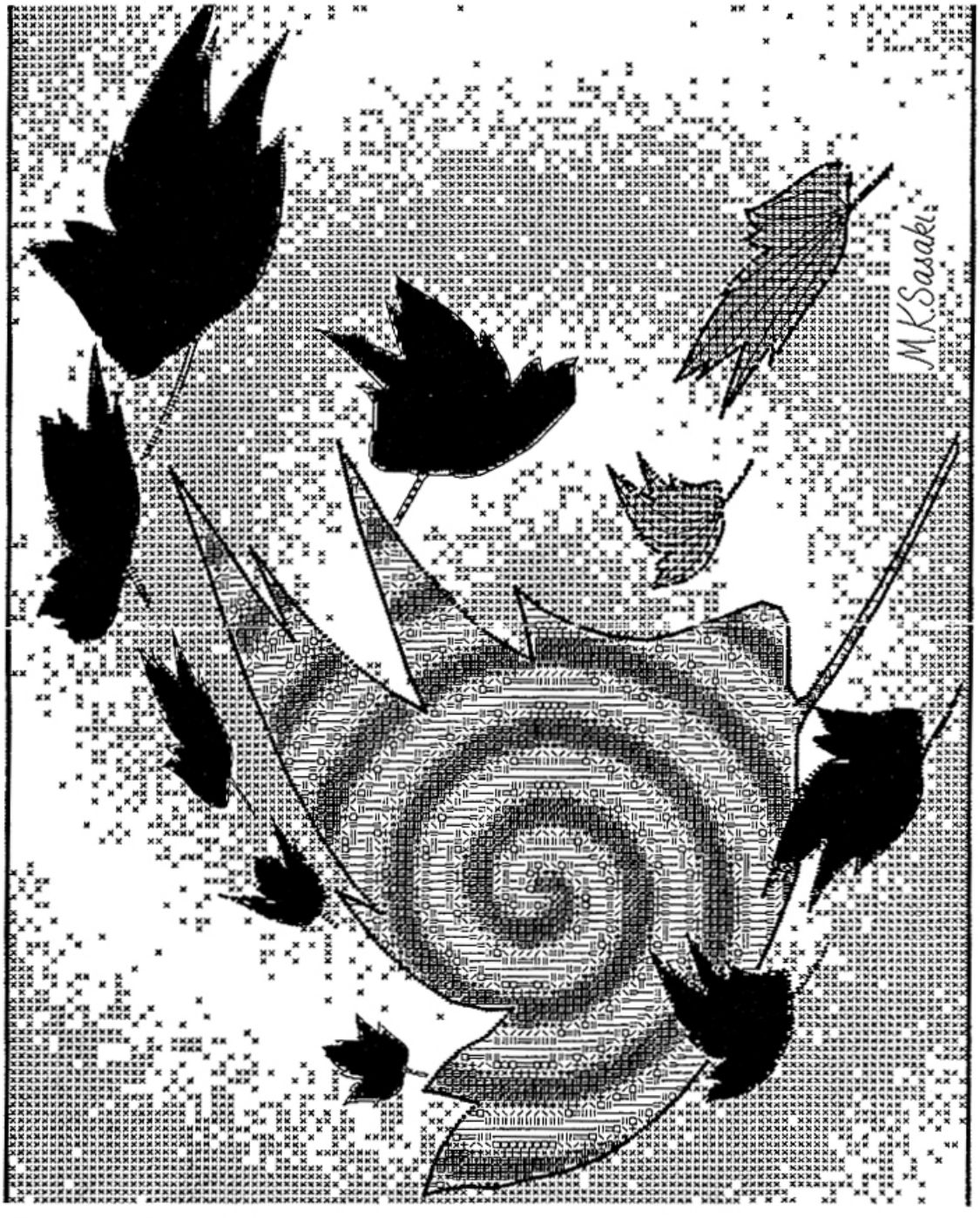
BEAUTY AND IMPRESSION

by Mutsuko K. Sasaki
Syoan 1-18-17
Suginami-Ku
Tokyo 167, JAPAN

Beauty and Impression, these are what I want to manifest through pictures. Many traditional artists received their inspirations from natural objects or scenes, and this is also true for me.

However, computers have opened artists' eyes to another type of entity, that is, the mathematical or systematic pattern. The beauty and impression manifested by these new patterns is, in in some sense, more genuine and more universal than those of natural objects. I think computers are not only new media for art-making, but they present radical ideas that enlarge the field of art vastly.

My present aim is to develop techniques for combining natural objects and mathematical patterns.



ABOVE: "Maples in Storm" by Mutsuko Kunii Sasaki, Tokyo. MEDIUM: Ink on paper, Calcomp plotter.

ALGORITHMIC ART OF THE SPACE ERA

by Peter Milojevic
12 Old Mill Terrace
Toronto, Ontario, Canada M8X 1A2

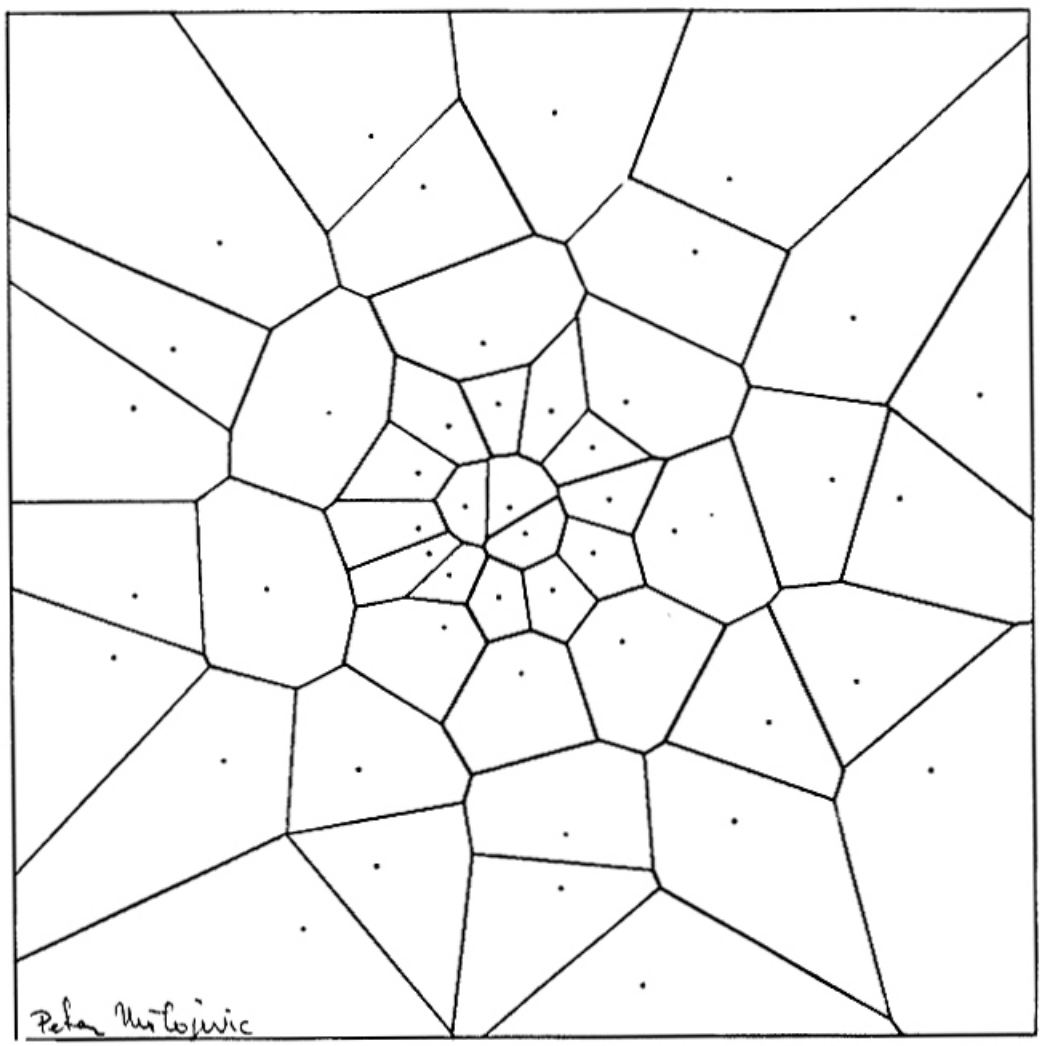
Today at the exhibitions we are presenting just frames and clips (or portions) of works of a new era. However these new works are presented in an orthodox manner and media of a passing era of prints and graphics on paper.

If art should represent its era, it must be able to express the space age with all scales of magnitude from pico and micro to mega and magna -- in full view of the beholder.

However, the new technology of today with all its magnificence, has given to art just a patch-work of ideas and techniques to come, a prelude rather than a finished product.

The old structures imposed on the thinking processes of human minds have a time lag and resistance of at least one generation, before realization and comprehension of techniques and methods of a new tool is assimilated by man. The new technology has opened up new avenues but has also imposed limitations by its states of technology of hardware, software and resources.

The artists of today rely much more on society because they need much more than paper and pen to create their works. The creations of the space era are conceived by one but created and dependent upon many men. The products of this new system we have titled computer art, but it will take quite some time until we realize that it is rather an algorithmic art, and that the art of thought, instructions, methods and techniques are still far from a symphony of mind orchestrations and compositions.



ABOVE: "Equidistant Space" by Peter Milojevic. MEDIUM: Ink on paper.

SNE COMP ART: A SOFTWARE PACKAGE FOR CREATIVE PROBLEMS BY GRAPHIC DATA PROCESSING

by Hans Korneder
Waldschulstr. 69
8000 Munich 82
Western Germany

INTRODUCTION

The possibilities of applying graphic data processing have multiplied within the last dozen years. While in the beginning, problems were often purely mathematical (the representation of functions), today the applications of data processing with graphic output are to be found in an extremely large number of fields. Computer graphics are playing an increasingly important role in many applications. The following are just a few examples: town-planning research, textile patterns, meteorological maps -- or moving processes, as the simulation of flight, the reproduction of microorganisms, or even cartoons and films.

However, it is not hardware alone, whose applications have facilitated this development, but the fact that software packages have been developed, by which even more complex problems can be represented and treated more readily for the user.

The software package SNE COMP ART discussed in this article is to be applied mainly in the artistic and creative fields. It is based on the didactic plan for practical computer graphics by Professor Reiner Schneeberger, instructor of Computer Graphics at the University of Munich. The fundamental characteristics of the system were outlined in an article, "Computer Graphics at the University of Munich", published in this periodical in November, 1976.

The system was first used during the summer semester of 1976 at the University of Munich. During the course of the lectures, participants used the software package to execute computer graphics and computer films. As stated in the earlier article, participants were expected to achieve computer graphics after the first class meeting. Readers are urged to review this article as further background.

STRUCTURE OF THE GRAPHIC SYSTEM, SNE COMP ART

The software package, SNE COMP ART, consists of FORTRAN subroutines. They are to be called, either as functions, by allocation with an "equal-sign", or as real subroutines by "CALL".

FORTRAN was chosen as the programming language, for it guarantees a greater compatibility between computers from different manufacturers. In addition, for elementary programming, the users need not learn additional materials, as is often the case with special graphic languages.

The program modules are connected with the graphic output equipment over the two vector graphic routines, MOVETO and DRAWTO. By means of these simple interfaces, the packages of SNE COMP ART can be installed on the various computers without additional adaptation expenditures.

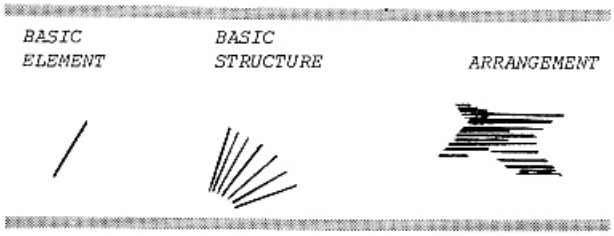
The modules are able to produce graphics that differ in complexity, as well as constructiveness (or casualness) of the figures produced.

DESCRIPTION AND ILLUSTRATIONS OF THE SUBROUTINES

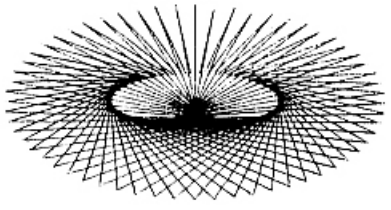
In the following section, the subroutines are briefly explained. The subroutine, its basic element, its basic structure and sample arrangements are illustrated within each descriptive section. Sample illustrations are given for the varied subroutines.

I. SNELLY

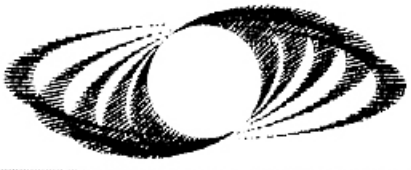
SNELLY is the most constructive routine and has no control of casualness. Thus extremely appealing drawings can be reproduced constantly when the parameters are familiar. The calls effect that two fragments of an ellipse are fixed, between which corresponding points are connected by the basic element, the vectors. The suitable parameter can produce a "moire effect", and when drawing several picture elements (that is, straight lines, one upon the other), a secondary pattern emerges, a so-called super-imposed drawing. This is the reason for the casualness, or the unpredictability of this module -- even the slightest parametric variation will cause the super-imposed drawing to appear in a completely different shape.



SNELLY -- SINGLE CALL



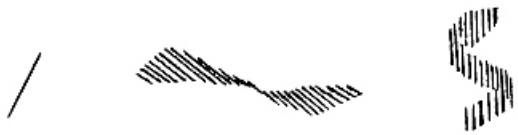
SNELLY -- WITHIN LOOP



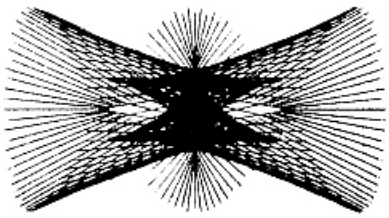
II. SNELIS

As in SNELLY, here also the basic element of the drawing is a basic line; however, the principal difference is to be found in the initial figures. Here cross connections can be drawn among the lissajous figures. Therefore, SNELIS performs an exact enlargement of SNELLY. The quantity of new graphics that can be achieved has been multiplied, as compared to SNELLY.

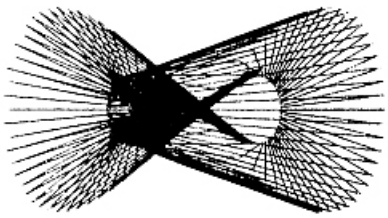
BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*



SNELIS -- SINGLE CALL



2ND VARIATION - SNELIS -- SINGLE CALL

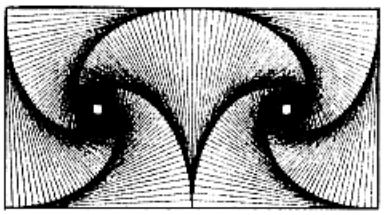


NOTE: On these pages, the works illustrated here very closely resemble graphics achieved via mathematics. Here the artist can readily utilize mathematics to output personal art.

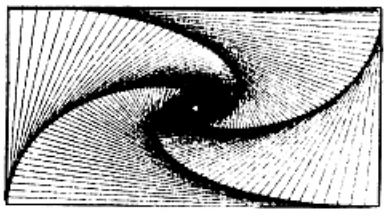
III. SNELIN

In this routine the line performs the basic element. It is, however, not a sequence of uninterrupted sketches, but the line is drawn along the edges of a previously defined polygon, scaling it down dynamically. The immediate associated or imagined connection of the respective corners evokes the impression that the polygons are revolving. This very charming effect is to be seen in almost every picture generated with SNELIN.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*



ABOVE: SNELIN -- DOUBLE CALL



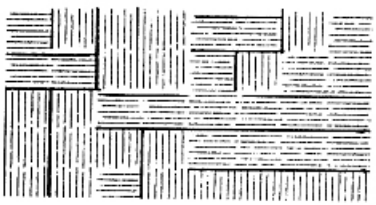
SECOND ILLUSTRATION: SNELIN -- SINGLE CALL

Using an art-designed system, the artist no longer needs to learn complex programming in order to achieve fine art graphics. Using such a system, the artist can bring more design, more of his manual capacities to this new art form.

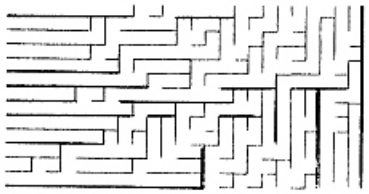
IV. SNEKAO

A certain number of parallel, horizontal or vertical lines are the basic element in this routine. Here the alternate grouping into horizontal or vertical blocks is the variable factor. A random generator decides on the grouping. Data concerning the share of frequency of the basic structures restrict its decisions. A variation of these parameters can produce adjusted structures. Due to the flat aspect of the basic structure, the resultant picture is of a two-dimensional character.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*



ABOVE: SNEKAO -- SINGLE CALL
BELOW: SNEKAO -- DOUBLE CALL



V. SNEWIS

The basic structure of SNEWIS is similar to that of SNEKAO. The possibility of determining additionally the cross-hatching angle of the rectangles performs the enlargement in this case. SNEWIS is an exact enlargement of SNEKAO and offers a multiple of SNEKAO's possibilities.

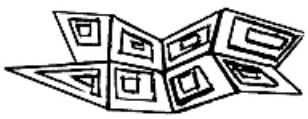
BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*

VI. SNEZNT

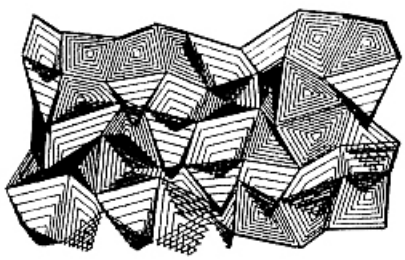
The graphic routine SNEZNT is based on a more complex basic figure, when compared with the routines discussed so far. In the basic element, any number of telescoped quadrangles can be drawn, which can be centered at will -- and can differ from the input rectangle in any intensity desired. However, the basic element of this routine (as well as every other one) can be arranged as often as desired in any direction. This aspect of the system, which may appear to be very casual, can be controlled very effectively, since all the dispersion is limitable. Inputting with only simple parameters with SNEZNT, very high-quality graphics can be produced. For example, by choosing suitable data, the impression of a creased foil can be achieved, with a striking plastic effect of the telescoped quadrangles.

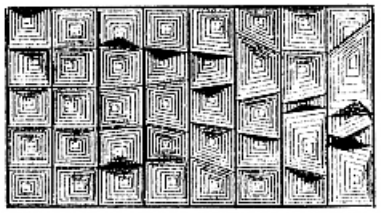
BASIC ELEMENT *BASIC STRUCTURE*

ARRANGEMENT



BELOW: SNEZNT -- SINGLE CALL USE



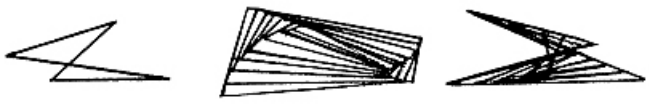


ABOVE: SNEZNT -- WITHIN LOOP
Again, notice how these routines afford complex graphics without requiring programming expertise by the user.

VII. SNEBID

SNEBID is the first routine to be less likely to control. Like SNELIN and SNEBID, it works with a continuous line, which connects the corners of the polygons according to their order. The only difference between SNELIN and SNEBID lies in the location of the polygon's corners. In the case of SNEBID this is made by a random generator and can be limited only to a certain interval on the resultant drawing.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*

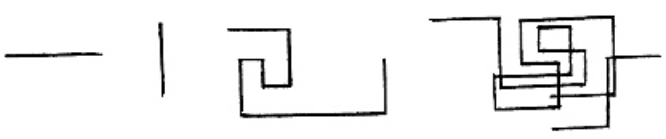


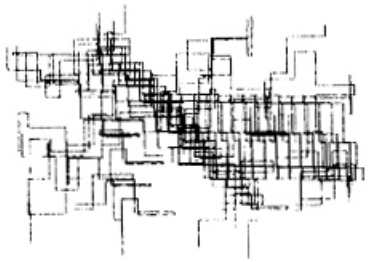
BELOW: SNEBID -- SINGLE CALL

VIII. SNERKT

The basic element of this routine is also the single line. It is drawn by means of a rectangle generator over a previously set part of the sheet. This means that the single segments of this stroke run horizontally or vertically and turn off at right angles, according to a specific length (or parameter) that is set.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*



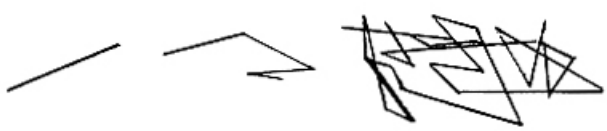


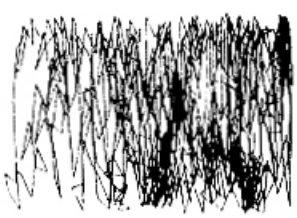
ABOVE: SNERKT -- WITHIN LOOP
How many variations can one achieve? Almost an unlimited number may be executed.

IX. SNEBRW

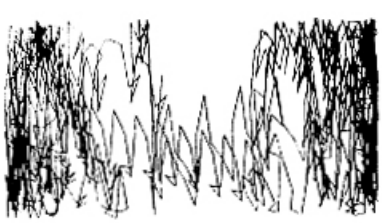
SNEBRW is an enlargement of SNERKT. The conditions of the right-angled turn of the line are eliminated in this case. This causes a primarily confusing course of the stroke, that looks like the "brownian" movement. Suitable data for the random generators can introduce a symmetry into the picture, which reduces its complexity in a way that allows the viewer easier interpretations of the given work.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*





ABOVE: SNEBRW -- SINGLE CALL



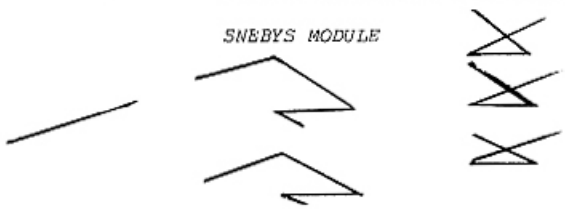
ABOVE: SNEBRW -- SINGLE CALL VARIATION

X. AND XI. SNEBXS AND SNEBYS

These routines control the graphic output of SNEBRW. The casual line of SNEBRW can be repeated in the direction of the X or Y axis as often as desired. The distance of the displacement can not only be chosen in the linear way, but can also be calculated by an internal dynamic parametric variation. There is the additional possibility of choosing only partial segments for the drawing.

BASIC ELEMENT *BASIC STRUCTURE* *ARRANGEMENT*

SNEBYS MODULE



XII. THE RANDOM GENERATORS IN SNE COMP ART

All modules of the SNE COMP ART system, which need rates of casualness (or randomness) are based on the three principal generators SNEZUF, SNERAD, and SNERGA. Of course, all the random generators are available to the user of this specific software package. These generators are explained briefly in the following paragraphs.

1. GENERATOR SNEZUF - The generator SNEZUF provides normally arranged random data, which can be limited to an interval at will through the setting of specific parameters.

2. GENERATOR SNERAD - This generator provides (like SNEZUF) normally arranged random data, which additionally, can repeat after a period, controlled by specific parameters.

3. GENERATOR SNERGA - This generator provides random numbers, whose share of frequency corresponds to the Gaussian normal parabola.

XIII. MODULE SNERUD

This subroutine selects "at random" a datum among an inputted number of data.

XIV. SNERRT

This module places back all random generators to their initial data. The application of this module is extremely important for the production of a sequence of pictures in which each time, the following picture is based on the preceding one. This is particularly useful for computer films.

XV. SNERIN

This subroutine changes the starting data of the generators. The application of this module is extremely interesting for the "impossibility of reproduction" -- and the personal touch of a graphic. Birth dates, for example, or similar data are recommended as input parameters in this case.

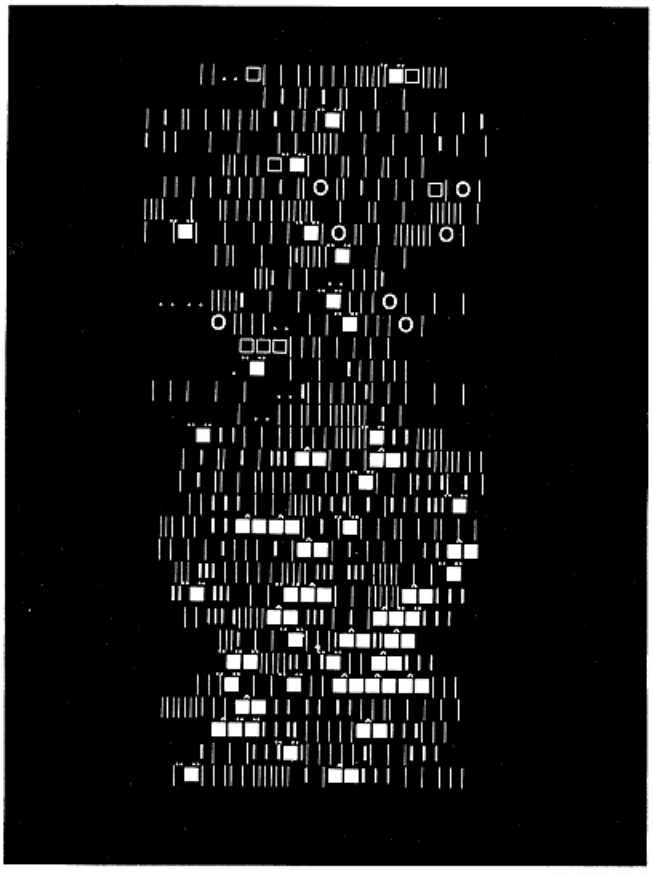
SUMMARY

With the availability of systems designed specifically for artist use, the state of the art of computer graphics should be advanced greatly. SNE COMP ART is an example of such a user-oriented system. The planning by Professor Reiner Schneeberger should prove invaluable to artists.

HIEROGLYPHS

by Aaron Marcus
Bezalel Academy of Arts and Design
1 Bezalel Street
Jerusalem, Israel 02-225111

Comments by Aaron Marcus are from varied writings of the artist. Throughout there is an intense interest in the markings or symbolic glyphs of man as graphic patterns.

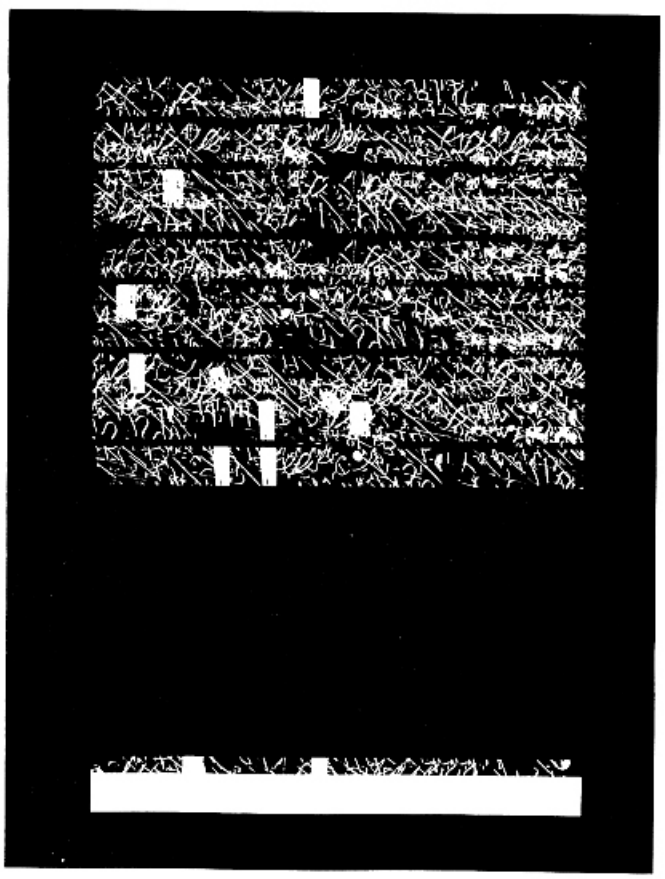


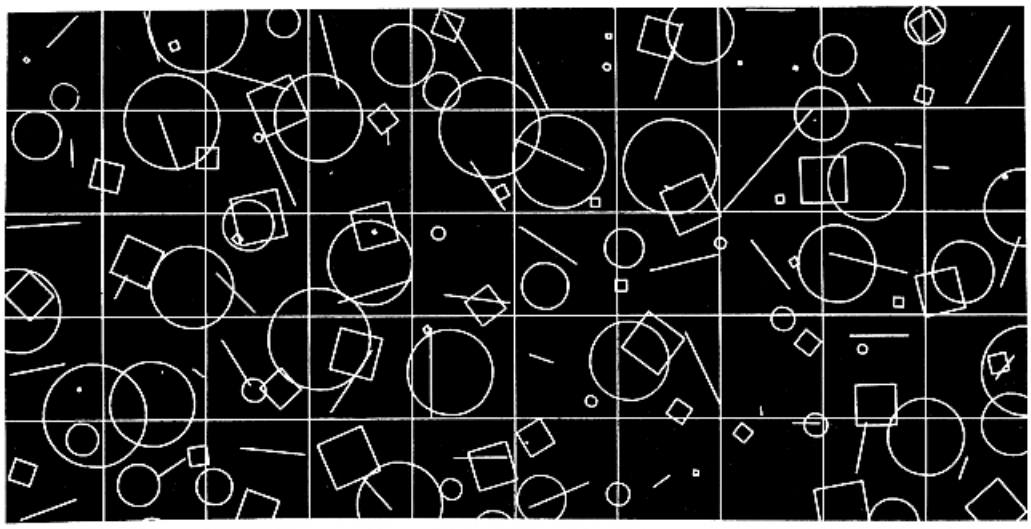
ABOVE: Untitled photoprint, 15" x 19".

...from CYBERNETIC ENVIRONMENTS: As writing was born, man struggled to find ways to compress his spatial, temporal wraparound experience into abstract, easily reproducible marks on specially prepared flat surfaces. From essentially pictographic images bearing an iconic resemblance to things and actions, abstract forms evolved to provide man with more complex conceptions and a more intricately structured cosmos. After two millenia of relatively stable symbols and 500 years of their mechanical reproduction, the forms of writing, the ideas expressible by them are changing rapidly. At this moment, with the aid of electronic media and computer-assisted displays, the semiotic parameters of verbi-vocovisual communications are revitalizing long unused possibilities and discovering new combinations of elements for restating the inner and outer worlds of man's experience.

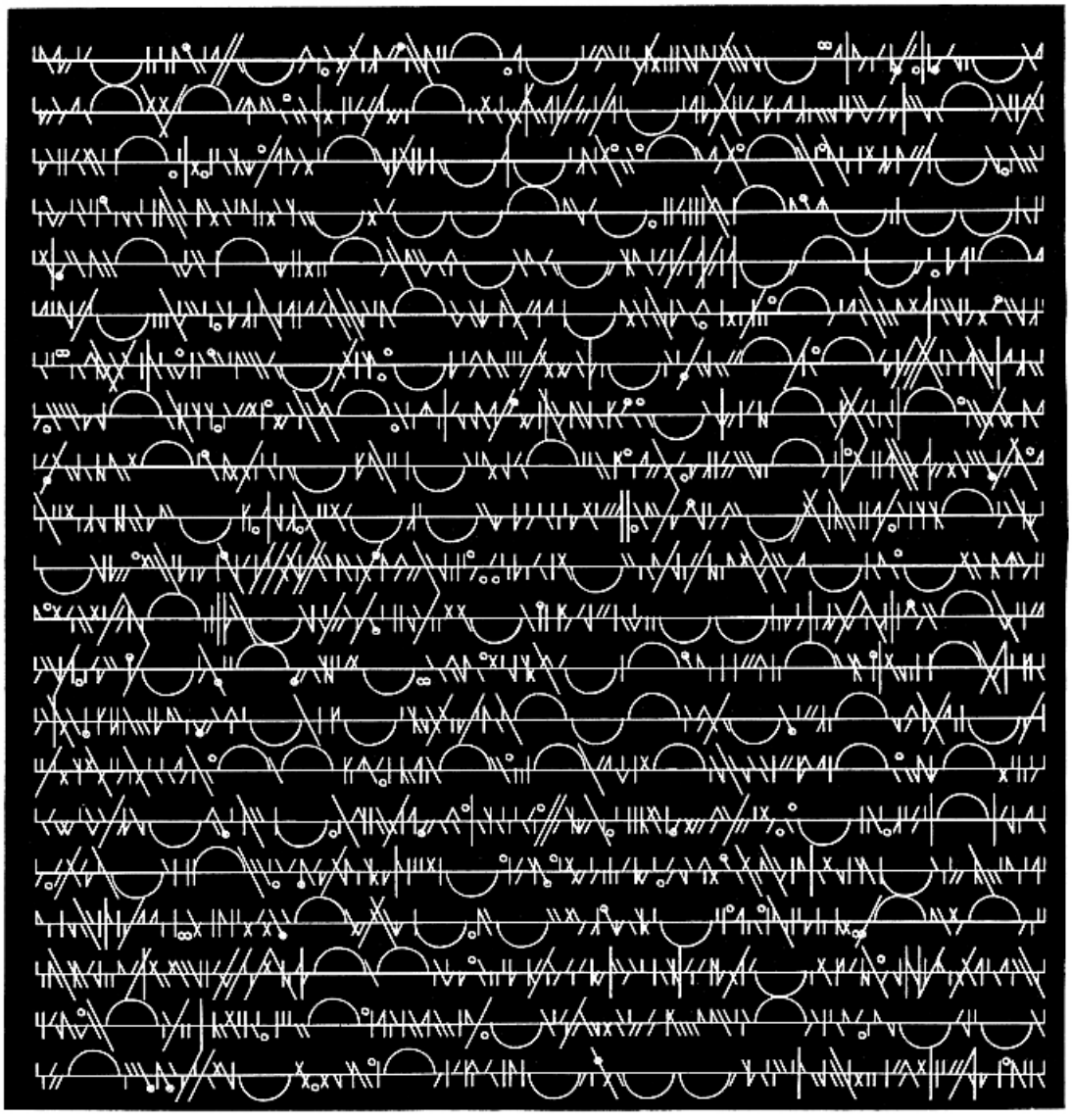
...from COMPUTER-ASSISTED POEM-DRAWINGS: As with most of my computer-assisted art works, they are meant to be seen as white symbols against dark fields. Therefore the positive space as well as the negative space is part of the total meaning. I am interested in this kind of computer-assisted image generation as it relates to the use of light/electromagnetic information display, the primary medium for a computerized, bureaucratized society. I am interested in relating the most advanced technological-symbolical achievements to the most archaic experiences of mankind. Hence, I find it appropriate to ponder Genesis II and II in considering these images; the creation of order out of chaos, the creation of light out of darkness.

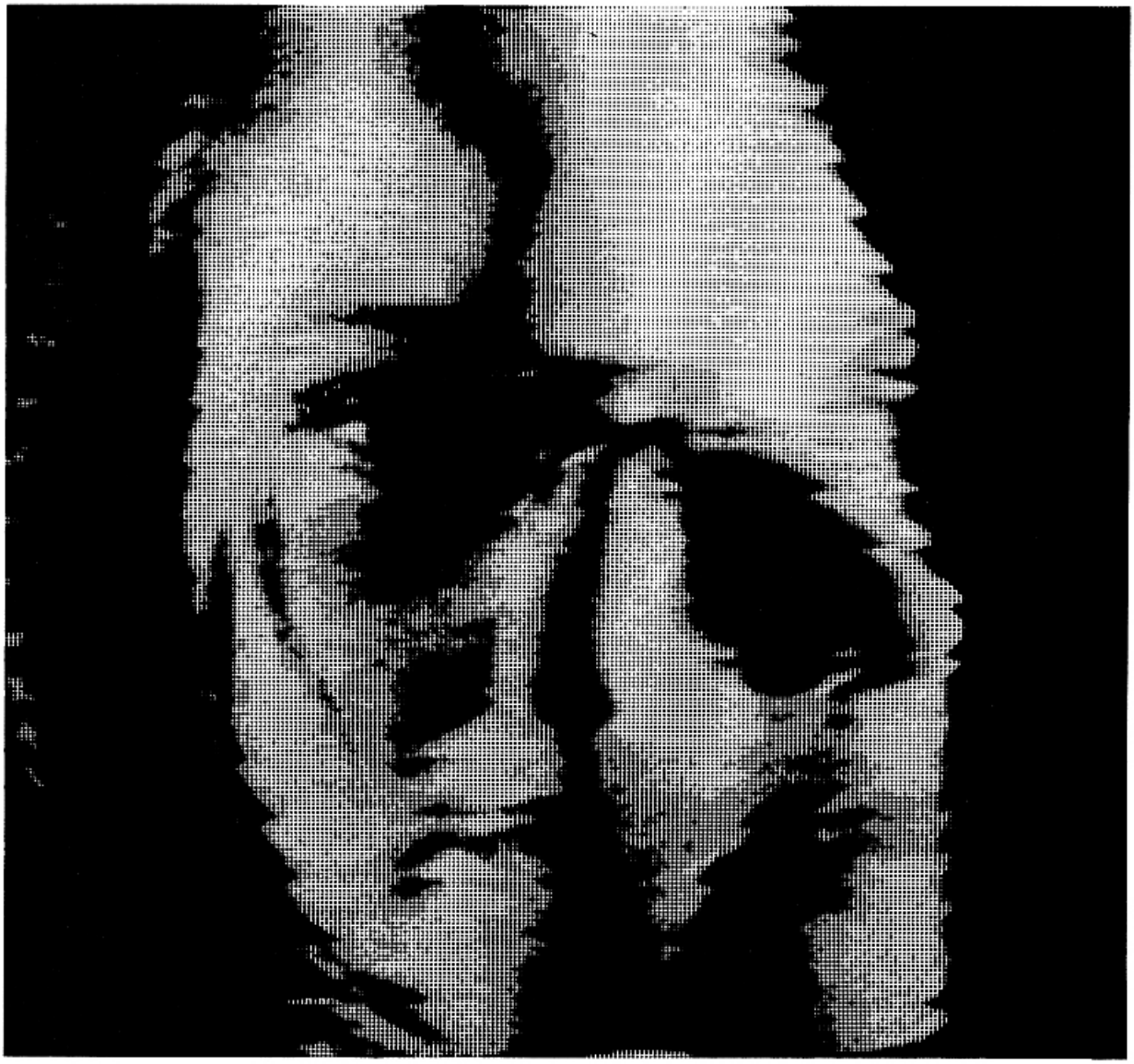
BELOW: "Noise Barrier" silkscreen in two colors, 12" x 17-3/4", 1974. This image is a transformation of the original computer-generated form. Copies of the edition are available through the Pratt Graphic Center, 831 Broadway, New York City, N.Y.





ABOVE: Untitled graphic from the "Hieroglyphs Series", 1978, Jerusalem, Israel. NOTE: Only a detail of the graphic is shown above. BELOW: Photographic reversal of a second new work from the "Hieroglyphs Series" by Aaron Marcus.





ABOVE: "Lillian II" by Lillian Schwartz and C. B. Rubenstein. MEDIUM: Photography.

THE TECHNOLOGY OF EACH ERA

by Lillian Schwartz
524 Ridge Road
Watchung, New Jersey 07060

The awesomeness of such a tool as the computer places the artist in quite a humble position. There is a necessary kind of readjustment for the artist, for here is a medium that may take some of the burdens from the artist. To find a real justification for the use of the computer by a painter would be to shift the emphasis by stimulating a new angle of approach; to maybe relieve the formal elements of some of the conscious emphases which are necessary and place more stress on centent.

It is no easy task for the artist to live with too much freedom in her medium. Great care must be given to the selectivity of these elements.

Artists must express their own creative character in the technology of their era in order to find their own historical and individual level.

I'm using the technology of today because it says what's going on in society today. Ignoring the computer would be ignoring a large part of our world today.

It seems clear that the results of this new medium may well fall into direct ascendency of the hieratic forms of Seurat and the mosaics of Byzantium. The artists in India also worked from set Sudras. Even among the more recent artists, Delacroix, Cezanne, and Matisse, the same desire for system and regularity for an ordered universe seem to dominate.

The computer has also assisted me in the visualization of sculpture in 3 dimensions. Programs can be used to rotate sculptures, to view them stereoscopically, to place in a given site -- all before any execution has taken place.

For the artist newly exposed to using the computer, it is not unlike Stephen Leacock's hero, who jumped to his horse and dashed madly off in all directions!

OSCILLONS: ELECTRONIC ABSTRACTIONS

by Ben F. Laposky
301 S. 6th Street
Cherokee, Iowa 51012

The best of computer art should be acknowledged as fine art, even though it is technological in origin. Produced by the selection and control of the apparatus used, the visual results must be judged for their aesthetic value by the artist.

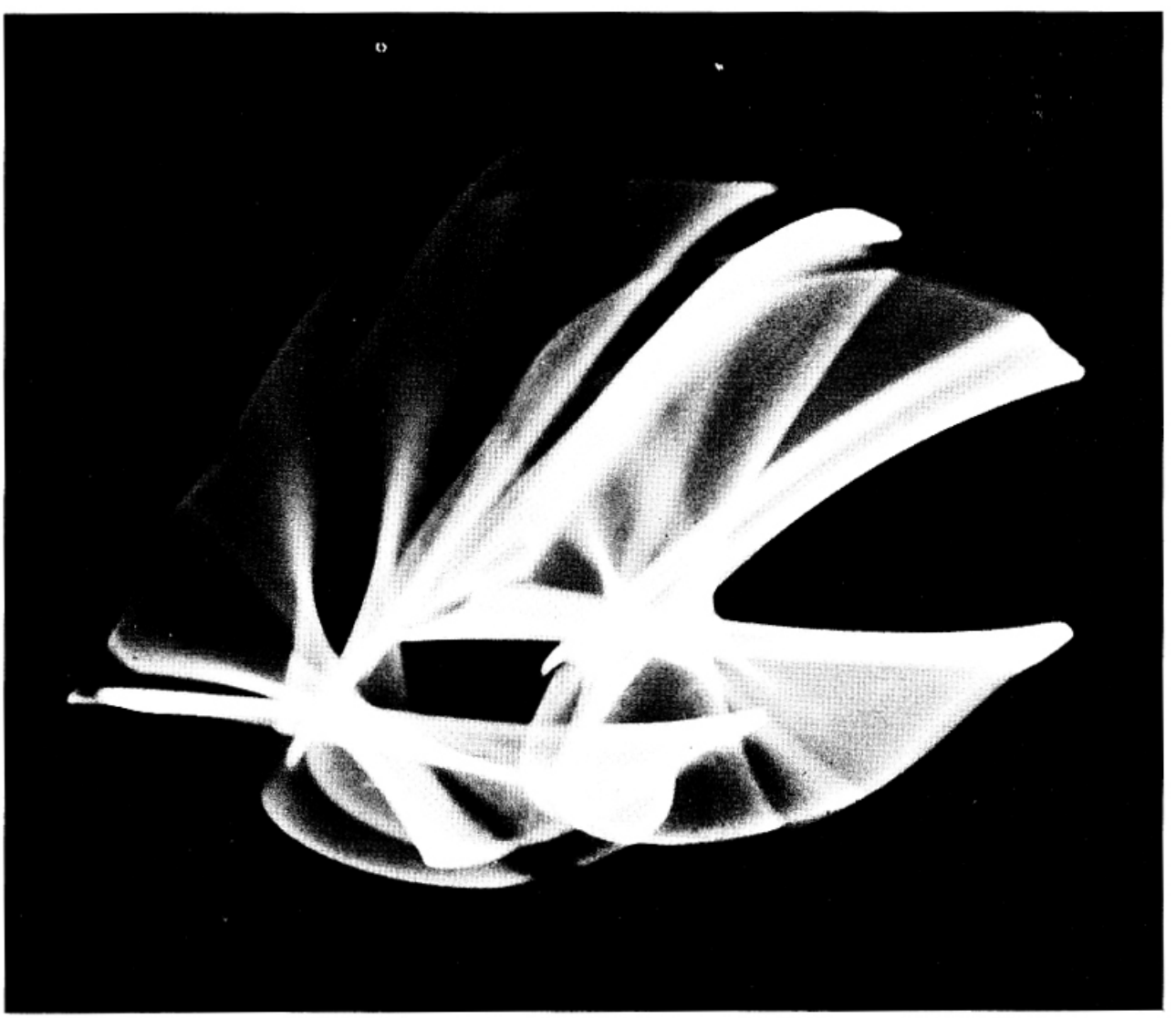
The oscillons or electronic abstractions are considered to be a kind of computer art since they are composed of analogue curves, which are related to the basic functions of the analogue computer. As oscillographic photographs, the electronic abstractions were the first such art to be widely exhibited and published in America and abroad. My work in this area has been exhibited and published beginning in 1952, a forerunner of current computer art.

The electronic abstractions are recorded on photographs, as this is the best way of preserving their intricate lines, planes and often very delicate color shadings. They may also be presented by means of lighted transparencies, motion pictures, direct kinetic displays on television tubes, plottings, drawings or paintings.

Special kinds of oscilloscope circuits, as well as a large number of many types of other output instruments, such as oscillators, amplifiers, modulators, and so on, are required in order to produce the wide range of forms shown in the oscillon technique.

Art forms for the space era, the oscillons represent in their glowing kinetic images the unseen forces of electrostatic and magnetic fields, as well as the vibrant motions of atoms and electrons.

BELOW: "Oscillon 1049" by Ben F. Laposky. MEDIUM: Photography. The work shown in the ART OF THE SPACE ERA EXHIBITION is in color, illustrated here in black and white, and also displayed horizontally.



EXPERIMENTAL ESTHETICS WITH COMPUTER GRAPHICS-- ANALYSES OF VIEWERS' IMPRESSIONS OF COMPUTER GRAPHICS

by Professor Reiner Schneeberger
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8043 Unterfohring
Munich, Western Germany

This article is closely related to the material on SNE COMP ART by Hans Korneder, on pages 12 through 15.

BACKGROUND INFORMATION

During the summer of 1976, the author gave a course in programming computer graphics at the pedagogic department of the University of Munich. The course was especially planned for art teachers. A brief article in the November, 1976 issue of this magazine describes the course itself. /1/ This new article discusses the first experiments at the University of Munich with statistical testing of impressions of viewers' impressions of computer graphics. In this paper, the statistical and simultaneous theoretic bases are given, along with the results of this first experiment with art teachers as test persons. The test itself is described, along with the results of the test. The graphics used in the test are shown throughout the article, as Figures 1 through 10.

AIMS AND OBJECTIVES OF THE BEGINNING TESTS

In a series of brief tests, computer graphics were to be evaluated by various criteria. The results were intended to afford answers to the following questions:

1. How are computer graphics evaluated by various criteria?

2. Up to what point do the opinions of the viewers coincide; i.e., how reliable (or concordant) are their statements of preferences?

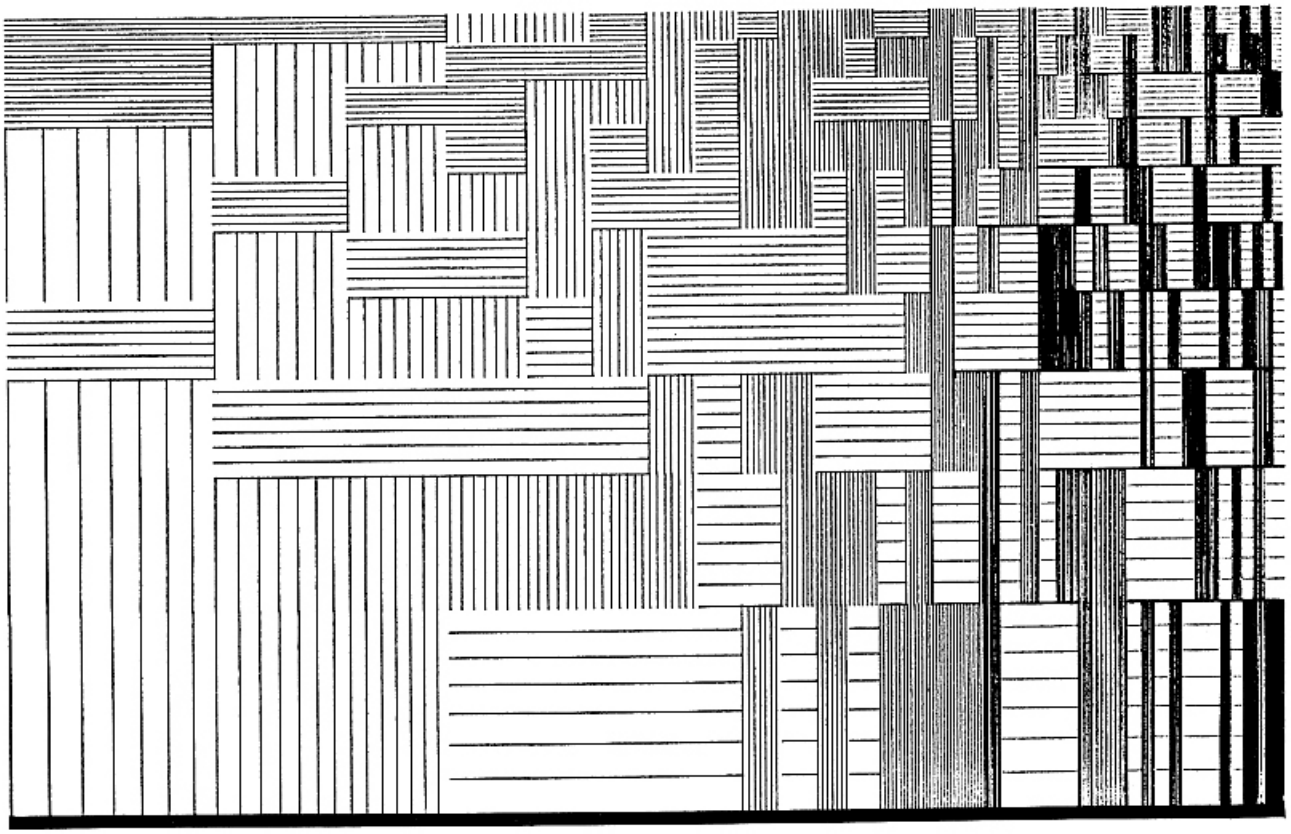
3. How can the expression "liking" (beauty, general impressions) be circumscribed by the various criteria?

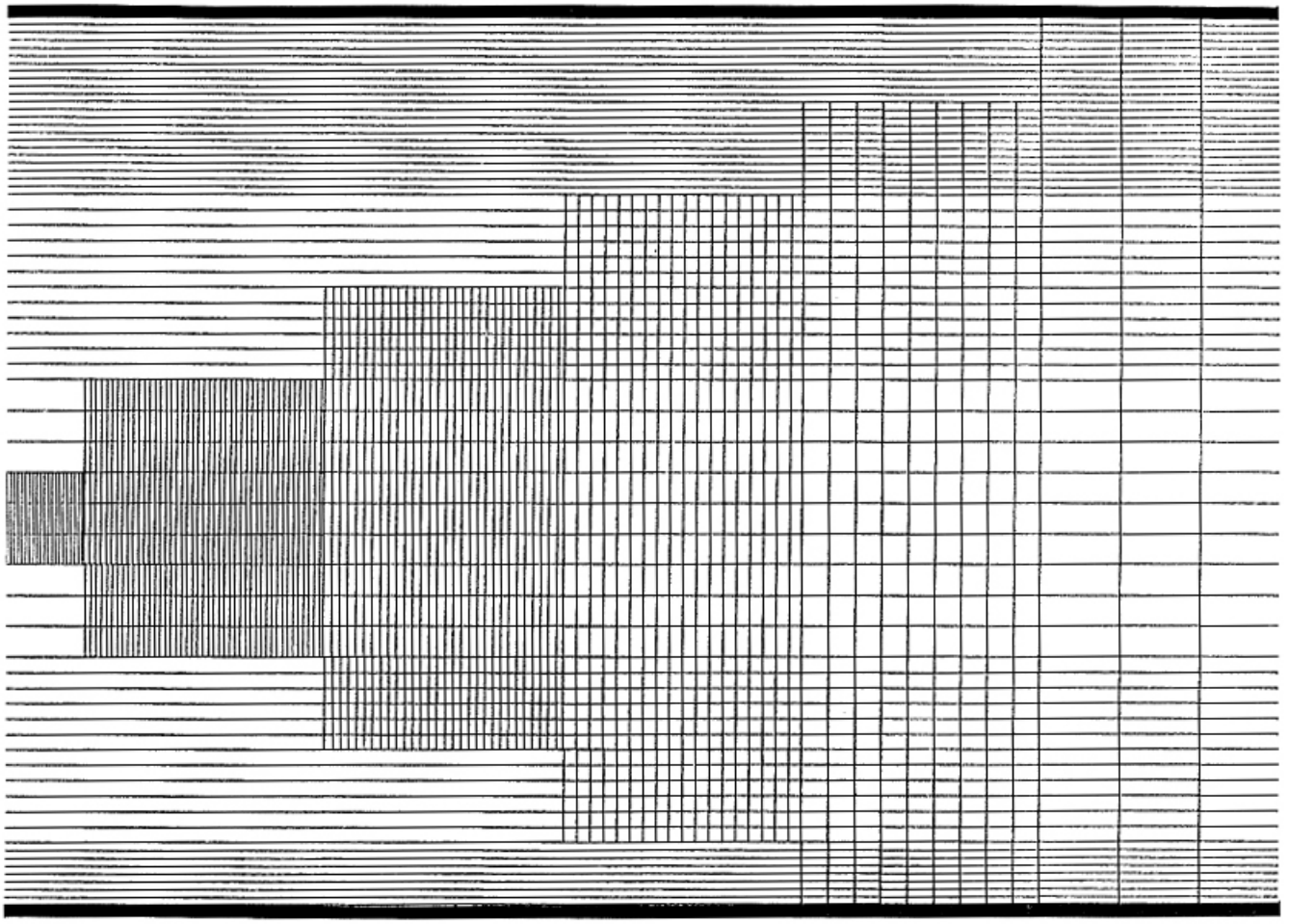
4. What are the differences between the opinions of "artists" (art teachers) and "non-artists" (industrial managers)?

In addition to seeking to measure preferences, as a long-range objective, the author wanted to set up rules for the optimal designing of computer graphics for different ranges of application. The impressions of viewers gives some clues as to this optimal designing of graphics.

The analysis of the differences between the opinions of "artists" and "non-artists" is not yet completed. However, sufficient information is available at this time to note some differences, and to form some conclusions. The finished work will be published at a later date.

BELOW: Picture number 1, one of a series of ten graphics used in the preference experiments. All works are rectilinear, yet each graphic is unique in spatial relationships, variety of black and white areas, etc.

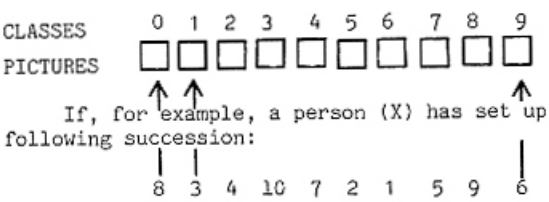




ABOVE: Picture number 2, a precise, orderly rectilinear composition.

DESCRIPTION OF THE TEST

The test persons (art teachers) were given the ten computer graphics included in this text. (See Figures 1 through 10, shown in numerical order.) The graphics served as test materials, together with questions Q1 through Q7. The viewer was asked to arrange the ten graphics in preference order, highest to lowest, in the artist's opinion. The results of this selection is a succession of ten classes for the ten pictures. Here the succession of classes starts with zero instead of one as the highest value. Nine receives the lowest preference value.



If, for example, a person (X) has set up the following succession:

8 3 4 10 7 2 1 5 9 6

this means, that person X has set the "highest" value on picture 8, followed by pictures 3 and 4. In this brief example, for picture 6, the viewer has assigned the "lowest" value.

It is necessary to note that successions of classes do not give a metric scale; i.e., they only show that picture 8 is considered "better" than picture 3, which in turn, is "better" than picture 4. The preferences given do not show how much the pictures are considered to be better.

For this initial test 18 art teachers participated in the research. The 10 computer graphics to be evaluated in the test were produced by the routine, SNEKAO, of the graphic system SNE COMP ART 76. The works are quite similar to each other; i.e., they are all of one "class" or family. Thus a relatively homogeneous test material is provided.

OTHER EXAMPLES -- AND POSSIBLE TESTS

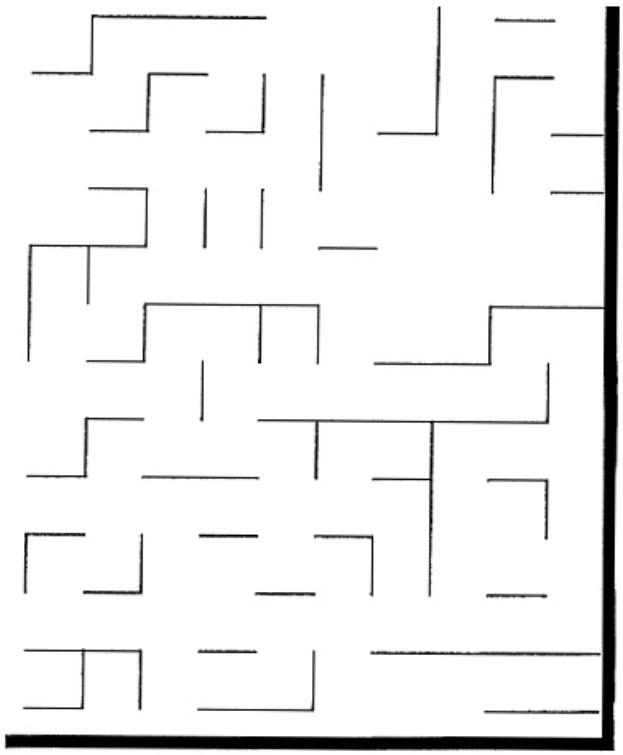
The article, "SNE COMP ART - A Software Package for Creative Problems by Graphic Data Processing" by Hans Korneder, illustrates further types of graphics available from the system.

The questions Q1 through Q6 referred only to the first three classes, and the latter three ones are not very evident. Working with all the classes would have required very intense concentration of the test persons. By answering the question Q7 (general impression), the test persons had to evaluate all the 10 classes.

THE TEST QUESTIONS

Question Q1 - Evaluate the balance (or share) of black and white in the graphic. Arrange the pictures according to this criterion. Write the number of the preferred pictures in the squares -- only first and latter three classes.

0 class - very good share or blance of black and white
9 class - poor share or balance of black and white



ABOVE: Picture number 3, a more minimal arrangement of pattern, recalling early Bauhaus works.

Question Q2 - Evaluate the variety in the graphic.

0 class - strong or pleasing variation
9 class - extremely monotonous

Question Q3 - Evaluate the work as seen by the taste of an "average viewer" (chances for sale of the work).

0 class - highest value for sale
9 class - lowest value for possible sale

Question Q4 - Rate the "casualness" of the graphic.

0 class - very casual, or free
9 class - constructive or least free

Question Q5 - Evaluate by the term, "piece of art".

0 class - a fine piece or work of art
9 class - not a piece or work of art

Question Q6 - Rate the amount of "information" in the pictures.

0 class - highest content of information
9 class - smallest information content

Question 7 - Rate the "general impression" (liking) for the graphics (all 10 classes).

For testing purposes, the following question T1 was added:

Question T1 - Study only the pictures 4, 6, 7, and 9. Evaluate your "general impression" (liking for the works).

PROCESS OF EVALUATION

For the analysis the methods "Paired Comparisons", /2/ and "Spearman's Correlation of Classes" /3/ were employed, using the program system SPSS with the Model SSA1. /4/ These methods are briefly described and shown by a model example:

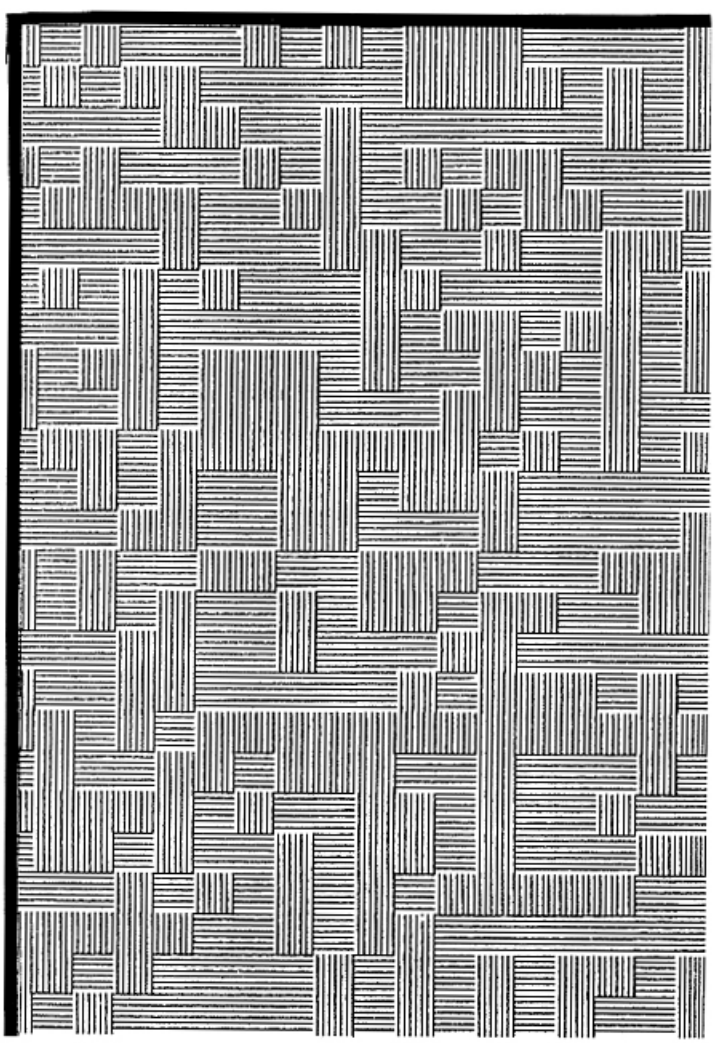
Three persons, A, B, and C have answered question Q2 (variety) as follows:

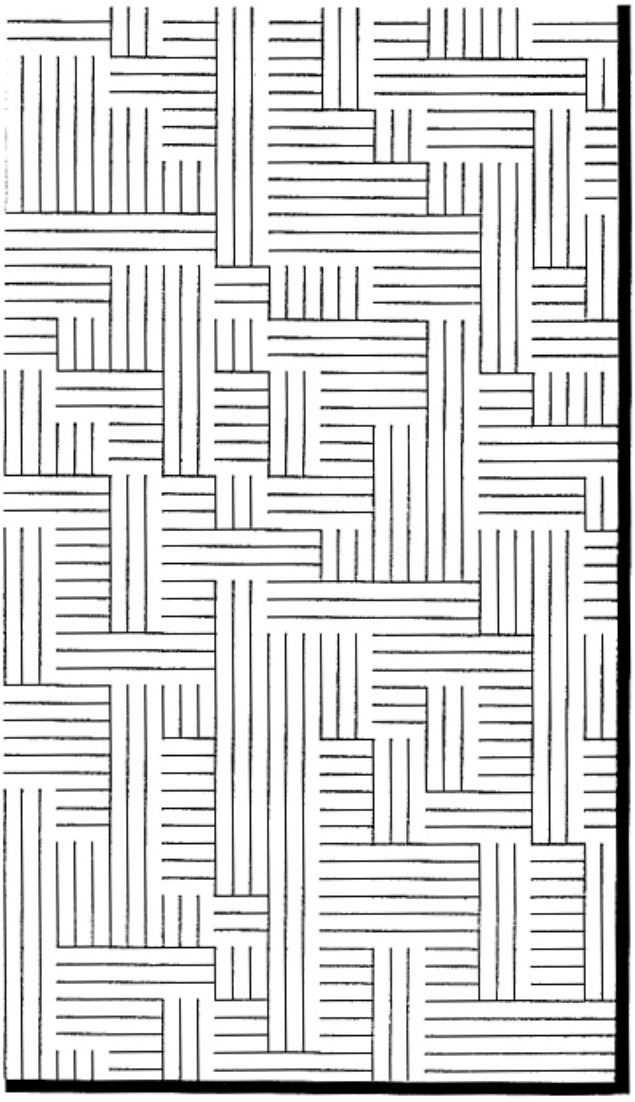
	0	1	2	3	4	5	6	7	8	9 ←(CLASSES)
A	8	1	10 ↖					↗ 9	4	5
B	1	8	1 ←		pictures			→ 6	10	5
C	1	8	2 ↙					↘ 9	4	5

The classes 3, 4, 5, and 6 which do not appear in the test can be randomized according to various methods, in order to complete the classes. An example of this method is given below:

	0	1	2	3	4	5	6	7	8	9 ←(CLASSES)
A	8	1	10	6	2	3	7	9	4	5
B	1	8	2	7	3	4	9	6	10	5
C	1	8	1	6	3	7	10	9	4	5

BELOW: Picture number 4, with precise, even spacing of lines, but with fine variations of the modules within the graphic.





ABOVE: Picture number 5, evenly spaced, sparce elements of pattern, differing markedly from number 6, at right.

Interpretation - Person A rates picture 8 as the most varying one. Persons B and C prefer picture 1. All the three persons share the opinion that picture 5 is the work with the least variety, or the most monotonous one.

However, they are not agreed on the frequency of variety in picture 10: Person A rates the graphic as class 2 (third place); person B finds it to be class 8 (this is penultimate, or next to the last place); person C finds it to be somewhere between class 3 and class 6.

Next the data is transformed into another style of representation. In this way, the method "Paired Comparisons" can be applied immediately, and the correlation values according to Spearman can be determined more easily. The transformation of the data is obvious ("exchange" of classes and pictures). An example is given below:

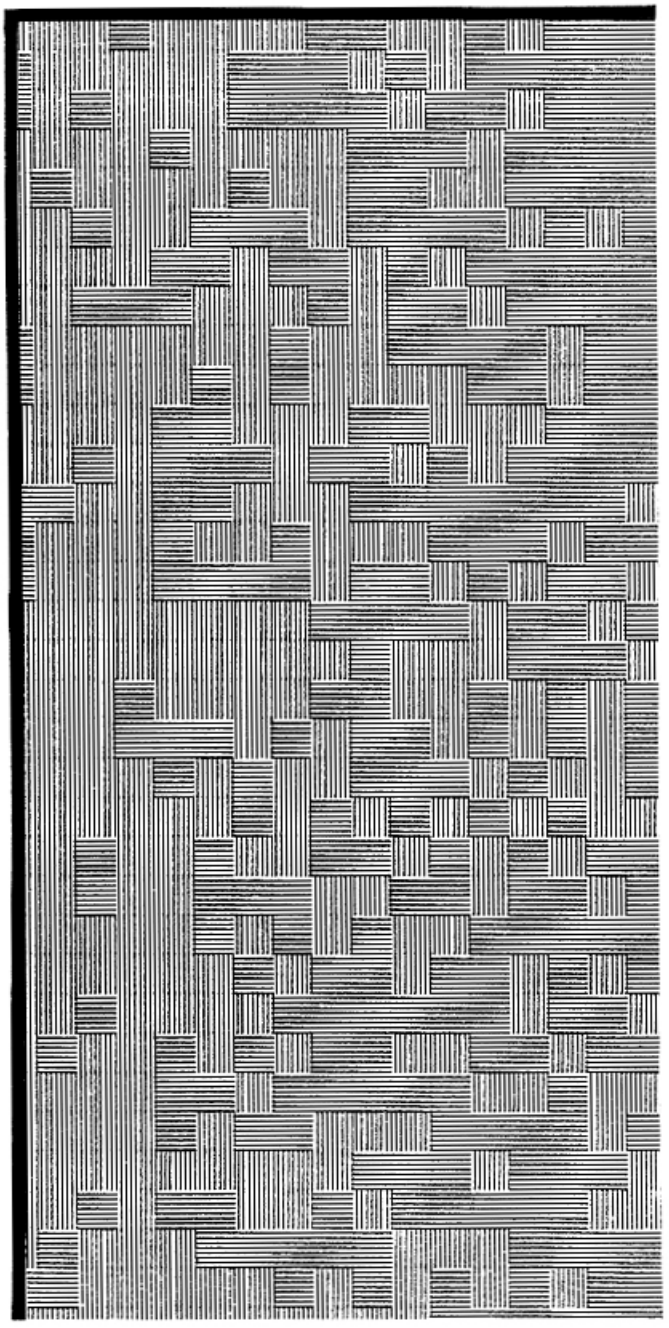
	1	2	3	4	5	6	7	8	9	10←(PICTURES)
A	1	4	5	8	9	3	6	0	7	2↖
B	0	2	3	5	9	7	3	1	6	8← CLASSES
C	0	2	4	8	9	3	5	1	7	6↙

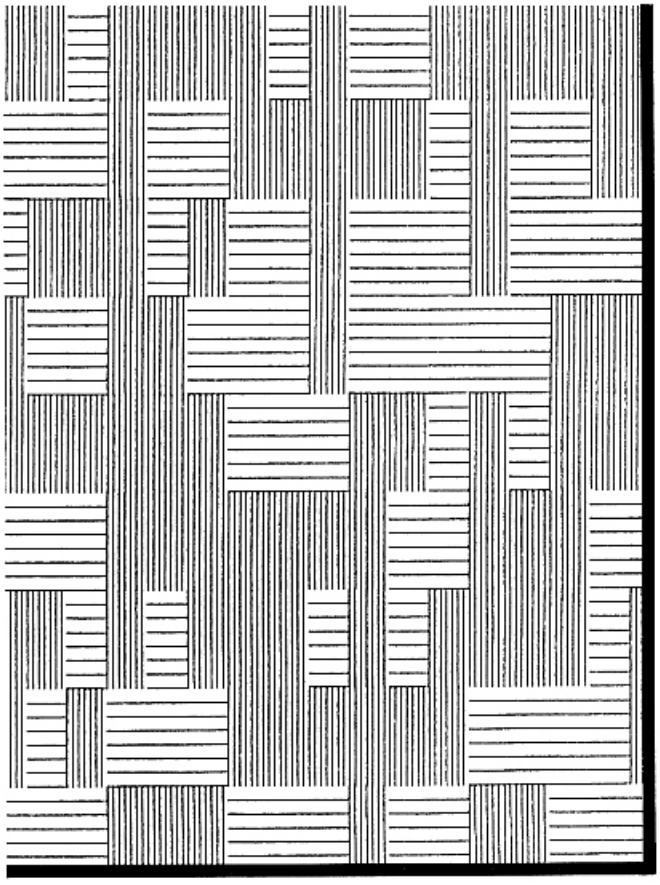
In the above example, picture 4 has been rated 8 by person A; 5 by person B; and 8 by person C.

The application of the method Paired Comparisons involves certain basic conditions, which cannot be attended to in detail here. Our test data do meet these conditions. It is possible to obtain a real metric scale by this method, totaling up the single rates for each picture. The admissibility of this summing can be taken from the article, given as Reference 2.

	1	2	3	4	5	6	7	8	9	10←(PICTURES)
A	1	4	5	8	9	3	6	0	7	2
B	0	2	4	5	9	7	3	1	6	8
C	0	2	4	8	9	3	5	1	7	6
Σ	1	8	13	21	27	13	14	2	20	15←SUM OF CLASSES

BELOW: Picture number six, closely related to 4.





ABOVE: Picture number 7, another variation of form.

In order to see the reliability of the scale obtained by the method of "Paired Comparisons", (i.e., in order to be able to measure the coincidence of the opinions of the test persons), the correlations of the persons had to be determined after the method of Spearman.

Correlations are a measure for the coincidence of opinions, facts, etc. The values (intensity) of correlations are always between -1 and + 1.

Two opinions are:	Correlation "r":
- exactly identical	+ 1
- almost identical, higher, about	+ 0,8
- very similar, " "	+ 0,5
- quite similar, " "	+ 0,3
- not obviously related to each other	0
- exactly opposite	- 1

Correlations can be calculated by successions of classes. Here is an example:

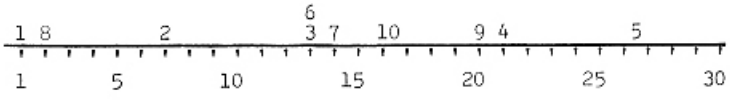
i =	1	2	3	4	5	6	7	8	9	10
A	1	4	5	8	9	3	6	0	7	2
B	0	2	4	5	9	7	3	1	6	8
C	0	2	4	8	9	3	5	1	7	6

The formula by Spearman for two marks, in this case persons, is the following:

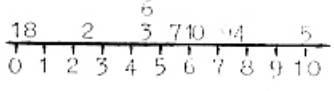
$$r = 1 - \frac{6 * \sum Di^2}{n\,(n^2-1)}$$

Di = differences between two classes
n = number of rates
$\sum$ = sum

The scale obtained for the pictures for Question Q2 (variety) with persons A, B, and C is given below:



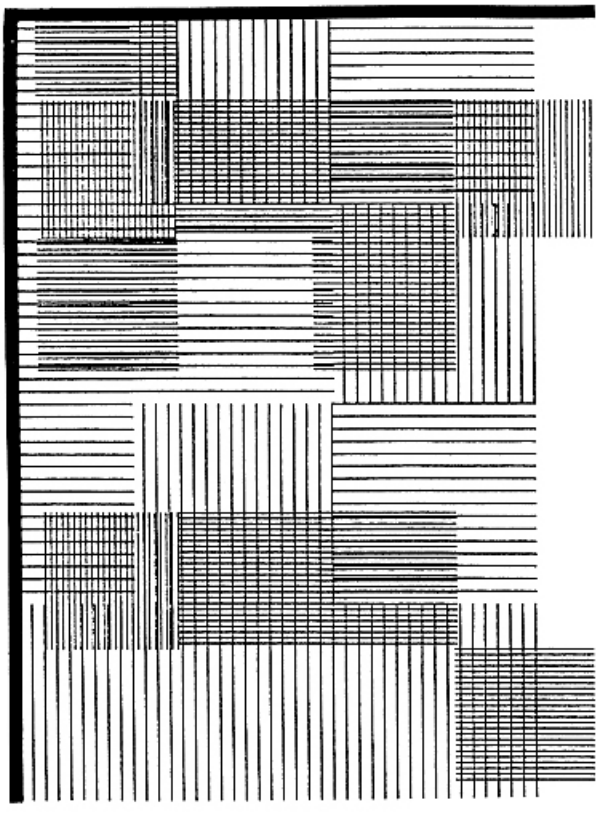
This shows the "average" valuation of the 10 computer graphics in real metric distances. To enable this scale to be compared easily with other ones, the scales have to be transferred into a "standard scale", between 0 and 10 (so-called standardization).

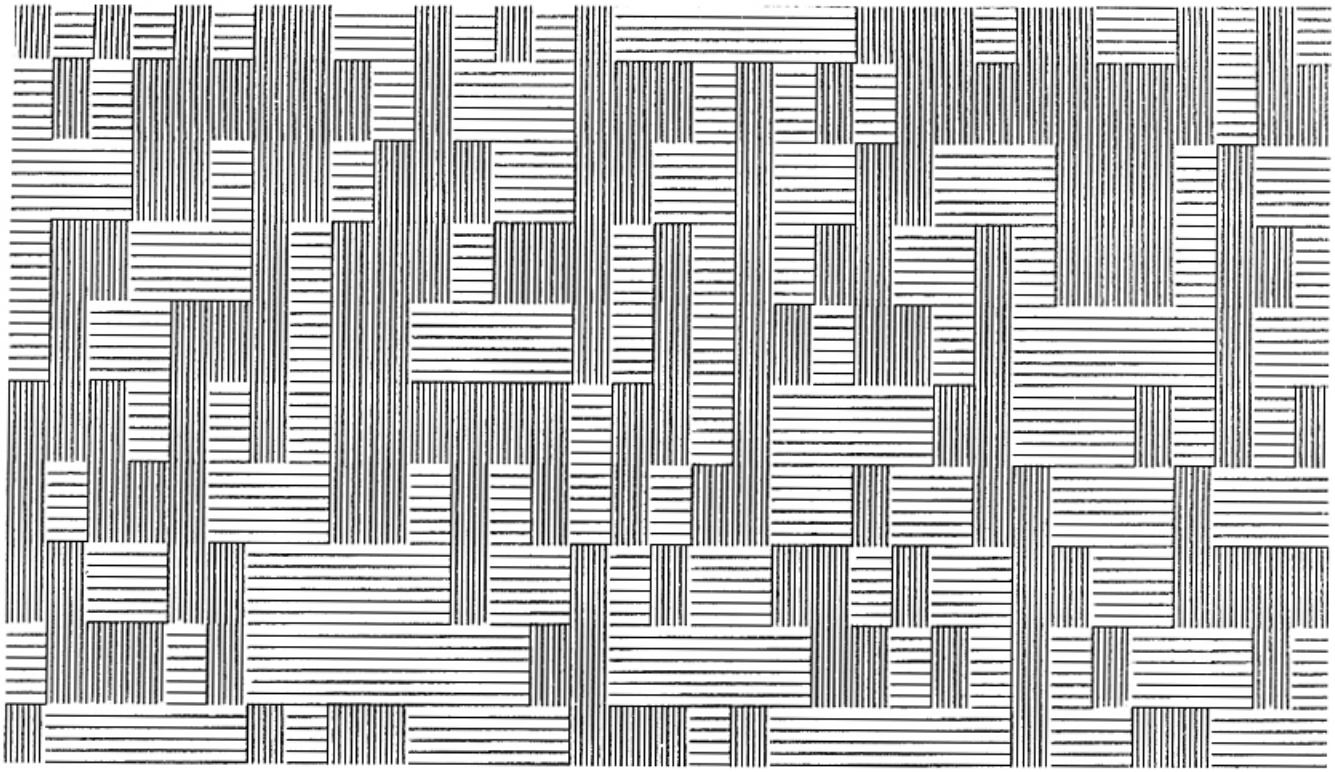


In summary, from this test, the following results were obtained:

- pictures 1 and 8 are the most varying ones;
- picture 2 is also considered to be rather varying;
- pictures 3, 6, 7, and 10 range in the middle of the classes (almost equally evaluated);
- pictures 9 and 4 are less varying; that is, they are more monotonous;
- picture 5 is the least varying, or the most monotonous of all the pictures.

BELOW: Picture number 8, intersecting patterns.





ABOVE: Picture number nine, more closely related to number 7. Note: All the pictures have been judiciously cropped to show details of the works. This in no way interferes with the compositional elements or values of each work.

Comparison between person A and B:

i =	1	2	3	4	5	6	7	8	9	10	
A	1	4	5	8	9	3	6	0	7	2	
B	0	2	4	5	9	7	3	1	6	8	
Di	1	2	1	3	0	-4	3	-1	1	-6	
Di^2	1	4	1	9	0	16	9	1	1	36	=78

$$r_{AB} = 1 - \frac{6 \quad 78}{10 \ (100-1)} = 1 - \frac{468}{990} = +0{,}527$$

The different opinions of the persons A and B correlate: r_{AB}=0,53. The correlation between person A and C, as well as between B and C can be calculated by analogy. The results are:

r_{AC} = +0,86 and r_{BC} = +0,79.

The range of all the correlations lies between +0,53 and +0,86. This is represented by a so-called correlation matrix:

r	A	B	C
A	/	+0,53	+0,86
B	+0,53	/	+0,79
C	+0,86	+0,79	/

Additionally, the measures "range 1", "Median m_e", "most frequent value m_h" and the expression "valuation w" have been applied to describe the correlation of the test persons.

A few lines are given to exemplify the determination of these measures. Supposing the following correlation values have been calculated:

+0,23; +0,69; +0,73; -0,12; +0,61.

The values are represented in round figures, sorted increasingly:

-0,1; +0,2; +0,6; +0,7; +0.7

This means that range 1 reaches from -0,1 to +0.7 and Median m_e (50% limit) is:++0.7.

The author, to facilitate the survey, summarized these values subjectively under the term "valuation w" with:

+++ = very high correlation (reliable scale)
++ = high correlation
+ = poor correlation (unreliable scale)

Our example would get "++" or "+".

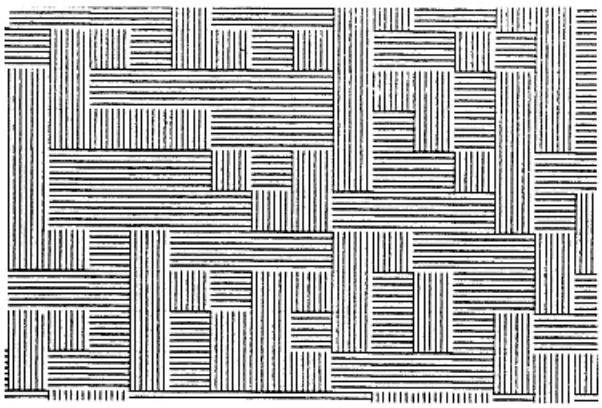
The methods "Paired Comparisons" and "Spearman's Correlation of Classes" as described above are to be employed at each question. The result is a "standard scale" and correlation values of the persons.

The standard scale of each question can be compared with the scales of the other questions and coincidences can be measured. It is also significant to correlate the class data of each person against each other, and to determine the resulting correlation values (coincidences).

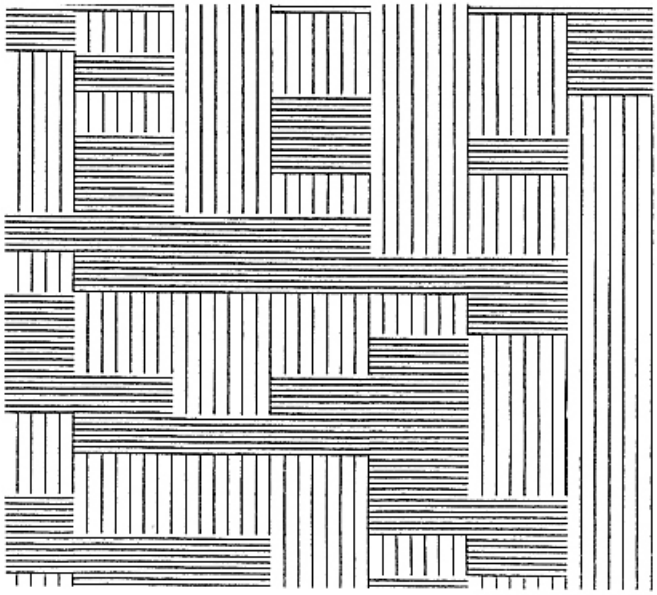
This coincidence test results in a correlation matrix of the questions, in which the correlation (degree of similarity) among the single questions is to be seen directly.

This particular analysis was made under the program system SPSS with the Model SSA1 at the

Leibniz Computing Center of the University of Munich. The Center owns a computer system CYBER 175 by Control Data. The evaluations according to the methods "Paired Comparisons" and "Spearman's Correlation of Classes" were programmed by the author.



ABOVE: Detail of Picture #4.



ABOVE: Detail of Picture #7.

RESULTS OBTAINED WITH THE ART TEACHERS

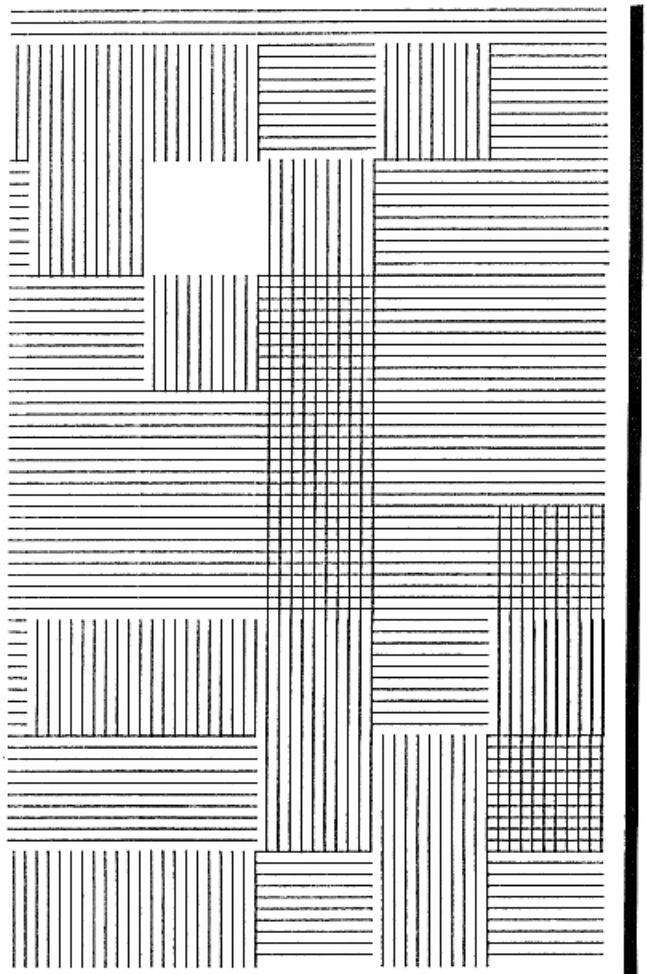
Questions — Paired Comparisons "Standard Scale" — Spearman's Correlation of the Test Persons

		range 1		m_e	m_h	w
Q1	7 1 2 9 8 10 4 6 5 3	-0,5	+0,9	+0,4	+0,7	+
Q2	1 8 7 2 3 6 9 4 5 10	-0,5	+0,4	+0,2	+0,1	++
Q3	1 6 4 8 2 7 9 10 3 5	-0,1	+0,8	+0,3	+0,1	+++
Q4	3 5 9 4 10 7 6 8 1 2	+0,5	+0,9	+0,7	+0,7	+++
Q5	1 3 8 6 4 2 5 10 9 7	-0,4	+0,8	+0,3	+0,4	++
Q6	1 3 8 6 7 2 4 9 5 10	+0,0	+0,8	+0,4	+0,5	+++
Q7	1 3 6 2 8 4 7 5 9 10 (0 … -10)	-0,2	+0,4	+0,3	+0,5	++
T1		-0,4	+1,0	+0,4	+0,8	++

CORRELATION MATRIX OF THE QUESTIONS:

		Q1	Q2	Q3	Q4	Q5	Q6	Q7
BLACK/WHITE	Q1	/						
VARIETY	Q2	+0,6	/					
AVERAGE VIEWER	Q3	+0,4*	+0,7*	/				
CASUALNESS	Q4	-0,6*	-0,5	-0,7	/			
PIECE OF ART	Q5	-0,1*	+0,7*	+0,5*	-0,1*	/		
INFORMATION	Q6	+0,3*	+0,9	+0,6	-0,2	+0,8	/	
LIKING	Q7	+0,2*	+0,8	+0,7	-0,3	+0,9	+0,9	/

NOTE: The values marked with (•) are still very unreliable.



ABOVE: Picture number 10, related to number 8.

INTERPRETATION AND PRACTICAL USE OF THE TEST

In consequence of the detailed representation of the methods and expressions employed, the reader is able to interpret the results easily by himself. The observation of the following points is important:

1. The uniformity of the test material (one class of computer graphics) and the homogeneity of the test group (art teachers from the course, Computer Graphics);

2. The relatively small number of 18 test persons;

3. The "middle" classes of the questions Q1 to Q6 had to be filled in according to various random methods.

The two latter points led to the fact that some questions have correlation values marked with stars (*), whose factors of insecurity are rather high. However, the other correlation values seem to be reliable, and an interpretation of the present results with this group of persons (art teachers interested in computer graphics) appears to be significant.

Even a superficial look at the single scales shows a special position of picture (or Figure) 1. Like the other pictures, it has been produced by the routine SNEKAO of the graphic system, SNE COMP ART 76 -- but it is the only one that has been "distorted". More formal, different reactions are to be found in the parameter data to SNEKAO for the pictures 10 and 5, which also take in a special position on the scale. Also, the single evaluations of picture 3, which the reader can see for himself from the scales, are very interesting. For this picture the parameter shows one very extreme value. Almost the same is true of picture 7 .

This and other detailed results supports the author's opinion that optimal computer graphics designing on the basis of the formal (that is, automatable) criteria must be feasible.

Looking at the correlation values of the questions, the extremely high correlation values among the questions Q5 and Q6 to Q7 are worth studying. This gives rise to the assumption, that for an artist, the criteria: art (piece or work of art), information (innovation), and liking (general impression) are almost the same. Also questions Q6 and Q7 are very highly correlated with question Q2. This means that a similar situation exists between the expression, variety -- at least towards the criterion information (innovation).

It is very interesting to see the separation from the criterion Q3, taste of an average viewer (or chances for selling). The correlation of Q3 with Q7 is smaller than of Q5 and Q6 with Q7. This means that the impression (Q7) of an artist is, according to the opinions given in the test, very different from the taste of the "average viewer" (Q3). It is significant to compare this with the rating of an average viewer (Q7 as well as Q3).

The component Q1 (balance or share of black and white) refers to certain effects of the surface. For example, in etchings, there is a good proportion of black and white, and in drawings, a lesser proportion of black and white. No direct influence of this criterion on the liking of computer graphics could be observed.

The criterion Q4 (casuality) seems to be completely different. All the correlation values are negative. If we look at the formation of Question Q4:

Question Q4 - Classify or evaluate the casuality of the graphic.

0 class - very casual
9 class - constructive, not casual

We see that the succession of the classes is "casuality - constructiveness". If the succession was determined "vice versa", like this: "constructiveness - casuality", all the correlation values of Q4 would have the same value -- with the only difference that they would now be positive.

In continuing this idea, let us do this, and call Q4 now Q4C (constructiveness). The correlation value of Q4C with Q3 is now +0.7, the one of Q4C with Q7, +0.3. This is a very interesting statement. According to the opinion of the test persons (art teachers), the criterion of Q4C (constructiveness) correlates considerably higher with Q3, or taste of the average viewer than Q7, general impression of an artist. Simply speaking, the average viewer tends much more towards constructiveness (or more structured placement) than does the artist. The author confirms this statement based on his experience with computer graphic courses. The components of the casual (or of the

random generator) in computer graphics should not be given that important function (or place of importance) as it still has for many people.

INSTRUCTIONS FOR APPLICATION OF THE TEST

The graphics are to be set up in the order of their numbers in front of the participants. Then the questions are to be distributed in the following order: Q7, Q4, Q3, Q2, Q1, Q6, and T1 as the last one. Each question is handed out separately, using an extra sheet of paper for each one. The sheets are gathered after they have been filled in by participants. This serves the purpose that each question is answered independently from the others.

Take also into account, which category of persons forms the group. Within this test, the classification of "artists" and "non-artists" appears to be successful.

Those who want to apply this test for other purposes (as in seminars or exercises) may contact the author, who is in a position to evaluate the results of the test, with the programs provided for this purpose.

SUMMARY

There is a growing need and interest in evaluating computer graphics objectively. This paper presents some ideas that may be useful in this search for the "measurable". The author will continue this research and will publish further results of this work in this and other journals.

REFERENCES

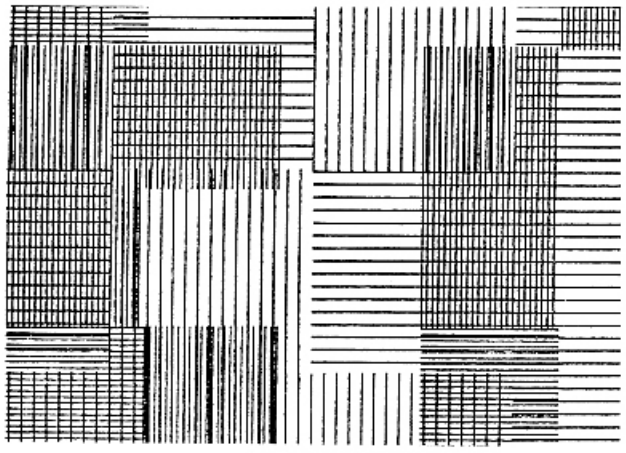
/1/ Schneeberger, R., "Computer Graphics at the University of Munich," Computer Graphics and Art, Vol. 1, No. 4, November, 1976, p. 28-31.

/2/ Gulliksen H. and Tucker, R., "The General Procedure for Obtaining Paired Comparisons from Multiple Rank Orders," Psychometrika, 1961, 26, p. 173-183.

/3/ Siegel S. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw Hill, 1956, p. 202-213.

/4/ Toledano, S., "Smallest Space Analysis - A New Subprogram 'SSA1' in the SPSS Package", Hebrew University of Jerusalem, Computation Center.

BELOW: Detail of #8.



NOTE: CONFERENCE PROCEEDINGS will be available for $10 from the Department of Computer Science, University of Iowa.

The University of Iowa

The University of Iowa, Iowa City, is holding a very special conference in memory of Gerard P. Weeg, a pioneer in academic computing, and one of the founders of the conferences titled "Computers in the Undergraduate Currilulum" series. Dr. Weeg saw the computer as a revolutionary force in higher education. He was a person respected and loved.

As a special tribute to Dr. Weeg, the Computer Center will be dedicated, to be retitled GERARD P. WEEG COMPUTING CENTER. Dates are May 1-2.

The objectives of the conference are:

- To explore ways that computing affects how and what we study;
- To look at different ways of providing computing at both small and large colleges;
- To identify the probable effects of the new technology on our institutions.

The title of the May conference is COMPUTING IN COLLEGE AND UNIVERSITY: 1978 AND BEYOND.

Invitational speakers for the conference are:

JOHN HAMBLEN -- University of Missouri, Rolla
"Computers in Education: Cycles and Trends"

JOHN EULENBERG and MORTEZA RAHIMI - Michigan State University
"Equality of Educational Opportunity through Computer Technology"

ARTHUR LUEHRMANN -- University of California, Berkeley
"Pre- and Post-College Computer Education"

STEVEN HEDETNIEMI -- University of Oregon
"Future Trends in Computer Science Curricula"

SEYMOUR PAPERT -- Massachusetts Institute of Technology
"Personal Computing and its Impact on Education"

WALTER DOHERTY -- IBM, Incorporated
"Computing in the Research Environment"

TOM KURTZ -- Dartmouth College
"The Case for the Network"

SISTER MARY KENNETH KELLER -- Clarke College
"The Microprocessing Revolution and its Effect on Small Colleges"

GRACE HERTLEIN -- California State University, Chico
"The Reshaping of Men's Minds via Computing"

AL BORK -- University of California, Irvine
"Computers, Education and the Future of Educational Institutions

GLENN CULLER -- Culler-Harrison Corporation
"The Trend Toward Personalized Computing"

OUTER SPACE AND TECHNOLOGICAL PROGRESS

by Roger Cogart
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B 1050 Brussels, Belgium

The space age revolutionized every aspect of our way of living. The fabulous adventure of the exploration of outer space stimulates the creative genius of man in every field of human activity.

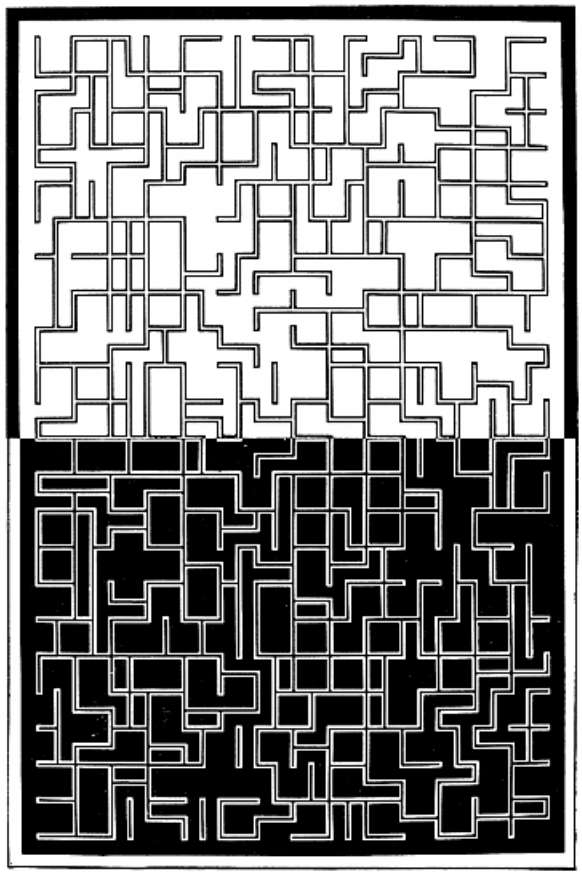
New materials are constantly evolving, and technological progress rushes ahead. New knowledge is gained in every domain, and to the layman it would seem that technology moves faster than the human intellect.

Man has to adapt himself to this spiraling movement, in order not to become enslaved and annihilated spiritually and physically by misusing the new riches of technology. On the other hand, man needs to take advantage of each new invention and each new idea, to liberate himself in every possible way.

As art is an image of its era, we can observe in the different tendencies (or directions) of art (or anti-art) how mankind adjusts to its own epoch.

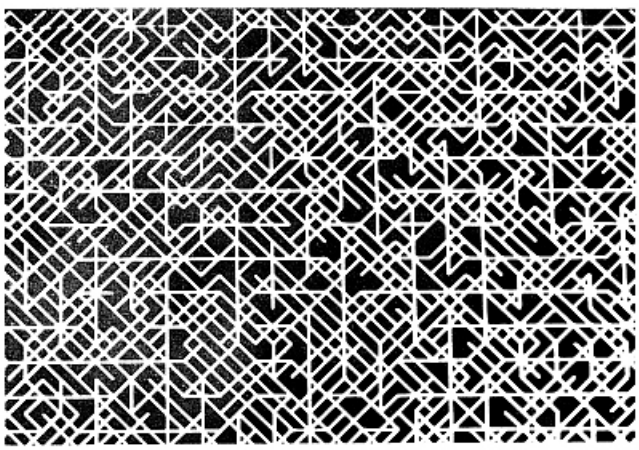
Throughout the history of art, new technological resources and devices have been applied in the varied art media of their time. One of the most significant instruments of our time is the computer, which has been used in diverse ways in the creative stages of artworks during the past dozen years.

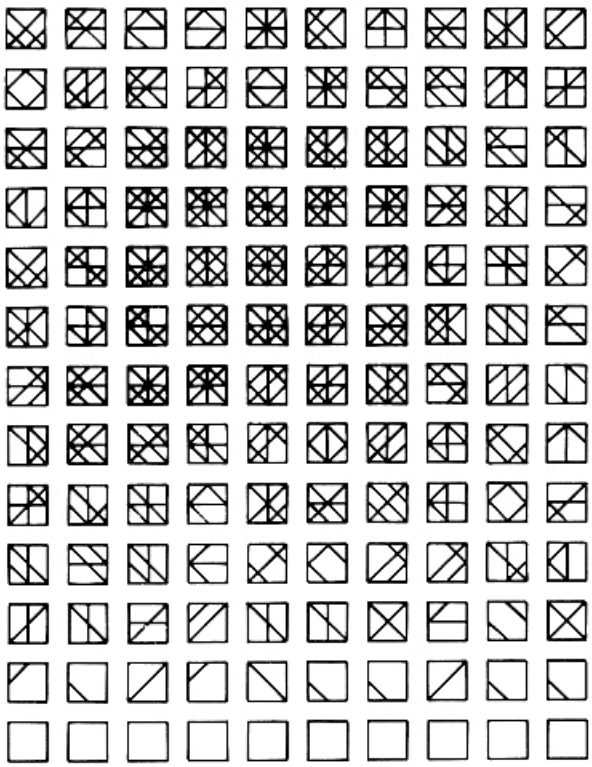
In my case, the computer is used as a means to create geometric constructions in which a few elements are arranged in a statistically valid manner, in order to obtain a great variety of objective examples of growth structures. These can be used in paintings, mosaics, sculptures, and so on. It is my belief that, in using the computer to create art, I gain a better insight into the work of Nature, the base of our existence.



ABOVE: "Positive-Negative Grid with Perpendicular Elements" by Roger Cogart. MEDIUM: Painting on Plexiglas, 80 x 120 cm.

BELOW: Detail of a plexiglas painting, white on black "From the Square Series" by Roger Cogart. (See the November, 1977 covers of CG&A.) AT RIGHT: Detail from the Structured Square Series by Cogart.





UNIMAGINABLE IMAGES

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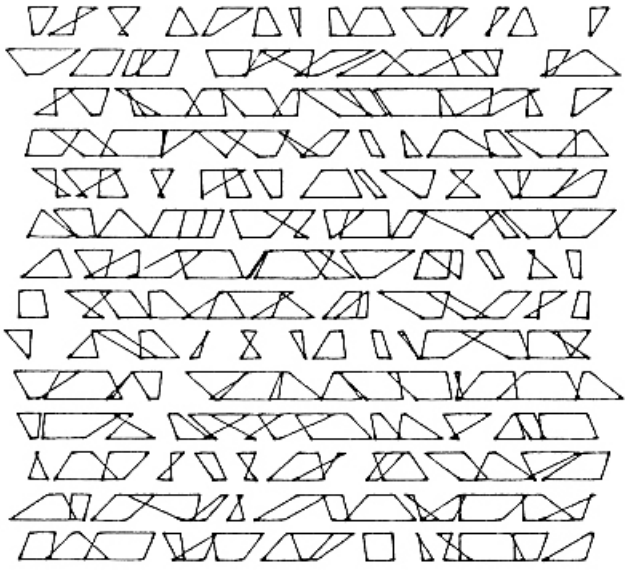


ABOVE: From the "196 Trapeziums Series" by Vera Molnar, variation 75.137/12.19.38. MEDIUM: Ink on paper.

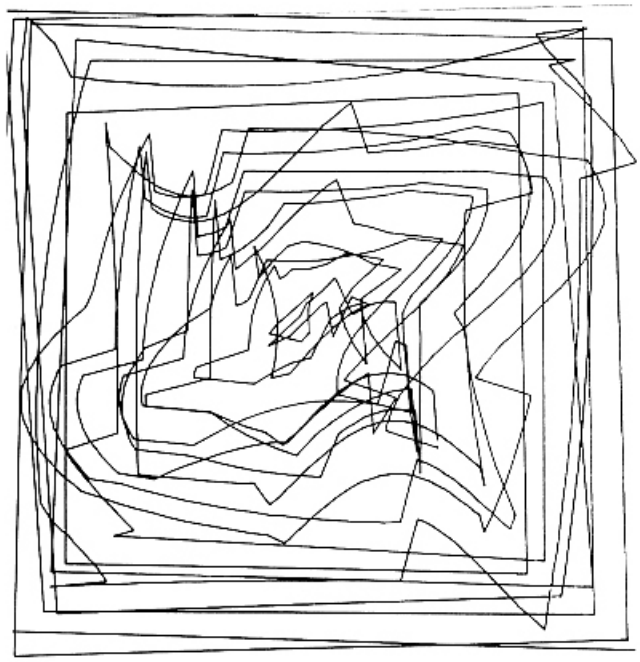
The task of a painter is to create forms, combinations of forms which correspond to certain combinations according to criteria called "plastic" by estheticians.

Let us stress that nobody knows exactly what this epithet "plastic" means. For my purpose, just as for Matisse and some other classics, plastic means a "feast for the eyes". A feast, which must have sensorial bases -- painting which is not done for the eyes is not a painting.

We maintain, we have to maintain, that all these "feasts" are not as rich as they could be. We maintain, we have to maintain, a relative poverty of the repertory of forms and their combinations if we compare them to the infinite number of possible forms. Imagination is set in motion only by elements seen in nature, or as far as a painter is concerned, in museums (as it has been shown by Malraux). The imaginary museum is full of real and not of imaginary works.

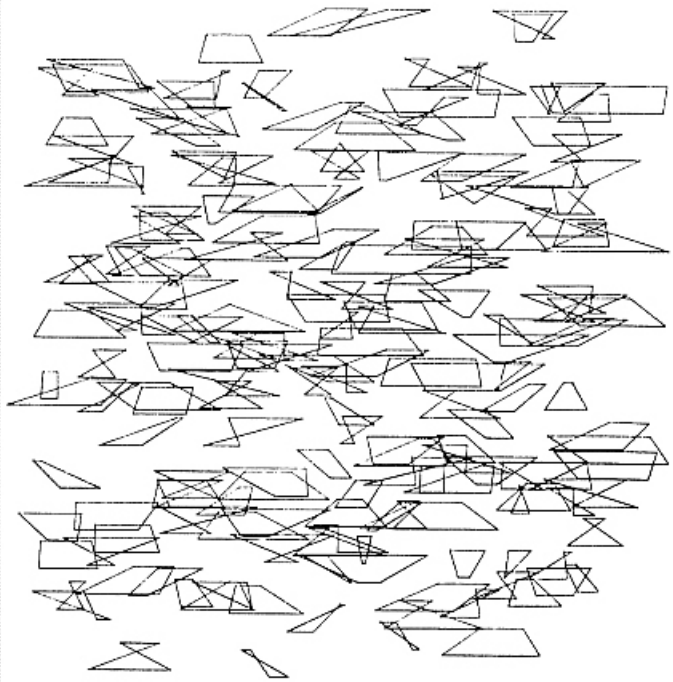
The computer is the only instrument up to the present which permits us to go beyond the bounds of learning, cultural heritage, environment -- in short, of the social thing which we must consider to be our second nature.

Because of its huge capacity of combinations, the computer permits systematic investigation of the field of possibles of the visual world permits clearing the brain of the painter of mental "ready-mades" of culture and allows the artist to produce combinations of forms never seen before either in nature or in museums -- images one would never imagine, that is to say, unimaginable images, an art of the SPACE ERA.



ABOVE: "Hypertransformations" by Vera Molnar. System: IBM 360, CRT Screen 2250, Benson Plotter.

BELOW: A second variation from the "196 Trapeziums Series" from the ART OF THE SPACE ERA EXHIBITION. MEDIUM: Ink on paper.



VARIED ATTITUDES HELD TOWARD COMPUTER ART

by Paul Shao and Ken Dunker
Department of Architecture
Iowa State University
Ames, Iowa 50011

We have observed a variety of attitudes or approaches toward computer art. These attitudes are conflicting. They are not always rational.

1. Any art form associated with the computer is junk.

2. The computer is such a supernatural medium that it becomes the sole message of computer art.

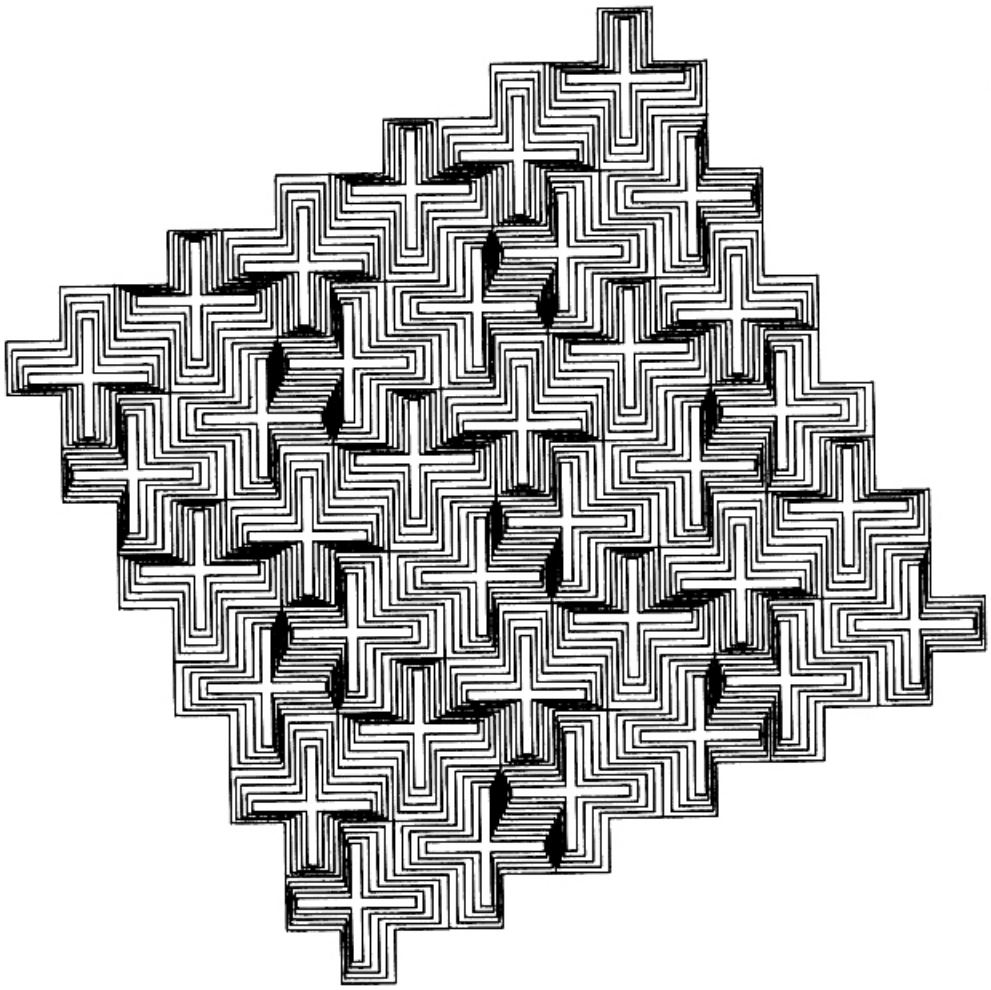
3. Computer art, due to its normally abstract nature, is a relatively low form of art and is relatively unappealing.

4. The computer is an information processing tool which can assist the artist.

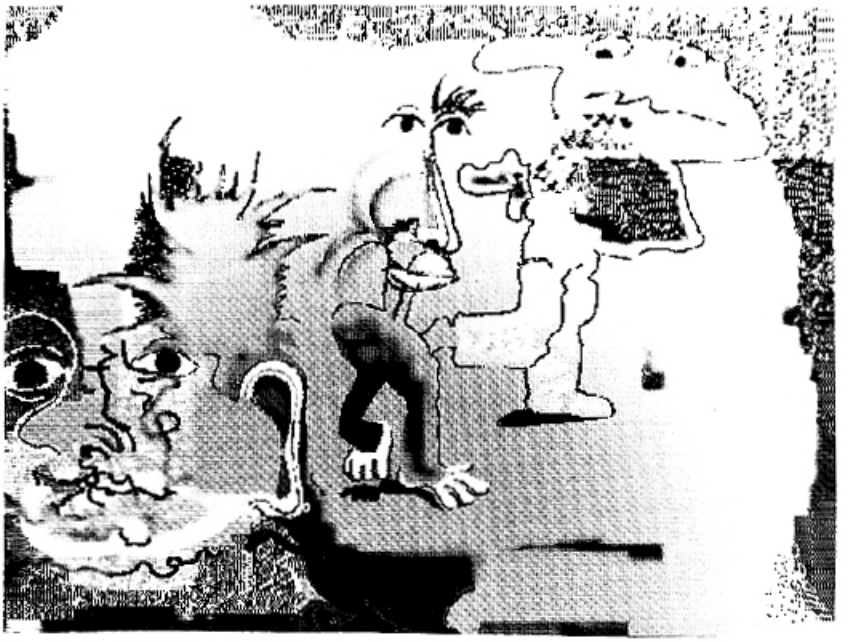
Basically we hold the fourth view. We see the computer as a powerful tool which can assist the artist or designer in conceiving, visualizing and solving an esthetic problem by providing a richer array of alternatives for optimization.

Due to hardware and software constraints, our work so far has been confined generally to linear projections of a modular nature. The drawing displayed here is from a series in which we aim to study tonalities or values, visual vibration, ambiguous figure-ground relationships, permutation of total configuration through juxtaposition of modular parts at regularly varied intervals -- and the impact of directional and densified change in the perception of pictorial protrusion and recession. In ZUP TZE 30, we have taken a series of five crosses, nested them eccentrically and placed the total cross-shaped module in a six by six array, with 180° rotations between modules in rows and 90° rotations between modules in columns.

In generating ZUP TZE 30, we have utilized PICS, a FORTRAN program which we have developed for perspective drawing on flat, cylindrical and spherical-projected-to-flat picture surfaces.



ABOVE: "ZUP TZE 30" by Paul Shao and Ken Dunker. MEDIUM: Ink on paper.



ABOVE: "Strange Bird" by Duane Palyka, from the ART OF THE SPACE ERA EXHIBITION. MEDIUM: Computer, frame buffer, film.

ABOVE: Detail of a "Self Portrait" by D. Palyka, revealing the Pointillistic technique of the medium. BELOW: Detail of a graphic from the "Bubble Series".

OUTER SPACE -- INNER SPACE

by Duane Palyka
Computer Graphics Laboratory
New York Institute of Technology
Wheatley Road
P. O. Box 170
Old Westbury, Long Island, New York 11568

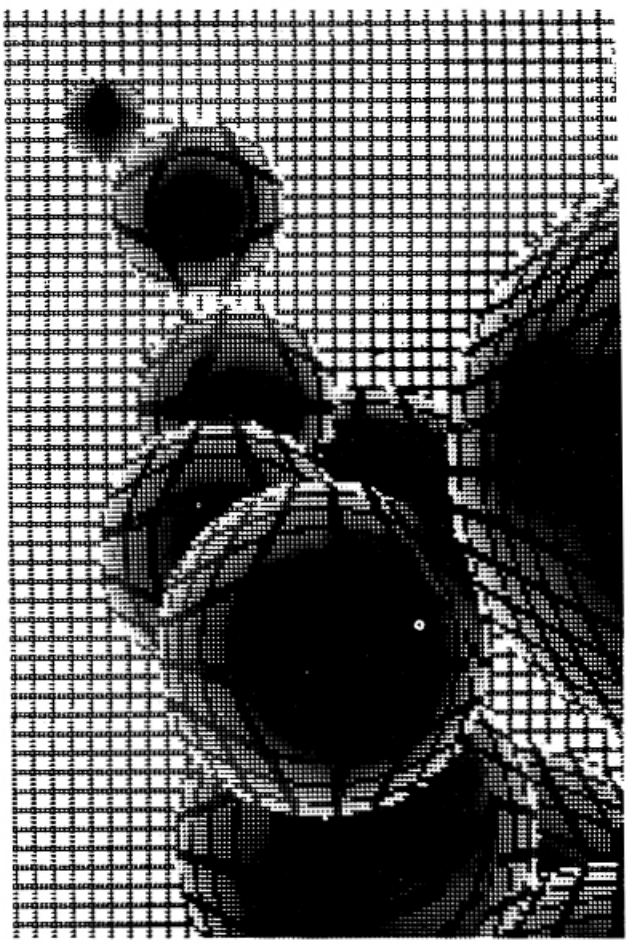
Art of the space era evokes thoughts of outer space, inner space -- 2D and 3D spaces Art has always dealt with now expands further into mathematical space, logical space, computer space.

In Computer Art we can render space curves and spline surfaces -- with pictures mapped upon the surfaces we have pictures within pictures, all generated logically.

"Strange Bird" is an example of photographing a painting produced totally within the computer memory -- a literal map of that memory onto photographic film. The painting was produced by viewing the computer memory with a color TV monitor and "painting" into it with logical brushes. The brush simulates painting techniques which go beyond what Art has known. Although not shown here, the artist can even place a picture on the brush and have it make copies of itself each time the brush is touched to the digital "canvas".

An added enjoyment of computer art is thinking about visual images in mathematical terms -- combining visual esthetics with logical esthetics, utilizing different areas of the brain to coordinate a complete piece of art.

We move from fragmentation of specialization to completeness again.



COMPUTER ART - THE EMBRYONIC STAGES OF A NEW ART

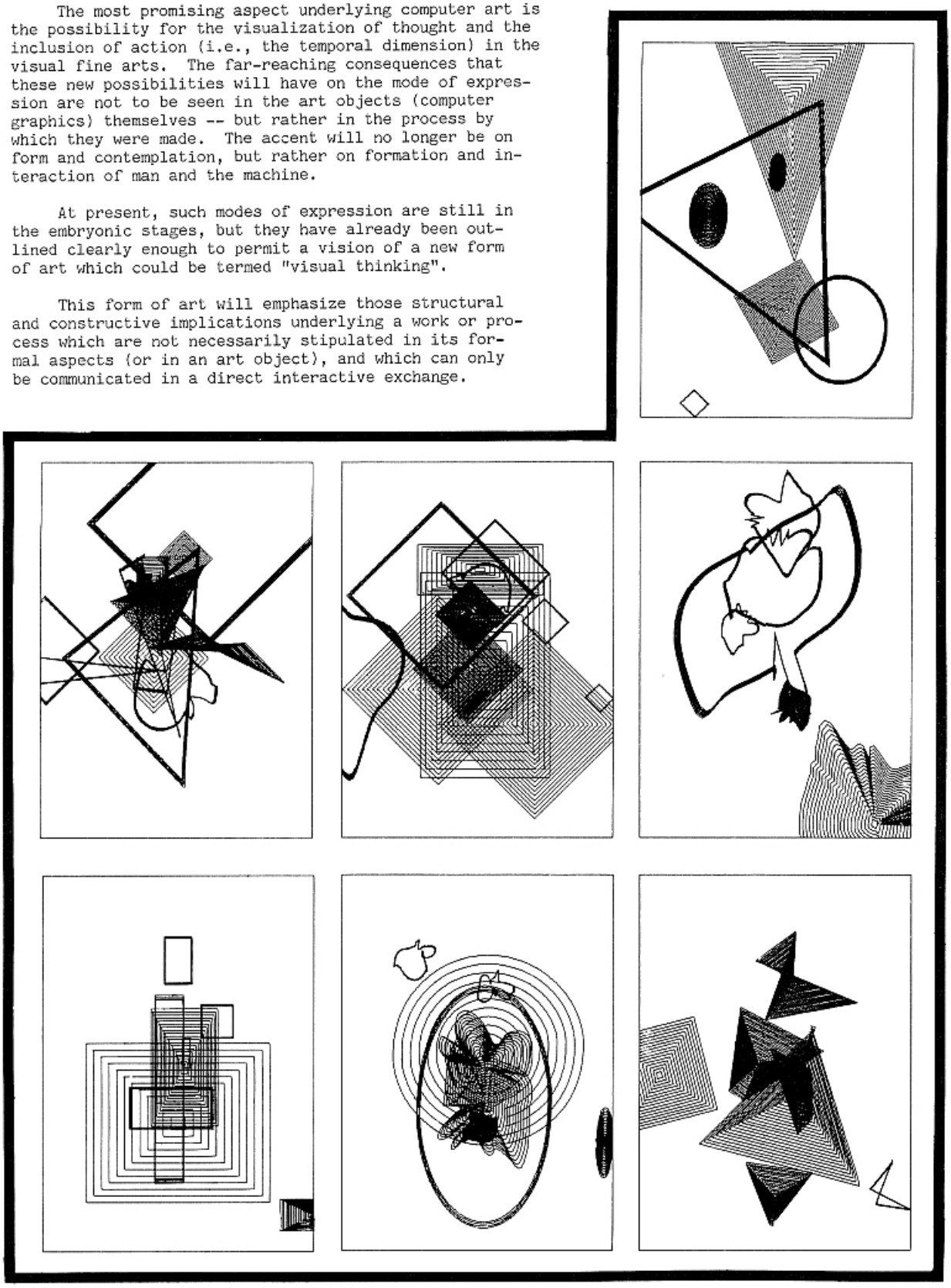
by Edvard Zajec and Matjaz Hmeljak
Via Degli Alpini 101
Opicina, Trieste, Italy

The most promising aspect underlying computer art is the possibility for the visualization of thought and the inclusion of action (i.e., the temporal dimension) in the visual fine arts. The far-reaching consequences that these new possibilities will have on the mode of expression are not to be seen in the art objects (computer graphics) themselves -- but rather in the process by which they were made. The accent will no longer be on form and contemplation, but rather on formation and interaction of man and the machine.

At present, such modes of expression are still in the embryonic stages, but they have already been outlined clearly enough to permit a vision of a new form of art which could be termed "visual thinking".

This form of art will emphasize those structural and constructive implications underlying a work or process which are not necessarily stipulated in its formal aspects (or in an art object), and which can only be communicated in a direct interactive exchange.

BELOW: "S.M.F. 71889" by Edvard Zajec and Matjaz Hmeljak. MEDIUM: Plotted drawing, Computer Center, University of Trieste. (See the November, 1977 issue of COMPUTER GRAPHICS AND ART, pages 20-25 for "Scherzo for Matrix and Figures" by Zajec and Hmeljak.



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COMPUTER GRAPHICS and ART is edited by Professor Grace C. Hertlein, California State University, Chico. Her work in pioneering computer graphics and art courses has received national and international recognition. She is a writer, bibliographer, artist, and educational innovator, and her work is featured in many national and international conferences.

COMPUTER GRAPHICS and ART is a magazine that encourages participation from its readers--in the form of articles, papers, illustrations. We cordially invite your participation.

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