UNIMAGINABLE IMAGES: AN ART OF THE SPACE ERA

by Joseph P. Covington, III
Curator of Education
*Huntsville Museum of Art**
700 Monroe Street, S.W.
Huntsville, Alabama 35801

The Huntsville "International Exhibition of Computer Graphics" is a companion exhibition to "Art of the Space Era," which features artistic documentation of the exploration of space and the kinetic art that utilizes space age technology. Neither the space effort nor the advances in technology would have been possible without computers. These "thinking" machines are assuming a greater role in the existence of humankind. The current exhibition explores the relationship between computer technology and aesthetic exploration.

HISTORY

Computer-generated and computer-assisted art is still in its infancy. To attempt definitive judgment in this new field in 1978 would be as foolhardy as the condemnation of Impressionism a century ago before the experiments of individual artists had run their course and had begun to influence a new generation.

It was only a quarter-century ago that computers became commercially available. Less than a decade later, in the early 1960's, equipment was developed to allow graphic displays of the information retrievable from computers. Computer specialists and other scientists almost immediately realized the potential of computer graphics for science and industry.

The Bell Telephone Laboratories in New Jersey produced some of the earliest practical applications of computer graphics in industrial research. Dr. E. E. Zajac used a computer-generated film in 1963 to simulate the motion of a communications satellite. Bell computer specialists are responsible for many past and present experiments with computer visuals.

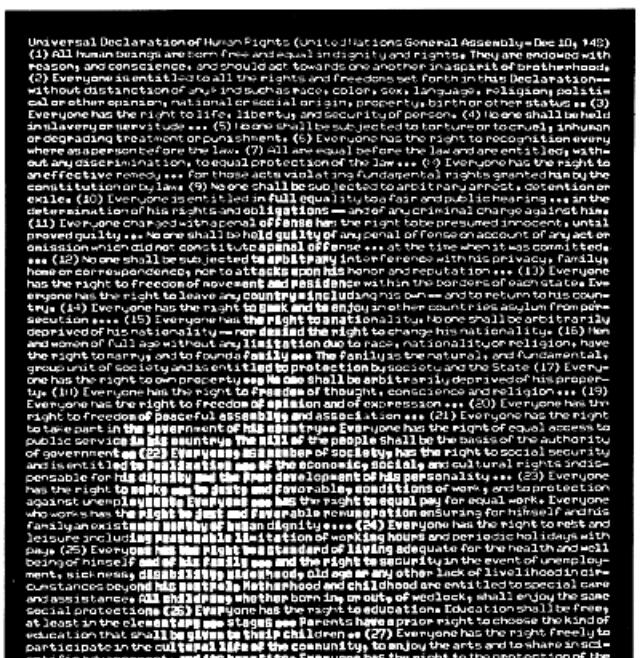
Boeing adapted the computer's capabilities to the visualization of several problems in airplane flight. It was Boeing who popularized the term "computer graphics," still the most common designation for two-dimensional works generated by computers. Science and industry continue to be the primary beneficiaries of the graphic output of computers.

EARLY COMPUTER GRAPHICS

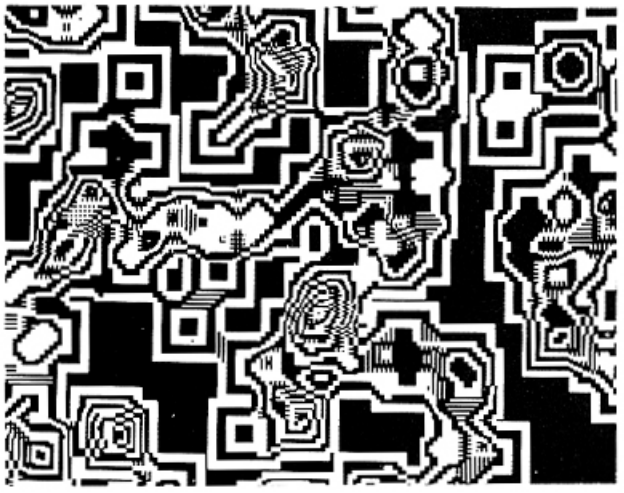
Producers of computer graphics very quickly conceived the idea of using the computer as a tool for producing art. Although the initial computer graphics were intended to illustrate mathematical and physical phenomena, these works pleased the sense of visual design of some scientists and, more importantly, at this stage, stimulated the imagination of others.

Early experiments were more interesting because of their implications for the future role of machines in heretofore exclusively human endeavors than for the intrinsic beauty of the works. Many people who saw pictures made with computer printouts dismissed them as curious by-products of technology. Nevertheless, the increasingly sophisticated techniques of scientists and the attempts by a few intrepid artists brought a measure of attention to computer graphics as art by the mid-1960's.

In 1968 the first important international exhibition of computer-generated art was organized at the Institute for Contemporary Arts in London, with the felicitous title "Cybernetic Serendipity." The principal organizer and editor of the accompanying book was Jasia Reichardt. Articles in this volume deal not only with computer graphics but also with the relationships between technology and many arts.



ABOVE: "Universal Declaration of Human Rights" by Kenneth Knowlton. CRT output. This is an example of computer techniques that has a strong social commentary. The work was executed in 1971.



ABOVE: "Tapestry" by Ken Knowlton and Lillian Schwartz, an example of early collaboration between computer scientists and artists. CRT output photograph.

John Cage wrote on computers and music. Wen Ying Tsai exhibited early examples of his lovely kinetic sculpture. Lowell Nesbitt contributed paintings, and James Seawright "Cybernetic Sculpture" (as they have again in the other current Huntsville exhibition on "Art of the Space Era").

*The computer-assisted graphics of six artists in the Huntsville "International Invitational," Ken Knowlton, Stan Vanderbeek, Ben Laposky, Frank Malina, Peter Milojevic and Duane Palyka, can be compared to their contributions ten years ago in "Cybernetic Serendipity." Knowlton and Vanderbeek were then producing films which were primarily of an illustrative nature. Their recent prints are more colorful, more textural, and more aesthetically pleasing. Palyka has accomplished enormous stylistic advancements from mathematical printouts composed of typewriter symbols -- and with no direct artist contact with the computer -- to his recent, colorful works of imagination. Milojevic's work, similarly, now shows more humor and fancy than his earlier networks of lines and cubes. Malina is represented here, not by a kinetic light work, as in 1968, but by two miniature paintings of extra-terrestrial scenes. Perhaps Laposky is the most consistent of this group in that he is still producing oscilloscope photographs.**

BELOW: "Metamorphosis" by Jacques Dupre, Paris, France. CRT output, with emphasis on transformation of design.

The present state of computer-assisted art parallels somewhat that of kinetic art, as outlined by Carolyn H. Wood in "Art of the Space Era": after a period of excitement and optimism, technical difficulties have overwhelmed some early artists, who have abandoned the field to those who are dedicated enough to master the technical requirements, and to go beyond facile diagrams in search of genuine aesthetic achievement.

TECHNIQUES

Much of the resistance to computer-assisted art is founded on the mistaken assumption that the machine usurps the traditional role of the artist as creator. There may be an element of truth in this belief in that the artist as craftsman is, in some cases, supplanted by the automatic operation of the computer's printmaking function. The creative power, however, remains uniquely within the human mind; the computer performs according to its instructions. Any computer-generated image must be prepared by a program.

The computer's instructions must be fed into it in a way that the machine can handle. The "rules of the game" are determined for the computer by the "program," the set of instructions given by the programmer.

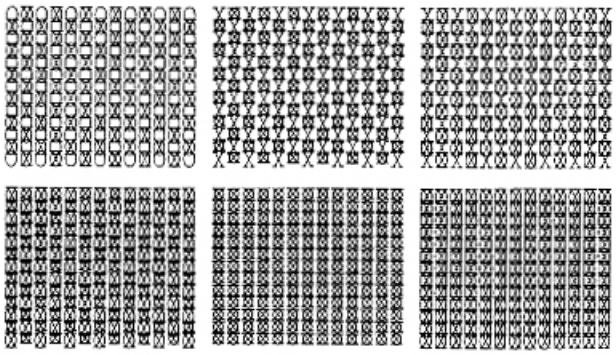
Programs are fed into the computer (hardware) on punched cards (software), which determine the coordinates of points, much like those on the "X" and "Y" axes of a graph. Lines connecting these points form linear drawings. There are several "languages" or sets of coded instructions in general use by computer programmers.

An important point in the development of computer-assisted art came when artists realized that accomplishing their objectives depends on the creation of programming languages that allow the sophisticated aesthetic thought of the artist to be transmitted to the computer. The necessary collaboration between artist and computer programmer is difficult and has limited the success of artists' experiments in this field.

The response of many kinetic artists to technical problems has been to use simpler technology. The nature of computers, however, requires sophistication and specialization of programs. The future of computer-assisted art may depend on the artists' mastery of computer languages so that they can produce programs suited to their needs. Much of the contribution of Kenneth Knowlton at Bell Laboratories is his authorship of programming languages for producing images.

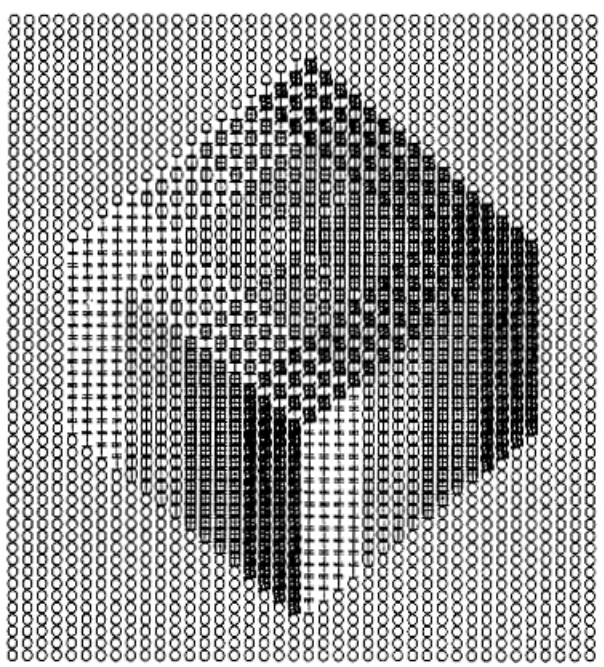
Computers do not make images. They simply store, organize and reproduce information which is fed into them. In order to generate a computer print, one of several types of devices must be added. These devices are either typewriters (line printers), plotters, or cathode ray tubes.

**For additional illustrations of works cited in this discussion, see the February and May, 1978 Computer Graphics & Art.*



ABOVE: Line printer output by Klaus Basset, Stuttgart, Germany, with examples of varied patterns that may be achieved.

1. Printers - The first method of data retrieval from computers was the printout. By operating a typewriter, the computer can print verbal and mathematical information. Since these machines print typewriter letters and symbols in whatever order is asked of them by the operator, the symbols may be arranged to form a picture, rather than words. Some symbols appear darker than others and are used to print dark areas of the picture. Additional contrast can be produced by having combinations of symbols further darken some area. This method has the advantage of gradations of grey from black to white, but offers little intrinsic beauty unless greatly refined. Printouts are usually black and white pictures on industrial paper. Printout pictures based on scanned photographs can often be obtained in amusement parks, in which case they are more novelties than aesthetic works.



ABOVE: "Diagonale, Raumbeschreibende Matrixform" by Klaus Basset. These works have a specific appeal in their "solidity", departing from the linear emphasis so predominant in most computer art.

2. Plotters - The development of the plotter enormously enhanced the visual interest of computer graphics. A plotter is a device that, when given instructions by a computer, moves a pen to make a line drawing. While most early computer graphics were black and white, any color ink may be used in the plotter pen, and either in felt-tip or ball-point form. The drawings are, of course, linear -- with little variation in thickness of line. Texture can be produced by combinations of line patterns, as Jean Bevis does in his his "Seated Nude."

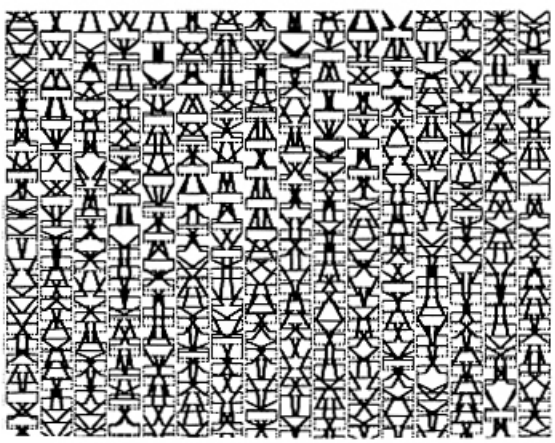
The plotter has the additional benefit of allowing in some cases, a variety of good quality papers to be used. If the paper moves, it must be of a kind that will go through the machine.

Many arresting visual diagrams describe curving lines based on the actions of physical forces; for example, the regular changing motion of a swinging pendulum, or mathematical functions. These patterns of curving lines, often overlapping to form variations of texture and shade, are called Lissajous figures, after the 19th century French scientist who used a mechanical device to describe them. Although among the most elegant early plotted drawings, Lissajous figures seem less prominent among computer-assisted artists than a decade ago.

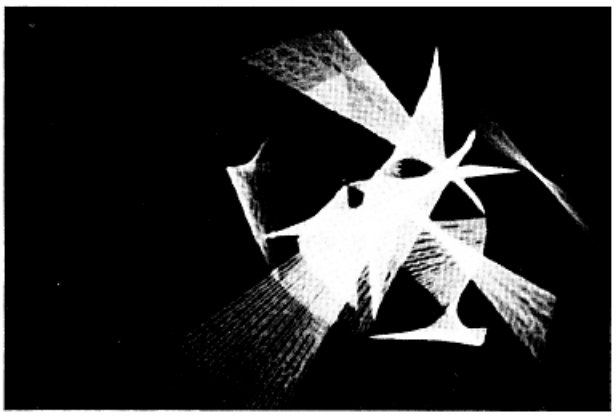
Plotters have produced a wide variety of images from representational to abstract. "Abstraction" is perhaps an appropriate term for many geometric forms taken from nature, but it is not applicable to purely nonrepresentational line patterns.

One gift of the computer to the artist is the capability of forming combinations of lines based not on his conscious or unconscious bank of images and associations, but on random numbers as coordinates. These patterns are abstracted from nothing, thus taking art a step closer to "art for art's sake."

The range of plotted drawings can be seen by comparing William Kolomyjec's easily recognizable "Flying Elephants" with Mutsuko Sasaki's "Maples in Storm," a combination of representational and nonrepresentational patterns produced on a CalComp plotter, and with Shao and Dunker's purely geometric "Zup Tze 30."



ABOVE: Detail of "Meta Language II" by Manfred Mohr, plotter output - an example of mathematics approaches to computer art.



ABOVE: Example from "The Flower Series" by Richard Land and Dan Cohen, CRT output. (See the May, 1978 Computer Graphics and Art for an article by the two artists.) Work is displayed in black and white, and then photographed with color filters.

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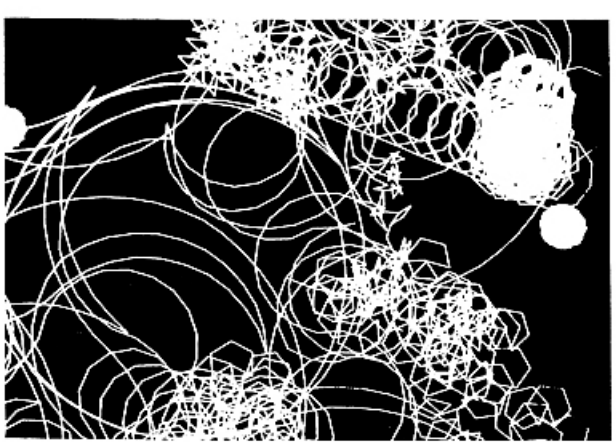
3. Cathode Ray Tubes - The third medium of computer graphics is the cathode ray tube (CRT). Ben Laposky pioneered printmaking with the CRT in the form of an oscilloscope as early as 1950. (Figure 7) Within the CRT, lines are produced by directing a stream of electrons at a fluorescent screen, rather like a television monitor. The image on the screen becomes a print only when photographed. This method has been used extensively for computer-assisted movies. In fact, many computer prints are "stills" from films.

The CRT gives the artist a measure of control, in that he may alter the image as he sees it appear on the screen before making a print. Originally white lines on black, CRT prints were later photographed in color by using combinations of red, blue and green filters for the primary colors of light.

Richard Land and Dan Cohen's Dance is a pattern of lines photographed in color from a CRT. Although "Dance" is a nonrepresentational pattern of curving lines, it suggests motion and the visual beauty of choreography. This work is one of a series called "Flowers" and "Birds," all linear abstractions and yet capturing some of the essence of delicacy and flight.

BELOW: Detail from CRT output in chemistry and physics teaching, by Charles J. Fritchie and Robert Morriss, Tulane University, New Orleans.



LIMITATIONS OF HARDWARE

The existing hardware for printing computer graphics has limited the development of the artists' aesthetic styles. Computer art has been dismissed by some critics who object to the linearity and the absence of color and texture in the drawings. Many artists have felt severely limited as well by their hardware. Their solutions to these problems will be seen in the discussion below of the "New Directions" in computer art.

THE CREATIVE IMPULSE

Two motivations direct the experimentation of computer artists: the intellectual and the aesthetic.

Computer graphics were born as diagrams of mathematical formulae and illustrations of unrealized objects in hypothetical situations; the ability of the computer to diagram these concepts remains the animating force behind much of the work being done.

Computer images transcend the level of illustration, however, only when the eye is stimulated along with the intellect. Some artists emphasize the intellectual quality or the sensory quality over the other.

THE INTELLECTUAL MOTIVATION

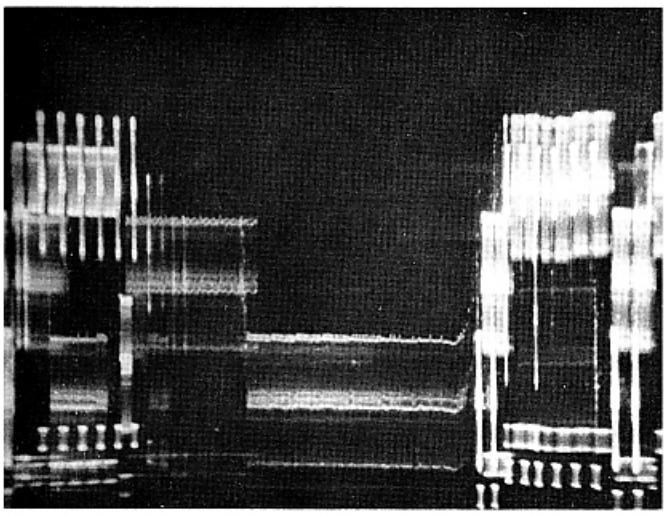
Scientists and mathematicians are more likely to produce diagrams based on logic than on intuition. The predominance of angular drawings from point-to-point plotting is a result of their scientific usefulness as well as of limitations on hardware. Manfred Mohr's art is typical of computer generated prints controlled by mathematics.

Many scientists and computer specialists have not responded enthusiastically to less rational art. The philosophy of Edvard Zajec presents this intellectual point of view: "The most promising aspect underlying computer art is the possibility for the visualization of thought ...the far reaching consequences that these new possibilities will have on the mode of expression are not to be seen in the art objects themselves (computer graphics) but rather in the process by which they were made." The emphasis in Zajec's statement, as in those of William Kolomyjec and other artists in the exhibition, is more on the cybernetic function of the computer in art than on aesthetic form.

THE AESTHETIC MOTIVATION

An attitude fundamentally different from that of Zajec is shared by artists who are object-oriented, rather than process-oriented. Vera Molnar's statement leaves no doubt as to her motivation: "The task of the painter is to create forms, combinations of forms, according to criteria called 'plastic' by aestheticians...'plastic' means 'a feast for the eyes.' A feast must have sensorial bases; painting which is not done for the eyes is not painting."

Molnar's "2500 Trapeziums" has a geometric appearance similar to that of many mathematically plotted drawings. Her work shows that geometry can be the source of both intellectual and sensory simulation.



ABOVE: "Scene Design" by Otto Beckmann, Vienna, Austria. CRT output from a hybrid computer system designed for this purpose by Otto Beckmann and his colleagues in Vienna.

James C. Ver Hague exemplifies the mathematician who, through experiments with computer-assisted forms, has discovered the intrinsic beauty of well designed objects.

It is -- in the tradition of Leonardo -- the scientist who is sensitive to the aesthetic value of form and the artist who has absorbed the knowledge produced through technology who will benefit most from computer art. It is the complete being who will produce the satisfying images that increase human perception of the world in some new way, the art Vera Molnar describes as "Unimaginable Images: An Art of the Space Era."

THE ROLE OF GEOMETRY IN COMPUTER ART

The intellectual significance of a large number of computer images lies in the computer's exploration of the geometric structure of the universe. The graphic function of the computer is based on coordinate geometry. By manipulating horizontal and vertical coordinate points, the houter reveals the configurations possible from a given set of instructions. A semiotic analysis of geometric structure is impossible here, but some classification can be made of the approaches to geometric structure by the artists in the exhibition.

Artists may either break natural forms into simple components (analysis) or combine forms into superstructures (synthesis). Either of these operations, which the cubists anticipated throuth intuition, can be accomplished in the computer by logic.

GEOMETRY: THE ANALYTICAL APPROACH

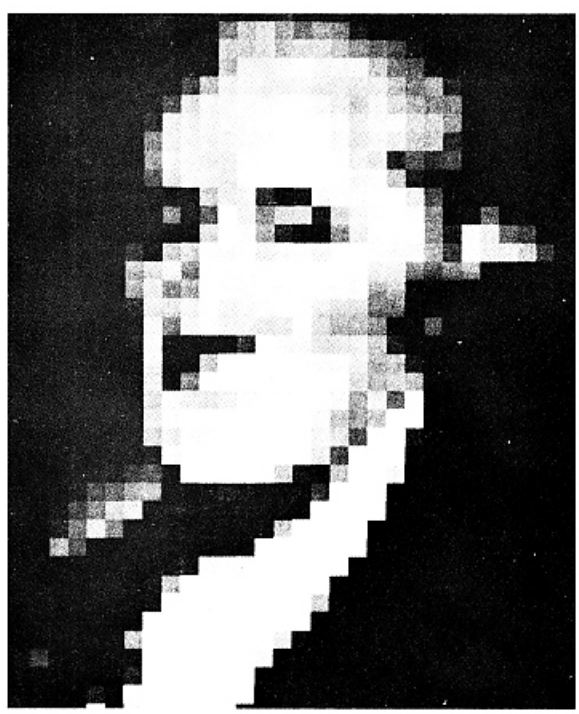
Three artists have used machines to analyze the structure of objects. E. T. Manning's block picture, "Werhner Von Braun" simplifies the human form into squares of various single colors. This process utilizes an optical processor to accomplish a task somewhat reminiscent of Cezanne's analysis of objects in planes of color. Lillian Schwartz in her "Lillian II" transforms a human face into tiny blocks, ranging in shade from black to white. She also separates and shifts planes, causing structural permutations. Representing a different subject, Otto Beckmann's "Architecture of Stage" analyzes white and black. These black and white masses have the effect of an x-ray photograph, which eliminates the unessential portion of an object so that one may recognize the sub-structure.

GEOMETRY: THE SYNTHETIC APPROACH

Sunthesis is the principle underlying the structure of a considerable number of computer-assisted designs. Edvard Zajec's "Scherzo for Matrix and Figures" overlaps simple shapes formed by bold black lines. The combinations of rectangles, triangles, and ovoid figures are delimited within rectangular frames. The entire series of eight compositions together on one sheet of paper form a superstructure.

The apparently random distribution of Zajec's varying figures contrasts with the very regular organization of Shao and Dunker's "Zup Tze 30." The latter is a tightly constructed shape composed of reiterations of lines and crosses. "Zup Tze 30" suggests the harmony of nature, while Zajec's figures give an impression of diversity.

Other comparisons place in relief the variety of syntheses among the linear, geometric products of the computer. Javier Segui's combinations of lines and circles seem to represent chaos in comparison with Vera Molnar's subtle, rhythmic variations on the theme of the trapezoid. Herbert Franke's "Sicogram" and Mutsuko Sasaki's "Maples in Storm" both convey energy in motion by building patterns of small rectangles, but the former is a sharp, angular movement, while the latter depicts a switling rhythm appropriate to its subject.



ABOVE: "George Washington" by E. T. Manning, 7' X 9' - an example of a spatially quantized image.

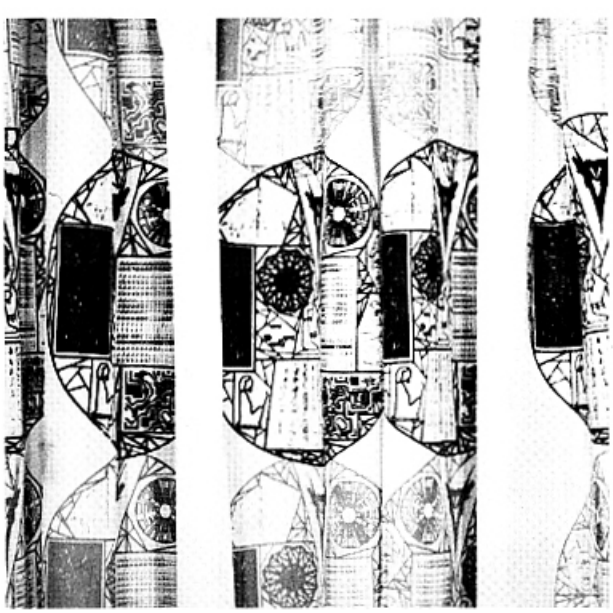
Some artists' experiments in synthesis probe the function of syntactic relationships. Manuel Barbadillo speaks of the computer-generated modules arranged in his serigraphs as his "alphabet." He uses this modular alphabet to create larger structures. The drama of his syntheses, usually in groups of four modules, comes from the differing perception of the four modules because of their positions in the group. The Groupe Couleur de Belfort creates a similar syntax with two modules. Here the halves are matrices of flat colors containing reverse rectilinear patterns. Since the two modules are otherwise identical, color and the position of the pattern function as morphemes within the syntactic structure.

GEOMETRY: THE AESTHETIC APPROACH

Geometry -- whatever its significance within a work -- is also a link between computer-assisted imagery and the aesthetic theories of some of the most important artists of the 20th century. Mondrian is a precursor of much computer art in that he introduced simple geometric shapes as a subject of art. He began painting representational landscapes and then distilled his designs to geometric shapes. Mondrian's many experiments with combinations of rectangles could be carried out in a tiny fraction of time by a computer. Recognition of the aesthetically successful combinations would, of course, depend on the eye of the artist.

Computer-generated images frequently meet the criteria of minimalist art set by Frank Stella and others. Geometric forms are perfect material for the construction of more representational pictures for their own sake, pure visual objects. The stripe paintings of Stella or Morris Louis might be compared with some of the computer works of Robert Mallary.

BELOW: Detail of a computer-designed textile by Grace C. Hertlein. In the past three years, the artist has experimented with computer art applications in textiles and wallpapers.



Perhaps the most widely accepted artist who is associated with computer-aided art is Josef Albers. Albers' Bauhaus philosophy of bringing art through technology to a mass audience is being continued today by the Groupe Couleur de Belfort, who have applied computer-assisted images to subway decoration. Albers' interest in serial imagery predated his computer prints by several decades but reached its conclusion in the series "Embossed Linear Constructions" produced at Gemini G.E.L. in Los Angeles in 1969. These embossings were printed from plates engraved by an entirely automatic process activated by digital tape. Albers had written in 1942 that the effects of his prints based on parallel lines "require the use of ruler and draughting pen and establish unmodulated lines as a legitimate artistic means. In this way they oppose a belief that the handmade is better than the machine made, or that mechanical construction is anti-graphic or unable to arouse emotion."[1]

NEW DIRECTIONS

The emergence of more versatile hardware now allows more varied forms and richer color in computer-assisted art. Artists are currently drawing on special tablets which allow their input to the computer to be more painterly and less linear, more organic and less angular. The "Strange Bird" of Duane Palyka, executed with a frame buffer and film, perhaps goes furthest from geometry among the works in the exhibition. The image is fantastic and organic. It is also disturbing to one's sense of logic and order. This type of work subjects the rationality of the programmer to the imagination of the artist.

The hybrid (analog-digital) computer used by Otto Beckmann yields further variety of form. While there is an element of similarity among most analog computer graphics, the hybrid computer is more versatile and enriches the field with new styles.

In addition to new means of generating images, there are now more ways of printing them. A great number of computer-assisted artists are dissatisfied with the limitations of the plotter and the CRT. Since about 1975, they have enhanced the color, texture, and painterliness of their computer-assisted works by transforming computer designs into serigraphs or paintings. Manuel Barbadillo considers his printout pictures only quickly produced sketches to be transformed by him into works of art like his serigraph in the exhibition. Grace Hertlein's silk-screened textile work is an example of the application of computer-generated patterns to decorative arts. Stan Vanderbeek, an early computer filmmaker, is represented here by etchings. These artists have not lessened the importance of computer-generated images; rather they have multiplied the media in which computer designs can be printed and thus have increased the artists' control of the aesthetic value of the finished works.

The shift to traditional art media by some artists after years of experimentation with computer images may indicate the beginning of a period of maturity in computer-assisted art.

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[1] *Quoted by Riva Castleman in Contemporary Prints, New York: Viking, 1973, 146 pages.*