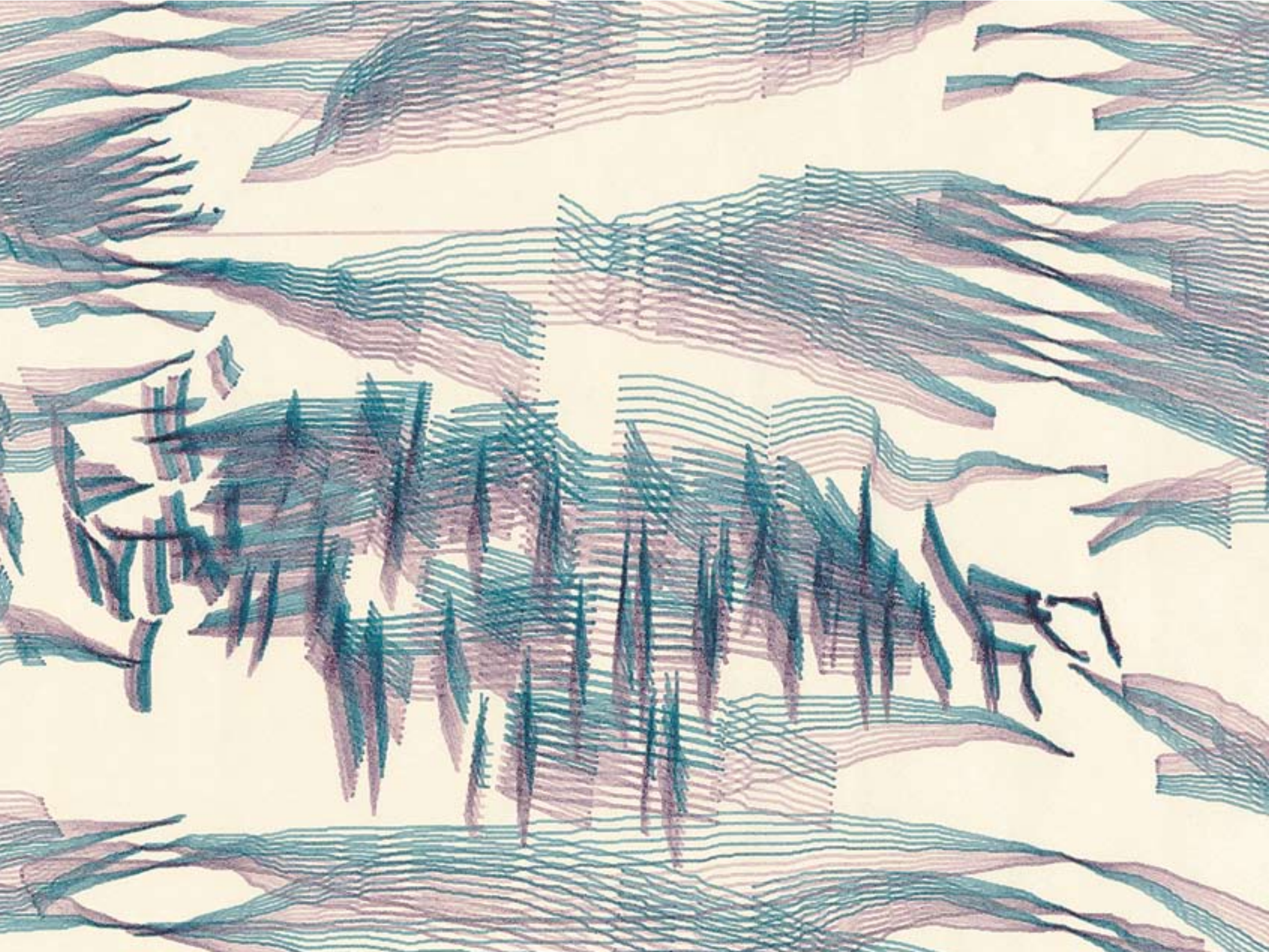
Early Period

1963 to the mid-1970s



A Record of Decisions: Envisioning Computer Art

Margit Rosen

Painting with rapid brushstrokes, the young man seems almost to attack the canvas. "I've painted with oil and acrylic, and I've poured paint, and spread it with knives, and I've walked in paint."[1] If he is not in the studio, he carries the canvas outside in the fields, where he accomplishes a full landscape within an hour. In 1966, only about four years later, the same man, Charles A. Csuri, sits in an air-conditioned clean room filled with the humming of an IBM 7094 mainframe computer. Patiently, he watches the computer-controlled plotter lowering the pen to the surface of the thin paper, drawing a line accurate to a millimeter, lifting the pen, moving it, and lowering it again. After 20 minutes, five overlaying line portraits of a bearded man are accomplished (Catalogue 13).

This scenic confrontation of two phases in the work of Charles A. Csuri might indicate the plurality of a life and lifework that spanned most of the 20th century and beyond. It is the starting point to trace the path of an artist who made use of a broad range of media: drawing, painting, sculpture, and language, as well as computer graphics, film, and animation—media in which Csuri counts among the recognized worldwide pioneers of technical innovation.

A retrospective allows for seeing relations between the artistic procedures of the different phases, which were perceived by contemporary observers as distinct disruptions. Charles Csuri's step out of the art world into the computer research laboratory might have been hinted at in a comment by Paul Valéry as he was trying to follow the traces of Leonardo.

> In certain extraordinary cases one wonders perplexed…how it could come to such events…. The inspired man had been prepared already for a year. He was ripened. He had always thought about it, maybe without being clear in his mind, and where the others were still unable to see, he had observed and combined, in such a way he was now doing nothing else, than reading in his secret.[2]

Charles Csuri had a classical art education, studying art and industrial design and painting at The Ohio State University (OSU). From 1947 on, he taught at OSU, first as an instructor, then as an assistant professor, and from 1963 on as a professor. During his first years of teaching, from 1948 to 1953, Csuri shared an office with Roy Lichtenstein. They had studied together and become close friends. In 1955, Csuri's career in the contemporary art world began. He presented his works in a group exhibition in New York, and the next year, he held his first one-man show in the Harry Salpeter Gallery. Several exhibitions followed. At that time, Csuri already was involved in an intensive conversation and reflection beyond the field of contemporary art. Csuri recalls that, beginning in 1954, he met regularly during the cocktail hour with Jack Mitten, the industrial engineer who introduced Csuri to computer theory and technology. With a Campari, their favorite drink, in hand, their dialogue evolved into the essence and role of the computer. Csuri brought with him prior knowledge of the topic. In 1943, he had been drafted into the Army to fight in Europe during World War II. Before he was transferred, the Army sent him to the Newark College of Engineering, where he passed a one-year program of algebra, trigonometry, analytic geometry, calculus, physics, chemistry, and engineering drawing. The dialogue between the young artist and the engineer lasted for ten years. "We did reach the stage where we talked about the computer as a philosopher, a theorist and an intellect."[3] Csuri and Mitten imagined the computer as a medium of rationality that could think through aesthetic theories—proceeding with imperturbable logic from one term to the next. They did not, however, think of the computer as a possible tool to produce images. Although there is a link in the history of technology between the automated, pattern-producing loom of the nineteenth century and the development of the computer, at that moment, this association was far away. Outside of military projects, until the beginning of the 1960s, visual equipment such as plotters and cathode-ray-tube monitors were something of a rarity.

One day in 1964, without being in search of it, Csuri discovered a picture of an Ingrid Bergman-like female face in profile in a research publication of The Ohio State University's Department of Electrical Engineering (Figure 1). The image had been regenerated by an IBM 1620 computer. A student, J. G. Raudseps, had researched a procedure to reduce the data of a digitized image, without loss of image quality for human perception, when the image was regenerated.[4] The scanned and compressed image was printed out in nine gray scales on a Flexowriter, a teletype machine also usable for data input. The serendipitous finding of the portrait led Csuri to merge his artistic reflections with the ideas developed over the years with Jack Mitten. One could say that a piece of peripheral equipment, the Flexowriter, had transformed Csuri's imagination of the computer as an electronic brain into an image-generating machine. The artist immediately contacted the OSU laboratory and enrolled in a course for computer programming. In the same year, he created his first digital images, using the FORTRAN programming language and an IBM 7094.[5]

The Artist in the Laboratory

In the computer center, Csuri was surrounded by scientists from different fields of study. The single giant machine, the mainframe computer, drew them together and facilitated interdisciplinary exchange. The artist discussed with the scientists the possibilities of digital image generation and processing, and scientific visualization and artistic research. He produced a large number of drawings, which were mathematically transformed, as well as an eleven-minute computer-animated movie called *Hummingbird* (1967). Most of all, he produced ideas. While his colleagues in the Department of Fine Art observed his new engagement with resentment,[6] the scientists encouraged him to write a proposal for the National Science Foundation (NSF) in order to receive financial support. The grant application from 1968, entitled *A Software Requirement for Research and Education in the Visual Arts*,[7] is a document of unique historical importance in its fusion of visionary artistic thought and technological research at the end of the 1960s. The National Science Foundation accepted the proposal and agreed to provide a grant of $100,000. Csuri was overwhelmed. NSF was impressed by his ideas. Nevertheless, Csuri's case left the program officials with a certain uneasiness. Csuri recalls, "They said they did not want any publicity, because they had never given a grant to an artist. They only worked with computer scientists. They were very fearful of misunderstanding."[8] It was the beginning of more than twenty years of support for Csuri's work by the National Science Foundation.

Csuri's notion of artistic research is free from avant-garde claims, like those formulated in the 1960s by European artist groups, such as the *Groupe de Recherche d'Art Visuelle*. In contrast to them, he was not concerned with the redefinition of the artist as a researcher in order to overcome traditional ideas of the irrational and socially marginalized creator. These European groups produced paintings, kinetic sculptures, and environments under the new notion of research, working closely within their artistic groups. Csuri, in contrast, crossed the border into the research-and-development laboratories. In building his own research context, he even transgressed the aims of the American art and technology movement as defined by Billy Klüver and Maurice Tuchman, who tried to establish project-bound collaborations of artists and engineers.[9] Having received the grant by the National Science Foundation and additional support by The Ohio State University, Csuri began to implement a three-part program: building up a library with programs for the generation and transformation of images, developing a graphic console, and establishing an educational program. It should be remembered that it was primarily the military, automotive, and the aviation industries that had been defining the goals for interactive graphical systems and computer simulation. Now, an artist appeared on the scene, defining different goals. He wanted to develop tools for artists—software and hardware—that would enable them to subject drawings to mathematical transformations, to construct multidimensional pictorial spaces, to virtually render sculptures that then could be milled automatically, and to draw objects that could move in these spaces and be manipulated in real time.

Figure 1-A.

J. G. Raudseps.
Profile of a Woman.
1963.
Antenna Lab.

Figure 1-B.

J. G. Raudseps.
Smoothed Figure.
1963.
Antenna Lab.

Rausped's work represents one of the first attempts to interpolate raster data. In sum, his research proceeded in the following way:

Step 1: A black and white photograph of a woman in profile was identified.

Step 2: In order to simplify the grayscale data in the photograph, a painting of the photograph was created.

Step 3: The painting was subsequently photographed and digitized.

Step 4: The grays in the photograph were "quantized," or mapped into regions.

Step 5: The program created by Rausped to interpolate the quantized raster data was implemented.

The goal of this process was to introduce enough gradation in the grayscale that the final output image was indiscernible from the photograph in Step 3.

Explanation of Antenna Lab Images

"What we call 'real-time,' that is time which is 'real' because the moment of the artistic idea is also the moment of its materialization."[10] In his research program, Csuri never speaks of the user, but only of the artist.

The Artwork: A Recording of Decisions Taken

What is evident and easy for any artist—to draw a smooth line or a three-dimensional opaque origami swallow, showing only those contours perceptible to the observer and hiding the others—is very difficult to realize if you have to atomize those processes into single steps and instruct a computer digit per digit. As Friedrich Nietzsche claimed, we can understand only a universe that we have constructed completely ourselves. Early developers in computer graphics learned slowly to understand the universe of human visual production and perception, at least a small part of it.

Charles Csuri took up this task systematically and enhanced the computer as an artistic tool, first working with an IBM 1130, then with a PDP 11/45.[11] Constructing a tool presupposes the analysis of the production process. Csuri, the artist, was prepared. He followed up an aesthetic interest rooted in his study with impressionist painters John Hopkins and Hoyt Sherman, who taught him to understand Monet, Cézanne, Braque, and Picasso—an interest in the structure of artworks and the decision-procedures involved in their production. Since the 1960s, Csuri studied the relationship between idea, decision, and physical production, as well as the effects of the art object on the observer. By 1961, he had developed a form of conceptual word poems, anticipating methods of conceptual art that emerged only a few years later. Csuri's methods allowed him to replace a painting with its verbal description. "The notion of nonvisual cues, such as words, as the art object was of interest to me," Csuri remembers.[12] *Hand*, a later example of this series from 1965, offers the observer only the verbal description of a hand, challenging the different modes of information communicable by image and words (Figure 2):

> Here is a hand—
> a hand of a thin, ninety nine
> year old man. The skin is
> pinkish in color and the network
> of veins are clear. The movements
> of his fingers and thumb
> are slow and stiff and one can
> almost hear the crackling of
> joints. His hand is rough in
> texture and feels warm.

Csuri used words to define an image in the mind of the observer. As a programmer, he would use numbers to define images drawn with electrons on the screen of a cathode-ray tube. Words and numbers stepped into the mimetic, painterly depiction of the world.

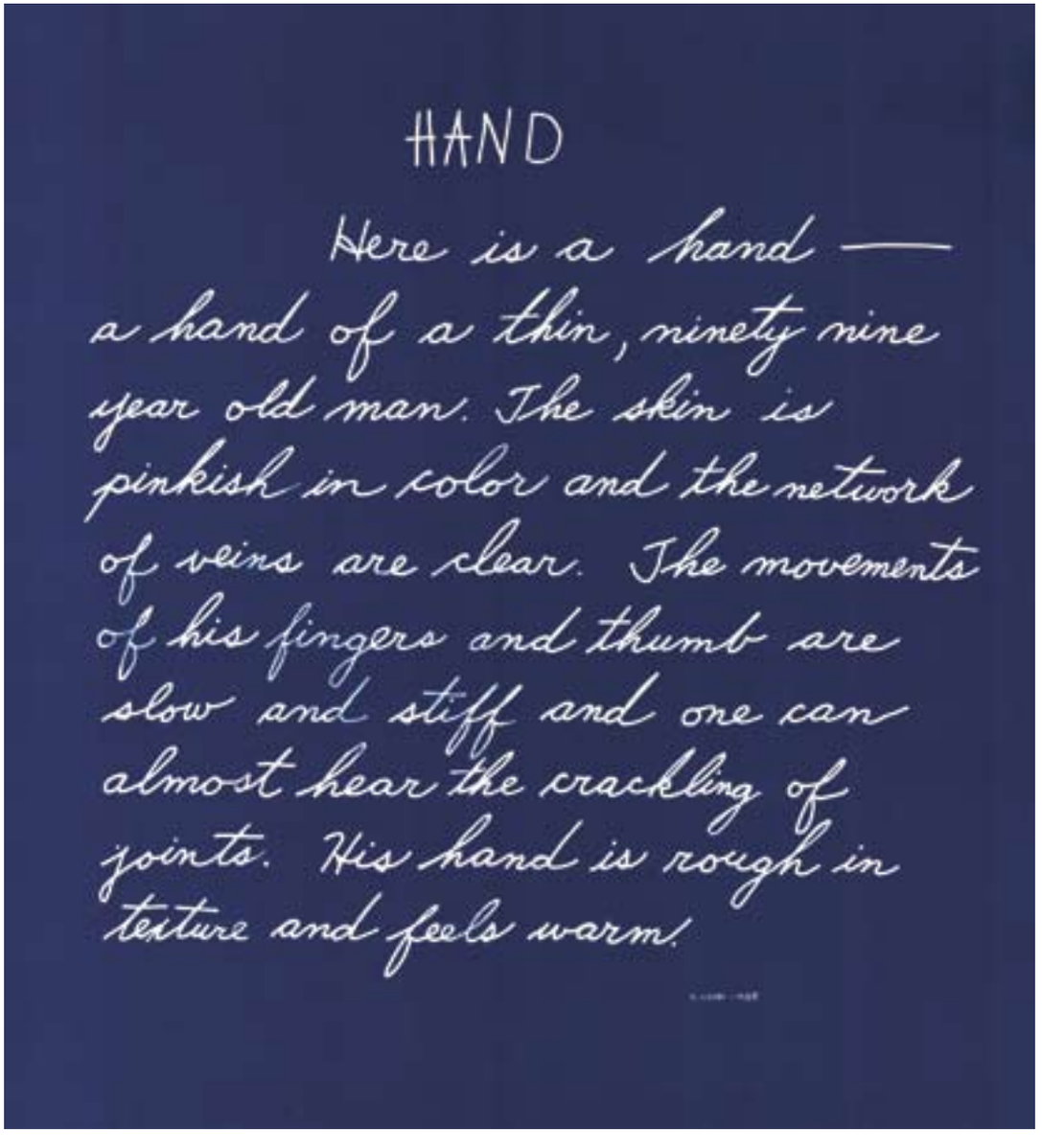


Figure 2.

Hand.
1965.
Blueprint.
119 x 102 cm
(47 x 40 in).

Csuri looked closely at the process of creating an artwork, which he perceived as a series of intentional decisions. Marcel Duchamp once described painting as choosing different color tubes, combining so called "ready-mades."[13] Csuri stresses in his analysis the act of choice and decision:

> In making a landscape painting from nature, the artist responds primarily to visual cues in the landscape and makes decisions about color, texture, line and so forth. Then he records these decisions on a canvas to make his painting or transformation.[14]

In his quest for these decision procedures, Csuri developed a great interest in using different devices and strategies for the production of imagery, which would redirect the normal drafting procedures. In the drawing *She's Watching Superman* (1963–1964), Csuri creates an elderly woman with a pensive gaze by simulating a mechanical process and composing the image with countless little black dots (Catalogue 1). Between 1963 and 1964, shortly before Csuri started to work with computers, he deepened the idea of systematic quasimechanical image production. He modified a pantograph, a mechanical device for reproducing a drawing on a different scale, which consists of a framework of jointed rods in a roughly parallelogram form. One end of the pantograph device traces the drawing; the other end simultaneously plots a distorted copy. The image coordinates are relocated analogously. Csuri, therefore, called the device for this systematic procedure an "analogue computer." He generated several transformations with drawings copied from images by Paul Cézanne, Albrecht Dürer, Francisco de Goya, Paul Klee, Piet Mondrian, and Pablo Picasso, for example (Catalogue 3–11). One key inspiration for this method was not an artist, but biologist and mathematician D'Arcy Thompson. In his 1917 book, *On Growth and Form*, Thompson applied grids and distortions on animals, plants, bones, and human heads. Thompson sought a tool to deduce from a particular animal the ideal form, similar to the Aristotelian genus, as well as the laws of evolution.[15] Csuri reversed Thompson's enterprise. Rather than seeking the laws of transformation, he created them. He did not seek to reduce variety, but to produce it. Later, he transferred these experiments with his analogue computer to the digital computer and realized the beautiful distortion of Leonardo da Vinci's *Vitruvian Man* (1966), the Renaissance symbol for the harmonic body (Catalogue 15).

Within the process of image creation, the artist can delegate to the computer decisions that are at a lower level of the control hierarchy. He defines the elements and rules, which the computer has to follow. The elements might be flies and the rule chosen might be an equation that deals with conformal mapping. In one of his early works, *Flies on the Miller Transformation* (1967), Csuri had the computer generate a large number of flies (See Catalogue 25 for a related work). With a pseudorandom number generator, they were distributed and positioned in the region of a triangle. The flies then were mapped into the region of a half-circle. Another example is the morphing of a young woman

into an elderly woman in the *Aging Process* (1967). The drawings were broken down into line pieces, representing the elements to be manipulated. The rule then defined certain parameters of the dissolution of the young woman and the emergence of the old woman (Figure 3; Catalogue 20). All these procedures contained a certain aspect of surprise, although all events in the computer are strictly deterministic. Today, Charles Csuri says that these procedures have changed his "conception of control" and creativity.

> When I did a traditional painting, I was thinking in terms of start, beginning, and some end point—a painting, a drawing. Today I don't have the expectation in the same way. I explore the computer as a search engine for art. I am hoping that when I set up that environment, there will be something I cannot think of.

Already, while he was using the pantograph, Csuri started playing with the notion that he could not anticipate or imagine the result of the rules he had set up. In one of his first articles on computers and art, he stresses that the computer can help to overcome certain "set producing tendencies," certain patterns of thinking. The artist "usually gets only slight variations on a basic structural theme. A mathematical orientation toward visual problem solving can enable the artist both to break down his biases and to express another range of solutions."[16]

Artists used mathematics as a point of orientation and to enlarge their formal repertoire before the advent of the computer; however, the possibilities of electronic calculations and peripheral equipment, such as plotters, microfilm plotters, and cathode-ray-tube monitors, have shifted this rapport.[17]

Figure 3.

Aging Process.
1967.
Ink on paper.
IBM 7094 and drum plotter.
38 x 94 cm
(15 x 37 in).

> In the past, mathematics has been given limited application as a tool for the discovery of aesthetic form because the techniques employed were slow and extremely time-consuming.... As a consequence, the artist's concept of structure was limited by what he was able to design or draw by hand.

The digital computer now suggested "different approaches to problems involving the repetition of data and iterative procedures which can take advantage of the computer's speed of operation."[18] The electronic calculating machine became an "amplifier of human imagination," as Kenneth Knowlton, one of the pioneers of computer-generated animation, formulated it.[19] This vision, however, did not always correspond to the experiences of the first visual experiments with the computer.

> It was time consuming to write a single program, and then you had to do an overnight run, so to speak, to get feedback, and then wait for the plotter. And you thought, "Oh no, I should have done that." It really took a lot of time. It limited your productivity in terms of the number of images and ideas you could actually explore or express. [20]

The Internal Reality of Representation

The difficulties of the beginning did not limit Csuri's imagination. He was conscious of the potential of the new technology. Already, in 1967, he conceptualized a complex example for an artwork containing the potential of variability. He saw "a new approach to problem solving in the arts. With the computer, the artist can now deal with different variables in his decision making process." Csuri also suggested putting into the memory of the computer a color representation of a landscape that was visualized on a graphic console.

> Then with a computer which implements mathematical functions, the artist can watch the effects of wind velocity, temperature and factors which involve the amount of daylight upon his landscape. He can also observe data, which are generally unavailable such as the effects of molecular structure, weight, mass, and time upon the landscape. In this decision making process, the artist can rely on non-visual cues as well as visual cues. He can modify many more parameters in the total landscape environment to create a work of art than by conventional methods.[21]

Such a simulation could not be realized in those days. *Tangent Landscape* (1967), a distorted drawing, could only allude to such an enterprise (Figure 4). Within the computer art scene of the

1960s, even the idea of simulation of that kind was not to be found; Csuri's contribution to the discourse was therefore very precious. The simulation he envisioned contained the element of surprise, but it offered another interesting aspect. Designing a simulation, the artist does not act only on the level of visual mimesis, but also constructs a model generating the visible. The hills and clouds are one possible "sensualization" of a set of algorithms and data. The gaze of the artist glided from the surface to the system. "It was very important for me to learn an internal reality about the representation of nature and objects.... The mathematics and algorithmic modes of thinking and how to deal with information was crucial in my development as an artist."[22] Csuri's reflection reads like a page out of a book by Paul Klee, one of the artists he highly appreciates. Indeed, Klee, writing on art and mathematics remarked:

> Beneficial here is the constraint to get involved with the functions first and then with the accomplished form....You learn to look behind the facade, to catch a thing at its roots. One learns to perceive, what streams beneath, learns the prehistory of the visible.[23]

For his explorations in the universe of mathematically constructed images, it was important that Charles Csuri early on found open-minded companions with whom to explore the new artistic territory. In 1965, he met programmer James Shaffer and Professor of Mathematics Dr. Leslie Miller. Between 1965 and 1972, Csuri wrote programs and set the parameters for the special functions, and with Shaffer and Miller discussed different mathematical possibilities that would allow him to realize his artistic ideas and help him to implement them. "Both of them wrote specials functions for me. I specified the kind of function I needed, and they wrote the code for them."[24] Csuri gratefully worked with these programmers and mathematicians, because, after an initial fascination with the secrets of programming, the artist wished to limit the amount of time spent in that arena, and he was looking impatiently for ways to realize as much of his imaginations as possible. Csuri's vision was brought ever-closer through the process of interdisciplinary discussion and collaborative realization.

Figure 4.

Tangent Landscape.
1967.
IBM 7094 and drum plotter.
Original dimensions unknown.

The Computer as a Tool for Aesthetic Analysis

Csuri's interest in the creative process led him to develop in his 1967 research proposal the idea of the computer as a tool not only of image synthesis, but also of analysis. Scanned images should be used to

> construct a mathematical description or profile on an artist's work. It might be a kind of mathematical handwriting. His style could be analyzed. It might be interesting to compare these mathematical patterns in authenticated works by an artist and the works which are in question as to their authorship.[25]

The idea of defining an artist's style or the structure of an artwork or text mathematically and statistically with the help of a computer had been in the air since the late 1950s. In 1965, A. Michael Noll, for instance, analyzed Piet Mondrian's 1917 *Composition with Lines* in order to regenerate a similar picture on the computer. Another example is a student at the Massachusetts Institute of Technology trying to formulate mathematically the style of Rembrandt's and Seurat's brushstrokes.[26] The most important author with reference to Csuri's ideas here is German philosopher Max Bense, a key figure for the European computer art scene, who sought to detect within the framework of his "information aesthetics" the elements and rules of artworks. Since the mid-1950s, Bense had developed, in his *Aesthetica* series, the idea of "analytic aesthetics," applying methods of semiotics and Claude Shannon's information theory.[27] While Bense was analyzing completed artworks, paintings and texts, Csuri sought to observe and analyze the procedure of creating them. He imagined using a graphic console to automatically record the single steps of image creation: the inputs of the light pen as well as the programs used and the parameters chosen. "Using an 'on line' system, one could also keep track of the time required for decisions between each step."[28] Csuri even thought of a "comparative analysis of decision making by people." With German mathematician and artist Frieder Nake, Csuri was a theoretical companion, although Nake and Csuri were unfamiliar with each other's writings. Nake formulated conceptually what Csuri planned to realize practically—profiting from the computer's "traceability." In 1968, Nake published "The Art Production as a Decision Process," segmenting theoretically the creative process in points in time, attributing to every point a set of possible decisions.[29] He thereby put an emphasis on the temporal dimension of creation, an aspect that was already contained in Bense's information aesthetics through Claude Shannon's mathematical theory of communication.[30]

Nake suggested, following Bense, that if the process of image generation could be formalized mathematically, it could be mechanized. That is, an image could be composed and drawn automatically by a computer. Yet he emphasized that certain aspects of the creative process are beyond this kind of formalization. This point was central to Charles Csuri's concept of computer art: decisions of a certain level can be delegated to the computer. The

quest to formalize and mechanize certain processes had revealed to Csuri a level of control and decision-making that escapes this grasp: the artist's intention, the all-embracing aesthetic aim.

Interactive Systems

The question of artistic control emerged once again, when Csuri examined interactive systems within the research for real-time film animation beginning in 1969. Different objects, such as origami swallows, goldfish, butterflies, turtles, violins, and helicopters could be generated, turned and moved via a three-dimensional data table, a light pen, dials, a joystick, function switches, and the alphanumeric display terminal (Figure 5).[31] In a major exhibition project, Csuri again transcended different media in order to promote an idea. In cooperation with fourteen departments,[32] he organized the show *Interactive Systems: Computer Animated Film. Electronic Sound. Video. Light. Electromyogram. Environmental Collage* at OSU (Figure 6). The exhibition opened April 1, 1970, the same year that Jack Burnham curated the now famous *Software. Information Technology: Its New Meaning for Art* at the Jewish Museum in New York, pleading for "responsive systems" in art. In the introduction to the catalogue of *Interactive Systems*, Csuri wrote:

> The spectator will be permitted to participate in esthetic decision making. An effort has been made to create esthetic situations or environments in which the spectator can become involved. This is expected to be accomplished through a controlled electronic environment, in which a user can make decisions by electronic means to invent or modify images or sound systems.[33]

The catalogue bears witness to an impressive exhibition showing not only a selection of the films produced by Csuri and his students, but also, several interactive installations realized in the diverse media indicated in the exhibition's subtitle. Csuri even managed to install a complete computer graphics system, a PDP

Figure 5.

Origami Swallows.
1971.
Real-time art object.
PDP 11/45 and Vector General graphics display.

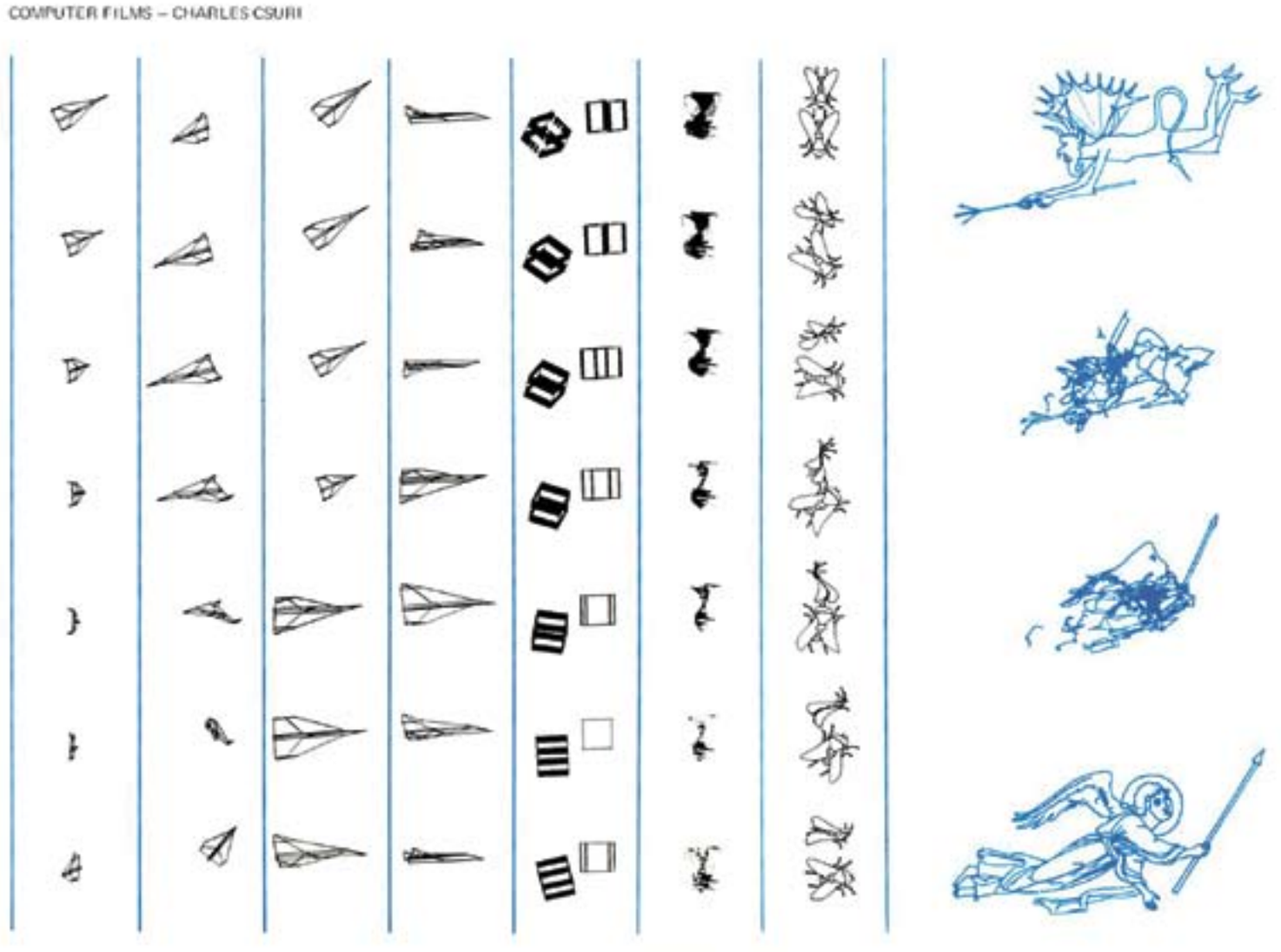


Figure 6.

Computer Films.
1970.
From Interactive Sound and Visual Systems.
For complete ISVS catalogue, see wmc.ohio-state.edu/csuri/.

11/45 computer line drawing display, to demonstrate the interactive process for animated film. Art students were scheduled to demonstrate to the public techniques for art graphics and film animation.[34] There is no documentation of the exhibition besides the catalogue, because after only five days, the entire campus was shut down when serious conflicts emerged in connection with the civil rights movement.

Computer Art Between Hype and Rejection

Charles Csuri is one of the outstanding figures in the computer art scene of the 1960s. Deciding not to follow his friend Roy Lichtenstein to New York, he stayed in Ohio, independently developing his concept of computer art and having no regular contact with other artists in the same search. It was only in 1968, after Csuri had already defined his early work, that computer art won a broader audience. This led to an intensive information exchange between its protagonists working in America, Europe, and Japan. Although the journal *Computers and Automation* announced a computer art competition in 1963, and although the first exhibitions with computer drawings took place in 1965,[35] it was only in 1968–69 that the exhibition activities reached their climax. Csuri's drawings and his film *Hummingbird* (1967) were among the most propagated works (See Catalogue 19 for a still image). He was acknowledged internationally, with exhibitions in the United States, Great Britain, Germany, Czechoslovakia, Yugoslavia, and Israel.

Before all of this hype, in August of 1967, *Sine-Curve Man*—the oscillating portrait of a bearded man—won the computer contest of *Computers and Automation* (Catalogue 17). The same year, *Hummingbird* received an award at the fourth *International Experimental Film Competition* in Brussels.[36] Thereupon, the Museum of Modern Art in New York purchased the film for its permanent collection.

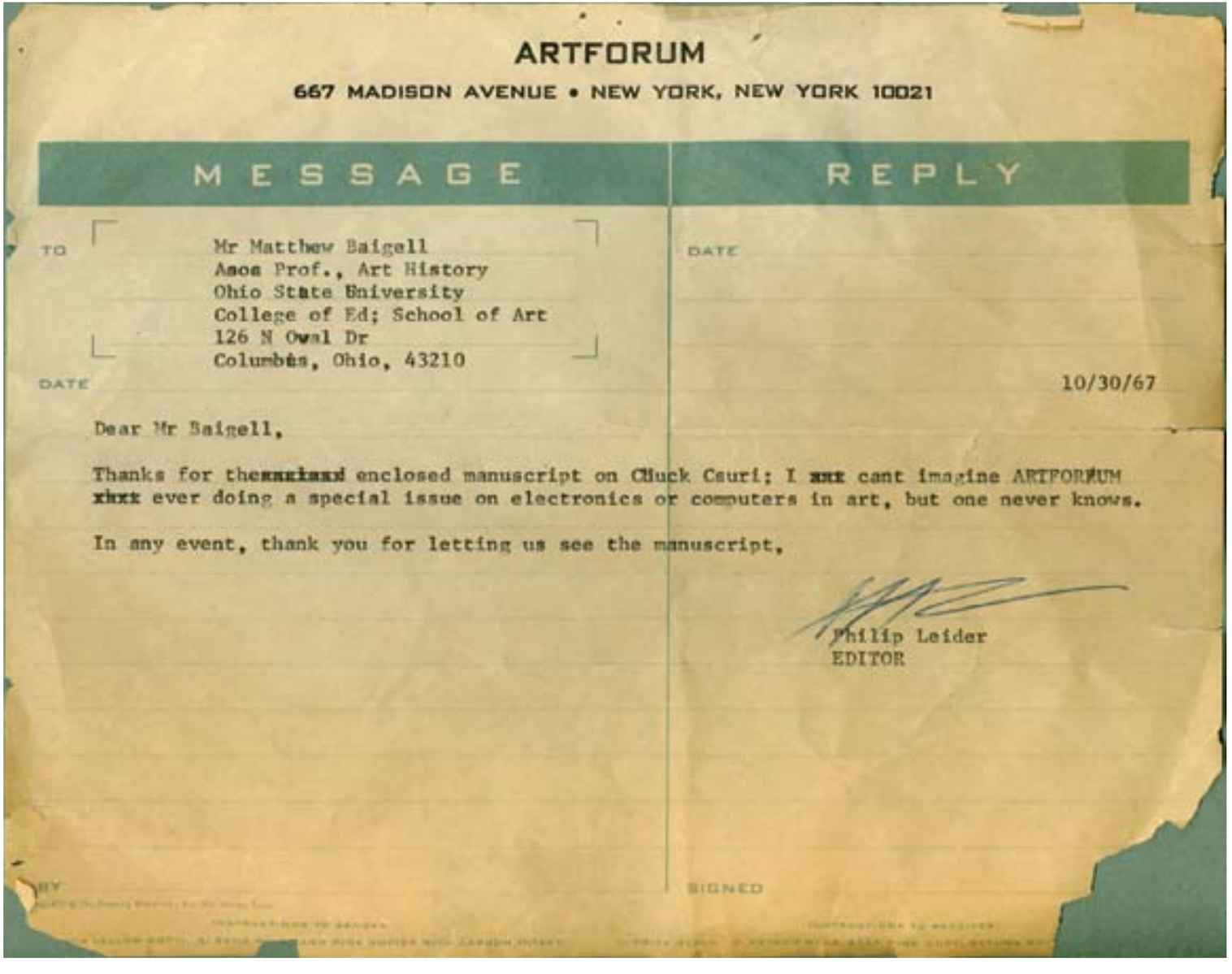
Despite all these activities, the art audience was at a loss with computer-generated art. Ken Knowlton described this perplexity: "The machinery which intervenes between artist and viewer precludes a great deal of normal communication. Even at the first stage—the punched card—one cannot tell whether the card was punched tenderly or in fury." For those who had no insight into the computing process, computer art remained largely inaccessible.[37] In addition to this helplessness resulting from a lack of knowledge on a technical level, the aesthetic theories of computer art did not enter the contemporary art discourse beyond a more general discussion of art and technology. No cultural authority tried to challenge computer art's aesthetic, to develop it and to spread a certain understanding. The traditional art world of galleries and art journals rejected art related to the computer.[38] The reasons were manifold and must be sought on theoretical and social levels. One was caused by the fact that the images, films, and sculptures were produced, in large part, by persons neither having an academic art education nor belonging to art circles. This was just one of many reasons why the projects realized and the theoretical statements formulated within

the framework of the computer art scene were not perceived as interesting, challenging provocations of and inspirations for the contemporary art context. They did, however, have the potential to actually scrutinize certain artistic values. A. Michael Noll, for instance, had the computer generate a Mondrian-like picture and described the difficulties of his colleagues to identify whether the original Mondrian or the computer-generated picture was composed by a machine. In doing so, he seemed to undermine the human domain of artistic creativity. In a manner similar to that of German Herbert W. Franke, Hiroshi Kawano, one of the pioneers of Japanese computer art, sought "the algorithm of art in order to simulate human art."[39] The emphasis of rationality, of the traceability of the creative process, of an art that can be measured objectively, communicated without loss, formalized and mechanized, seemed to attack the idea of the genius and the ineffable core of art. When Matthew Baigell, assistant professor at the Art History Department of The Ohio State University, in 1967, sent an article to the journal *Artforum*, he received a two-sentence answer from Philip Leider, one of the editors, which illustrates the atmosphere in those days. The letter read, "Thanks for the enclosed manuscript on Chuck Csuri. I can't imagine *Artforum* ever doing a special issue on electronics or computers in art, but one never knows."[40] (Figure 7)

The Artist's Personal Fiction

Charles Csuri's concept of art only *seemed* to resemble the militant ideas of "the computer as artist." Csuri never called into question the authority of the human artist. He did not cultivate the rhetoric of the extinction of the subject, of a transhuman art. As much as he explored the computer, the machine itself as a symbol of rationality and discipline never stood in the center of his reflection. The computer was a tool, which he tried to master and enhance. Foremost in his mind was that the relationship between man and machine was always, to a certain degree, reciprocal, and that in the process of taming, so to speak, the one who tames is transformed as well.[41]

Along with Otto Beckmann, the Computer Technique Group Japan, William Fetter, Peter Foldes, Leon Harmon, Ken Knowlton, Leslie Mezei, and others, Csuri explored the depiction of the visible world with new technical means. Most of the artists and scientists producing images and movies with the computer in the 1960s designed abstract imagery. They enquired in a nonfigurative way about variability, randomness, and complexity—aspects that represented the potential of the new medium. Csuri never focused his imagination on the visualization of the structure of the computer itself. Neither did he entertain a mythical relation to the eternal world of mathematics. Rather, Csuri used mathematics as a means of representation. He did not seek to represent the idea of mathematics itself. He applied trigonometric modifications, geometry (which is described in his papers as *n*-dimen-



ARTFORUM

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MESSAGE | REPLY

TO

Mr Matthew Baigell
Assoc Prof., Art History
Ohio State University
College of Ed; School of Art
126 N Oval Dr
Columbus, Ohio, 43210

DATE

DATE

10/30/67

Dear Mr Baigell,

Thanks for the enclosed manuscript on Chuck Csuri; I cant imagine ARTFORUM ever doing a special issue on electronics or computers in art, but one never knows.

In any event, thank you for letting us see the manuscript,

Philip Leider
EDITOR

BY

SIGNED

Figure 7.

Artforum Letter.
1967.

sional) projective transformations, and conformal mapping in order to construct a new spatiality. The result would be a linking of the mimetic depiction of the world with geometrical space. In one colored sketch from 1965, he drafted a portrait floating in *n*-dimensional space; in another, the movement of an imaginary camera turning around a drawing, which became an object (Catalogue 16). Watching the eight sequences of the movie *Hummingbird*,[42] which was composed of 14,000 pictures, one witnesses how the movements of a simple hand drawing generate an unimagined deep space. The hummingbird dissolves, recomposes, and floats along imaginary waves.

Next to the drawings and films, the potential of the new combination of art and electronic calculation is visible in *Numeric Milling*, a sculpture from 1968 that was produced with a numerically controlled milling machine[43] (Catalogue 22). Only a few artists, such as Georg Nees and Robert Mallary, explored the field of computer-generated sculpture. Csuri developed new drafting procedures, creating surprising three-dimensional surfaces using the Bessel function, which is applied for many problems involving wave propagation.[44] To virtually build an object with different surfaces without any physical resistance and, in a later phase of his work, to look at it in three dimensions before its materialization and play through hundreds of variations would shift the habits and results of the sculpting process. Csuri's special position in the field of computer art lies also in his ability to champion a new tool and to make use of new scientific ideas, something Leslie Mezei postulated early on.[45] Csuri envisioned the integration of scientific methods, linked to the new tool, into computer art:

> The computer which handles fantastic amounts of data for processing brings the artist close to the scientist. Both can now use the same disciplines and knowledge in different ways. For the first time, the artist is in a position to deal more directly with the basic scientific concepts of the twentieth century.[46]

He imagined simulating the distorting effects of the Lorentz transformation, a theory of special relativity, with a representation of a turtle moving at the speed of light. But he went one step further:

> The artist need not necessarily stop at the parameters defined by a transformation in relativity. He can arbitrarily declare that objects will move at a speed which is five times that of light….In fact, he can, with the computer, take a broad variety of well-known equations which describe our physical universe and change the parameters. He can create his own personal fiction.[47]

With his work *Random War*, Csuri adapted the idea of scientific simulation to reflect on processes that do not appear in physics books but are expressed in aphorisms and haiku (Catalogue 24). He told about randomness, which is not caught in terms of

stochastics but is experienced as destiny. The drawing *Random War* (1967) shows the result of a simulation: a picture with 400 soldiers and a written list. The drawing of a toy soldier had been put into the computer. With a pseudorandom number generator, the computer determined the distribution and position of 400 soldiers on a battlefield. One Army was called Red and the other one Black, and the names of members of his department and of some well-known national figures, such as Ronald Reagan, were given to the program. Another program assigned military ranks and army serial numbers, also at random. In addition, the random number generator decided the following information: (1) Dead (2) Wounded (3) Missing (4) Survivors (5) One Hero for Each Side (6) Medals for Valor (7) Good Conduct and (8) Efficiency.[48]

Csuri, who had survived a dangerous voluntary mission during the Ardennes Offensive in Belgium at the end of World War II, confronted the calculated pseudorandom numbers of mathematics with the randomness of human experience. The computer simulation, one of the great visions of the 1960s that was hoped to be able to predict the future in order to change the path of history,[49] here produces the microcosm of the battlefield. Using the potential of computer simulation, Csuri expressed one of the eternal subjects of mankind, while at the same time reflecting the role of this technology for twentieth-century warfare.

Random War is a paradigmatic example of Csuri's conception of computer art. In his essays and articles, Csuri always stressed that art transcends technology, that for him it is a medium to express human experiences, thoughts, and emotions. "The challenge is to use computer technology to serve our human spirituality."[50] Robert Zend once described a scene, which I paraphrase here. The messenger arrived out of breath at the king's court. For a moment, the hubbub at the banquet table died down. And the king, rising from his chair, asked, "Who sent you? What is the news?" Still short of breath, the messenger pulled himself together, looked the king in the eye and gasped, "Your Majesty, there is no message, because no one sent me. I just like running."[51] If Charles Csuri had sent the messenger, he would have answered "Your Majesty, there is no message because no one sent me. I just like running," and in the confused silence he would have started to tell a long story embracing "myth, magic, humor, and at times, even the brutal reality of suffering, pain, and fear."[52]

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[1] Paul Trachtman, "Charles Csuri Is an 'Old Master' in a New Medium," *Smithsonian* (February, 1995): 60.

[2] Paul Valéry, "Einführung in die Methode des Leonardo da Vinci," *Werke* 6, Frankfurt on the Main: Insel 1995, 15f. Translated by the author.

[3] Charles Csuri and John Staudhammer, "An Interview with Charles Csuri," *IEEE Computer Graphics & Applications* (January, 1990): 7.

[4] J. G. Raudseps, *Picture Regeneration from Quantized Data*. The Antenna Laboratory, Department of Electrical Engineering. The Ohio State University Research Foundation: 31. July 1963.

[5] Janice M. Glowski and Su-hsing Lin, "The Journey to An Artist's Signature," *Charles A. Csuri: In Search of Meaning, 1948–2000*. Columbus College of Art and Design (9 March–1 April 2000): 3.

[6] Csuri left the Department of Fine Arts and took up teaching and research in the Department of Art Education.

[7] *Proposal to the National Science Foundation. A Software Requirement for Research and Education in the Visual Arts*. Principal Investigator Charles A. Csuri, Department of Art Education. Proposed Starting Date: 1 November 1968. Proposed Duration: 2. Months. Total Funds Requested from NSF: $99,199. NSF Grant No. GJ-204-A01.

[8] Charles A. Csuri. Conversation with the author, Columbus, Ohio, 11-13 October 2005.

[9] See *Experiments in Art and Technology*, Billy Klüver (Ed.). E.A.T. bibliography: 1966–1977, New York: 1977. See also *Art and technology; a report on the Art and Technology Program of the Los Angeles County Museum of Art*, 1967-1971. Maurice Tuchman (Ed.). New York: Viking Press, 1971.

[10] Charles Csuri, "Real-Time Film Animation," *Proceedings of the Meeting of UAIDE*, San Diego, Cal., no. 9, (1970): 292.

[11] From 1969 through 1971, Csuri used a 32 K IBM 1130 computer interfaced to an IBM 2250 model IV graphics display. In 1971, he established the Computer Graphics Research Group (CGRG) at The Ohio State University. The university provided major support for hardware with a 48K word PDP-11/45 computer and a Vector General graphics display with three-dimensional rotation hardware and other features. See Charles Csuri, "Real-Time Film Animation." *Annual Report to the National Science Foundation*. Office of Computing Activities. Grant Number GJ-204. January 1, 1972 to January 1,1973. The Ohio State University Research Center, 5-116.

[12] Csuri. Conversation with the author, Columbus, Ohio, 11-13 October 2005.

[13] Marcel Duchamp, quoted in Katharine Kuh, *The Artist's Voice: Talks with Seventeen Artists*. New York: 1960, 90.

[14] Charles A. Csuri, *Proposal to the National Science Foundation*, The Ohio State University Research Foundation. Proposal Reference No. 68-466, 3.

[15] D'Arcy Thompson, "On the Theory of Transformations," *On Growth and Form*. Cambridge: Cambridge University Press, 1997, 268-325.

[16] Charles Csuri and James Shaffer, "Arts, Computers and Mathematics," *AFIPS Conference Proceedings*, Vol. 33, 1968, p. 1293-1298, p. 1295

[17] Charles Csuri and James Shaffer, "Arts, Computers and Mathematics", in: AFIPS Conference Proceedings, Volume 33, 1968, 1294.

[18] Arthur Efland, "An Interview with Charles Csuri." In *Cybernetic Serendipity: The Computer and the Arts*, edited by Jasia Reichardt. A Studio International special issue, 1968, 81.

[19] Ken Knowlton, quoted in Janet Vrchota, "Stan Vanderbeek. Technology's Migrant Fruitpicker." In *Experimental Animation: An Illustrated Anthology*, edited by Robert Russett and Celice Starr. New York and London: Van Nostrand Reinhold, 1976, 201. (Reprint from Print Magazine, March/April 1973.)

[20] Csuri, conversation with the author, Columbus, Ohio, 11-13 October 2005.

[21] Charles A. Csuri, *Proposal to the National Science Foundation*, The Ohio State University Research Foundation. Proposal Reference No. 68-466, 2; and Charles A. Csuri and James Shaffer, "Arts, Computers and Mathematics," *AFIPS Conference Proceedings*, Vol. 33, 1293.

[22]Charles Csuri, "In the Search of Meaning," *Charles A. Csuri: In Search of Meaning*, 1948–2000, 9 March–1 April 2000, Columbus College of Art and Design, 12.

[23]Paul Klee, "Exakte Versuche im Bereich der Kunst," 1928, and Hans M. Wingler, *Das Bauhaus: 1919–1933*, Cologne: Rasch, 1962, 156. Translated by the author.

[24]Csuri, e-mail to the author, 8 May 2006.

[25]Charles A. Csuri, *Proposal to the National Science Foundation*, The Ohio State University Research Foundation. Proposal Reference No. 68-466, 5.

[26]Leon D. Harmon, "Still Images," lecture at Experiments in Art and Technology (EAT), 3.3.68. Records 1966–1993, Getty Research Institute, Research Library, Accession no. 940003, Box 28/11.

[27]*Einführung in die neue Ästhetik* (Baden-Baden: Agis), a compendium of the four books between 1954 and 1960, revised and extended by six chapters.

[28]Charles A. Csuri, *Proposal to the National Science Foundation*, The Ohio State University Research Foundation. Proposal Reference No. 68-466, 13.

[29]Frieder Nake, "Die Kunstproduktion als Entscheidungsprozess," Boris Kelemen, Radoslav Putar, (eds.). *Bit International, No. 2. Computers and Visual Research*, Zagreb: Galerija Grada Zagreba 1968, 47.

[30]Claude Elwood Shannon, "A Mathematical Theory of Communication," *Bell System Technical Journal* 27, July and October 1948, 379–423 and 623–656.

[31]Tom DeFanti, "The Graphics Symbiosis System." In Charles Csuri, *Real-Time Film Animation. Annual Report to the National Science Foundation.* Office of Computing Activities. Grant Number GJ-204. 1 January 1972 to 1 January 1973. The Ohio State University Research Center, 5–116.

[32]Jasia Reichardt, *The Computer in Art*. London and New York: Studio Vista/Van Nostrand Reinhold, 1971, 34.

[33]Charles Csuri, "Introduction," *Interactive Systems*. College of the Arts, The Ohio State University. 25 April–12 May 1970, 1.

[34]Charles Csuri, "Computer Animated Film," *Interactive Systems*. College of the Arts, The Ohio State University. 25 April–12 May 1970, 4.

[35]The first exhibition known so far was initiated by philosopher Max Bense at the Studiengalerie of the Technical University in Stuttgart, Germany, showing computer-generated drawings by Georg Nees (5.2.–19.2, 1965). The second exhibition was organized by Howard Wise in his New York gallery, presenting works by Bela Julesz and A. Michael Noll (6.–23.3, 1965).

[36]Herbert W. Franke, *Computer Graphics, Computer Art*. Translated from the German by Gustav Metzger. London: Phaidon, 1971, 131.

[37]Kenneth Knowlton, "Computer Films" (based on a lecture at EAT in 1968). In *Experimental Animation: An Illustrated Anthology*, edited by Robert Russett and Celice Starr. New York and London: Van Nostrand Reinhold, 1976, 195.

[38]Taylor Grant, *The Machine That Made Science Art: The Troubled History of Computer Art*. 1963–1989, Ph.D. diss., The Faculty of Architecture, Landscape and Visual Arts, University of Western Australia, October 2004.

[39]Hiroshi Kawano, manuscript. Archive, Muzej Suvremene Umjetnosti (Museum for Contemporary Art). Zagreb, Croatia, 1971.

[40]Letter of Philip Leider to Matthew Baigell, 30.10., 1967, in the collection of Charles Csuri.

[41]Bruno Latour, "Mixing Humans with Non-Humans: Sociology of a Door-Closer." In *Social Problems* 35, 1988, 298–310.

[42]Charles Csuri and James Shaffer, *Hummingbird*. Programming Assistance: Samuel J. Cardman, and J. Carroll Notestine. Charles Csuri wanted the film "to begin as if an artist was making a drawing." Shaffer developed the technique to bring in short segments of the plotter drawings. Csuri conceived the ideas of morphing, randomness and fragmentation, which were implemented by Shaffer, Cardman, and Notestine. Charles Csuri, e-mail to the author, 8 May 2006.

[43]Charles Csuri discussed the idea of three-dimensional surfaces with Leslie Miller and told him about the possibility of creating sculpture with a three-axis milling machine. "He then devised a scheme using quadratic equations. He explained how the code worked and I experimented with parameters to see what was possible." Charles Csuri, e-mail to the author, 8 May 2006.

[44]Charles Csuri and James Shaffer, "Arts, Computers and Mathematics." *AFIPS Conference Proceedings*, Vol. 33, 1968, 1298.

[45]Leslie Mezei, "Science in Art in Science in Art in Science," *Arts Canada*. Toronto: June 1968, 38.

[46]Charles A. Csuri, *Proposal to the National Science Foundation*. The Ohio State University Research Foundation. Proposal Reference No. 68-466, 3.

[47]Charles Csuri and James Shaffer, "Arts, Computers and Mathematics." *AFIPS Conference Proceedings*, Vol. 33, 1294. See also, Charles A. Csuri, *Proposal to the National Science Foundation*. The Ohio State University Research Foundation. Proposal Reference No. 68-466, 4.

[48]See Arthur Efland, "An Interview with Charles Csuri." *Cybernetic Serendipity: The Computer and the Arts,* edited by Jasia Reichardt. A Studio International special issue. London: Studio International 1968, 81–84.

[49]See Martin Caidin, *The God Machine. A Novel*. New York: Dutton, 1968 or Jones, D. F., *Dennis Feltham Jones*, Colossus, London: Hart-Davis 1966.

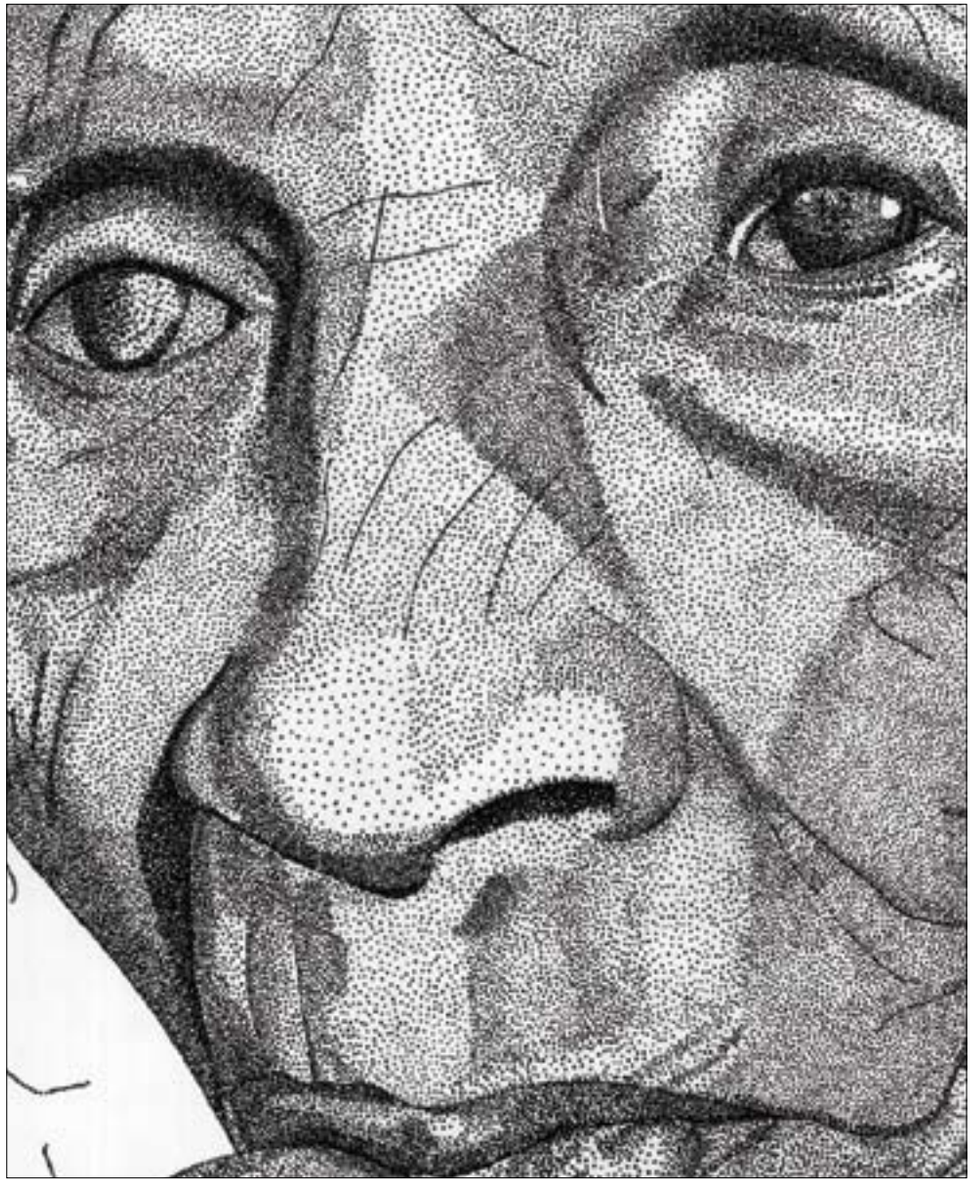
[50]Charles Csuri and John Staudhammer, "An Interview with Charles Csuri," IEEE Computer Graphics & Applications, January 1990, 3.

[51]Robert Zend, "The Message." In Robert Zend, *From Zero To One*. Victoria, British Columbia: The Sono Nis Press, 1973.

[52]Charles Csuri and John Staudhammer, "An Interview with Charles Csuri," *IEEE Computer Graphics & Applications*, January 1990, 3.

When I began working with the computer,
I had to look closely at how it could be
used within an artistic context.

– Charles A. Csuri



"I began questioning the role of a tactile-kinesthetic approach to painting and drawing. What is the relationship between the mind and the hand? As an experiment, I made this drawing, one dot at a time, with a pen. It was a procedural approach in which I worked mechanically like a machine. I also wondered if words and comments could contribute to and become part of an art object. I was curious to see if, in the end, there would still be an aesthetic quality." — Charles A. Csuri

1. ***She's Watching Superman.***
1963–1964.
Ink on paper.
Procedural drawing.
147 x 104 cm
(58 x 41 in.).

Contemplation

Created in 1964, *Contemplation* acknowledges Csuri's dual sources of artistic inspiration and experimentation, his fine arts training and the potential of technology. During the advent of applied computer science, there was only one computer available for the entire Ohio State University campus. As a result, Csuri found himself in dialogue with scientists more frequently than with fellow artists. Part of a series of works experimenting with imagery and technology, *Contemplation* delineates Csuri's break from art constrained by paint and canvas.

Contemplation's skewed lines were inspired, rather than created, by the pantograph device's capabilities and denote the incursion of the computer into the realm of Csuri's artistic sensibilities. What follows this experimentation was decidedly different. In essence, the dramatic shift in artistic tool sets, furnished by science, acted as the impetus for a new understanding of surface representation.

In *Contemplation*, Csuri first sketched a pencil line drawing on the stretched and gessoed canvas. Next, he used oil paint and created the defining lines by hand. The proportions of the man are subjected to transformations inconceivable in nature. A depiction of the same male figure, to the right of transformed renderings, is also rendered in Csuri's original media of paint. In stark contrast to the pantograph-derived figures in the *After the Artist* series, however, Csuri's thickly applied pigments give the male figure depth and form, allowing it to penetrate the third dimension.

This work, made concurrently with the *After the Artist* series, marks a significant transitional period in Csuri's artistic career. It demonstrates that he was beginning to conceive of the transformative possibilities that the computer offered. Although they are similar in their formal properties, *Contemplation* is distinct from the works contained in the *After the Artist* series, insofar as the subject matter does not allude to master works in the history of art. Rather, we see a seemingly ordinary man situated in the modern era, as indicated by his collared shirt and tie. Here, Csuri does not invoke the works of past masters, or the limitations of brush and palette. With *Contemplation*, Csuri shifts into a new phase of artistic development. Although he continues to be influenced by the history of art, from this point forward, Csuri will use the computer to revolutionize the ways in which artists negotiate representation of their world. [AM]

2. ***Contemplation.*** 1964. Oil paint on canvas. 76 x 127 cm (30 x 50 in.).

After the Artist Series

"This [technology] allowed me to systematically alter the original geometry of my drawing. One end of the pantograph device traced the drawing and the other end was simultaneously making transformations. I was intrigued with the idea of using devices and strategies to create art. I questioned the notion there had to be a tactile kinesthetic process to create a drawing or painting." — Charles A. Csuri

Over the centuries, many artists have sought to believably translate our three-dimensional world onto a two-dimensional surface. Csuri, like his early contemporaries who also worked as painters, defies a concern for strict realism and instead embraces the two-dimensional surface, challenging its limitations in his earliest endeavors with computer art. There were no mass-produced operating systems when Csuri began creating art in the early 1960s, necessitating that he create his own computer programs to challenge the limits of this new technology. Further, computers at this time were unable to assign values to account for mass, although the perception of spaces and their relatedness to mass will become a hallmark of Csuri's art created in a three-dimensional world space.

In his *After the Artist* series, the first analogue computer art created by Charles Csuri from 1963 to 1964, Csuri recalls and recreates classic works by historically significant and personally compelling artists. In all, he created nine analogue drawings, referencing works by Paul Cézanne, André Derain, and Albrecht Dürer, among others. In this series, Csuri creatively distills selected masterpieces into their vital components, thus placing the works by these artists into a new role he has assigned to them. Then, using his analogue process, Csuri masterfully repeats, stretches, skews, and inverts the elements. These works translate traditional art by harnessing a vehicle originally created for the scientific applications. The result is a new artistic paradigm, in which Csuri appropriates scientific elements and injects unpredictability, dynamism and controlled artistic chaos. By stripping the works of Cézanne, Derain and Dürer of their z-axis, Csuri removes that aspect which confers depth and volume, working instead with "relationships between objects as transformations involving position, rotation and scale."[1] These 'transformations' result from the distillation of well-known works into their simplified forms, and their subsequent manipulation results in tension between dimensions.

Albrecht Dürer (1471–1528), the patriarch of portraitists, dominated Germany in the late fifteenth century. Prior to him, artists generally did not paint independent self-portraits, which expressed the personality behind the canvas's production. In *After Albrecht Dürer*, Csuri recalls Dürer's *Self-Portrait with a Bandage* of 1491–92, a pen on paper sketch in which Dürer emphasizes the agency of his own hand (Catalogue 3). Csuri eliminates references to depth and space by removing shading, reducing Dürer's sketch to its most basic elements. The adjacent pantograph is flipped and slightly compressed as Csuri considers it from another perspective. He returns to the original orientation for the final replication, skewing the drawing along both its x and y axes, further emphasizing the presence of Dürer's hand and, by extension, reminding the viewer of the latent capabilities within it.

The intellectual climate of early twentieth century Paris generated schools of art such as Cubism and Fauvism, movements that sought to rebuke the photographic, mechanical reproduction of the tangible world. Their investigations into essential expressions of color and line drove artistic innovation. Here, Csuri reevaluates two of the artists who played significant roles in this milieu, Paul Cézanne (1839–1906) and André Derain (1880–1954).

While not as well known as many others of his time, André Derain painted captivating portraits in the company of Cézanne, Pablo Picasso and Henri Matisse, among others. Derain was noted for his infusion of Mannerism, recalling the famous Spaniard El Greco of the late 16th-early 17th century. In *After André Derain*, Csuri has condensed Derain's bold brushwork, reducing it to only the most expressive elements (Catalogue 4). One of the two figures has been elongated along its x-axis, forming the visual base to support a more conventionally proportioned figure in the center.

In *After Paul Cézanne*, Csuri pays homage to Cézanne's significant contributions to the art world, particularly his innovations as the forefather of Cubism, a style in which space is broken into planes outside traditional modes of representation (Catalogue 5). Csuri was well aware of Cézanne's prominent role in art history and had a personal affinity for his work, having spent long hours in museums and galleries closely studying the works of Cézanne and other master artists. In a personal symbolism of geometric forms, Csuri uses concentric circles and progressively larger squares that emanate from the center of Cézanne's eyes. Read from left to right, the circles and squares express Cézanne's unique vision and the modes through which he translated physical space onto two-dimensional canvas. When asked about the symbolism, Csuri stated, simply and with a smile, "He was the father of modern art, having the vision for Cubism…I couldn't resist playing with it." [2] [AM]

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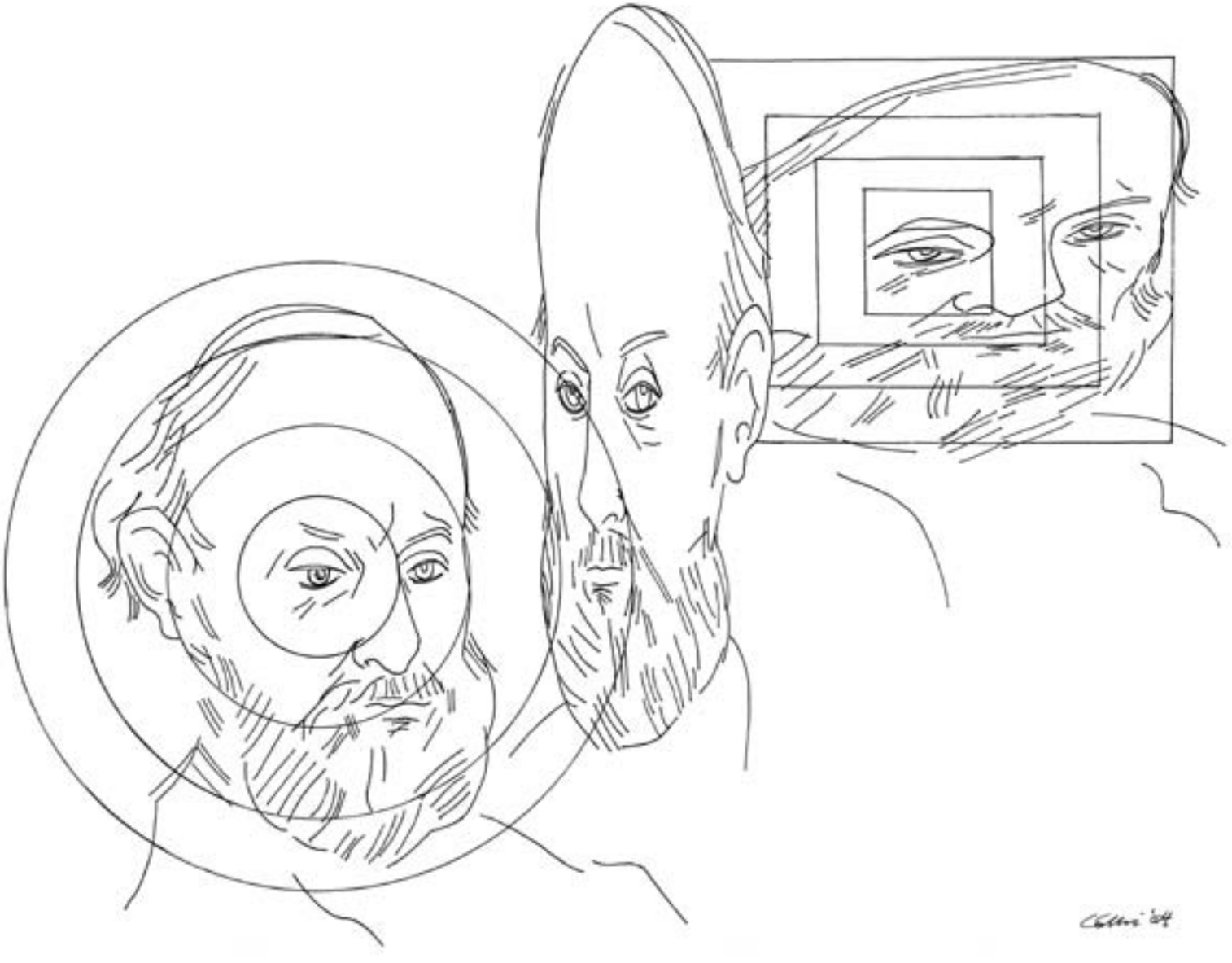
[1] Charles Csuri, *Tactile-Kinesthesis,* 1998.

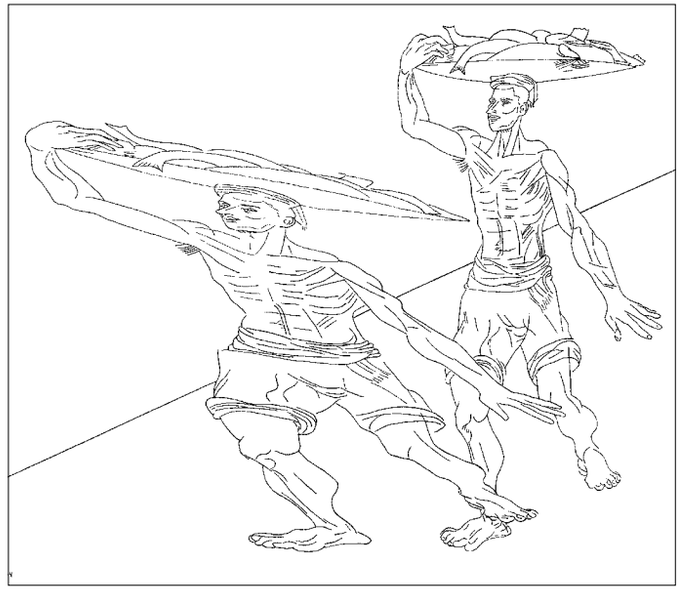
[2] Personal communication, March 2006.

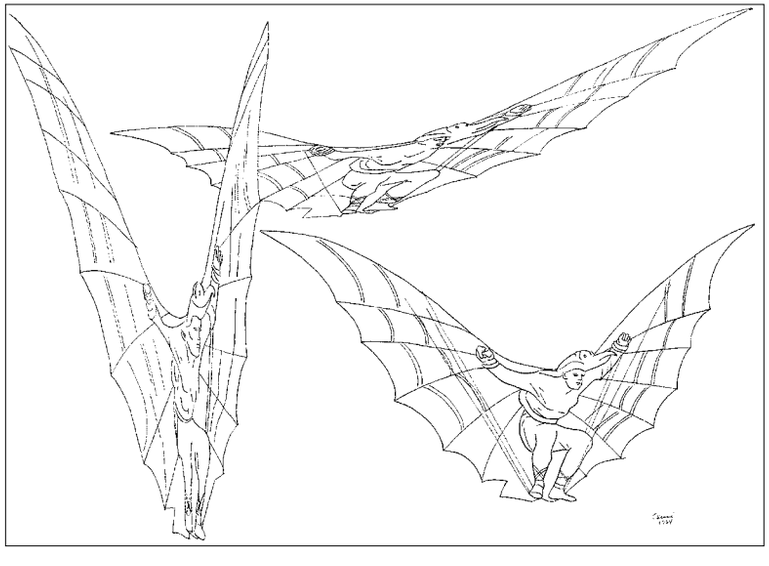
3. ***After Albrecht Dürer.***
1964.
Ink on paper.
Analogue Computer.
61 x 81 cm
(24 x 32 in.).

4. ***After André Derain.***
1964.
Ink on paper.
Analogue Computer.
61 x 81 cm
(24 x 32 in.).



5. ***After Paul Cézanne.***
1964.
Ink on paper.
Analogue Computer.
64 x 81 cm
(25 x 32 in.).



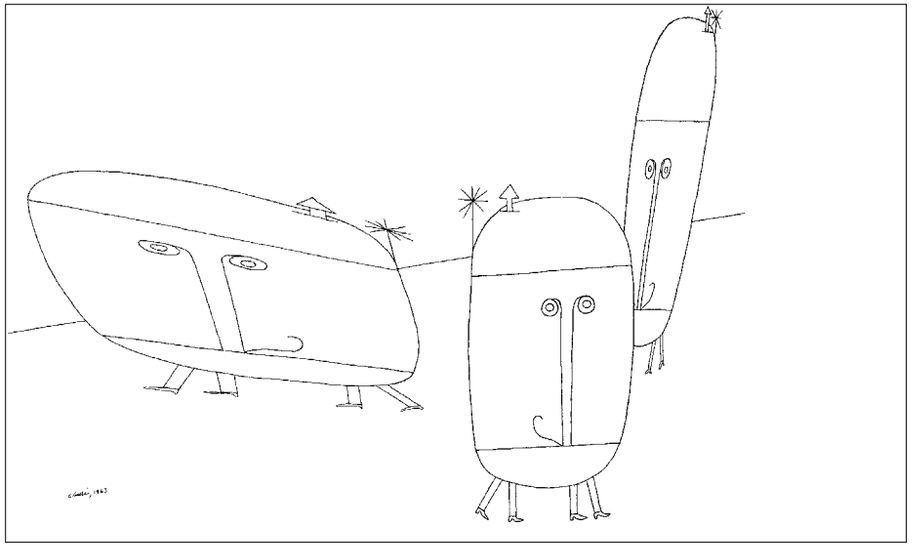


6. ***After Jean-Auguste Ingres.***
1964.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

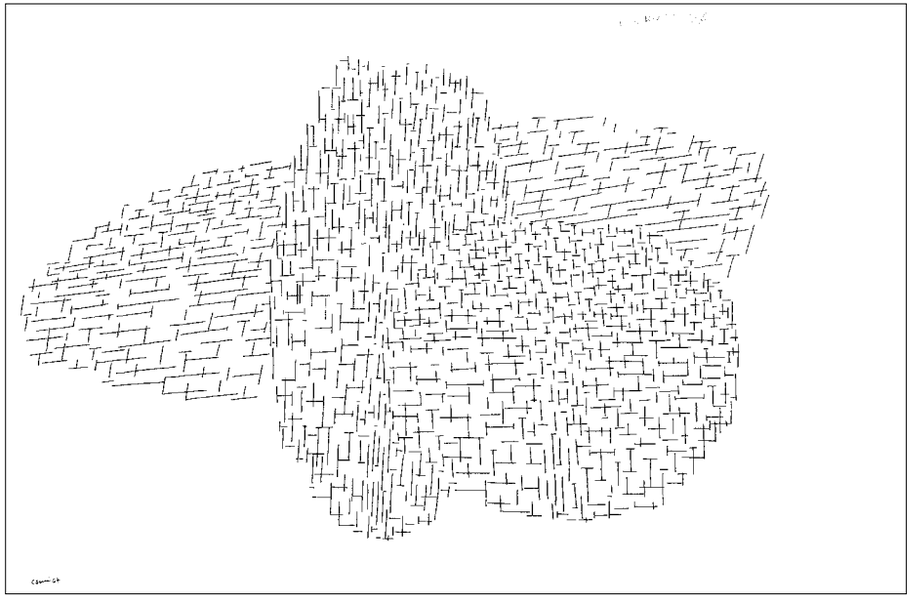
7. ***After Pablo Picasso.***
1964.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

8. ***After Francisco Goya.***
1964.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

9. ***After Albrecht Dürer's Study of Gentile Bellini.***
1964.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

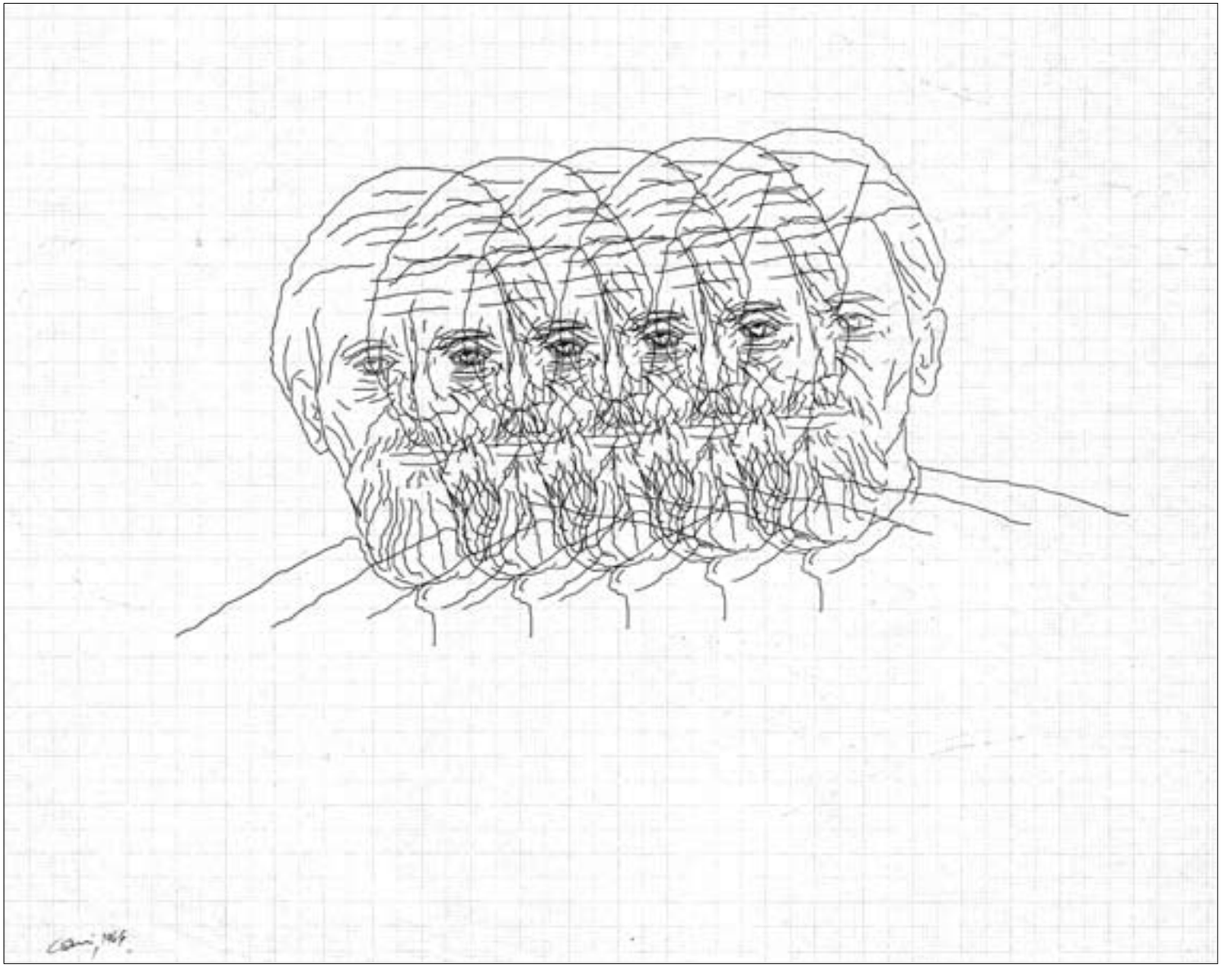


10. ***After Paul Klee.***
1963.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

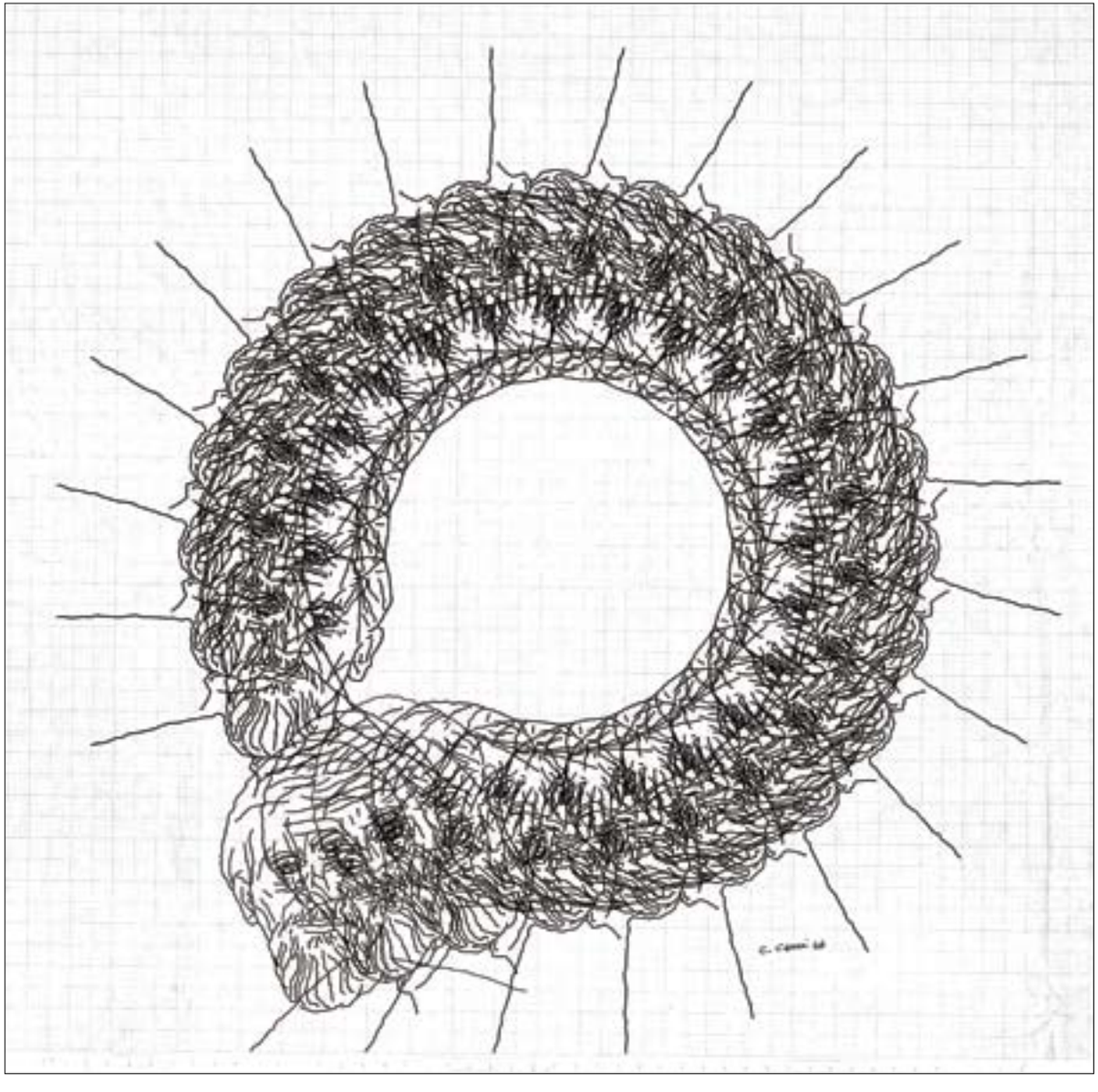


11. ***After Piet Mondrian.***
1964.
Ink on paper.
Analogue Computer.
66 x 51 cm
(26 x 20 in.).

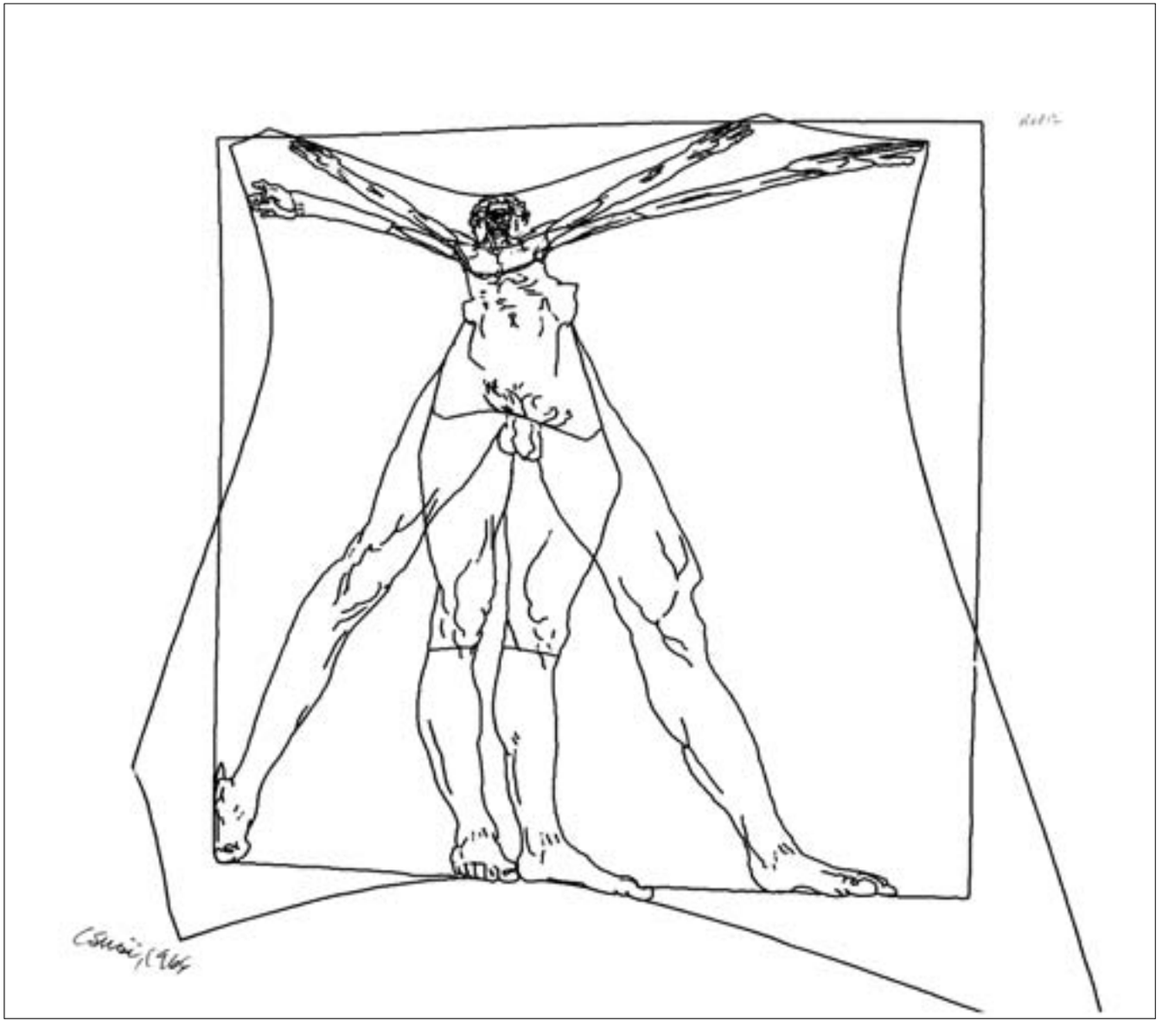
12. ***Dignified Lady.***
1964–1965.
Ink on paper.
IBM 7094 and
drum plotter.
8 x 10 cm
(3.25 x 4 in.).



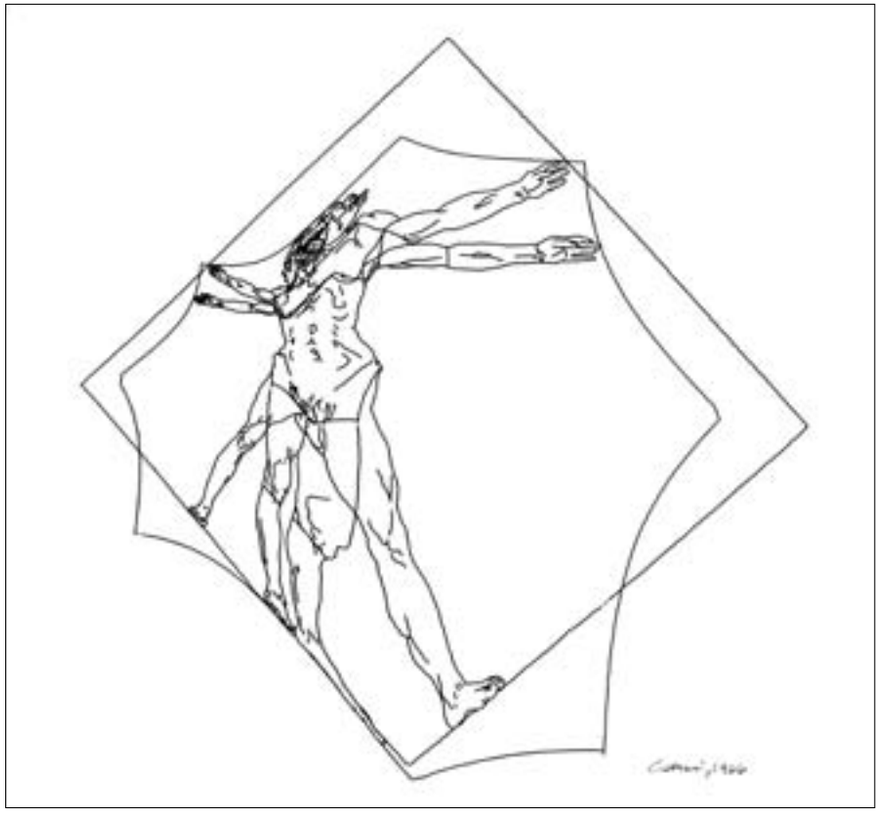
13. ***Five Faces.***
1966.
Ink on paper.
IBM 7094 and
drum plotter.
79 x 91 cm
(31 x 36 in.).

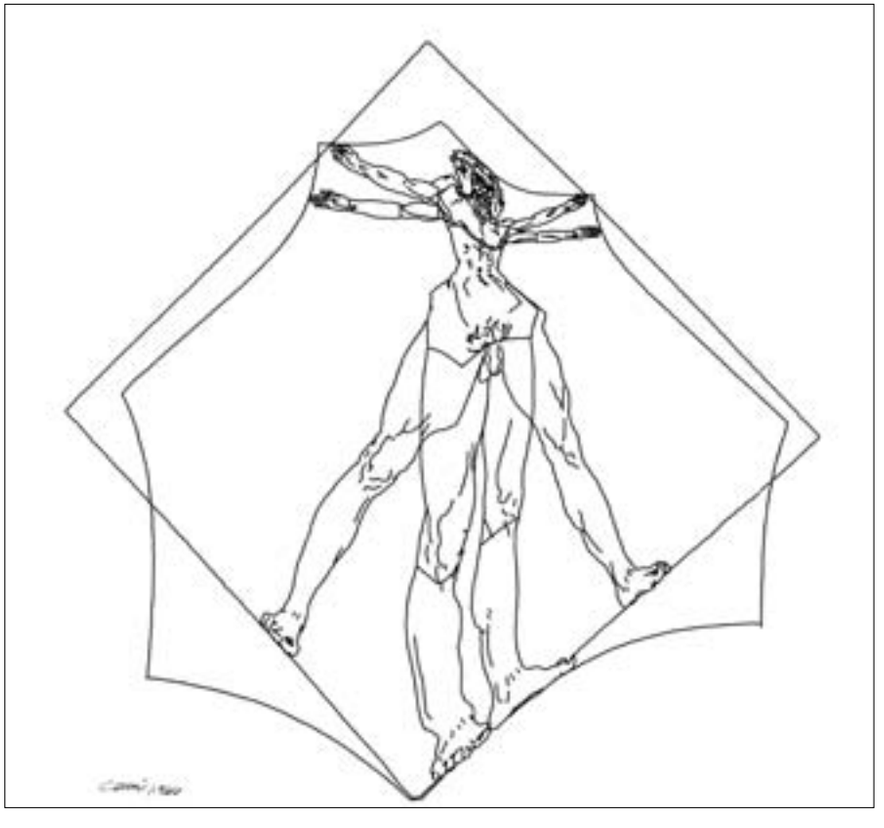


14. ***Bearded Man in a Circle.***
1966.
Ink on paper.
IBM 7094 and
drum plotter.
81 x 81 cm
(32x 32 in.).



15. ***Leonardo da Vinci Series.*** 1966. Ink on paper. IBM 7094 and drum plotter. 51 x 152 cm (20 x 60 in.).

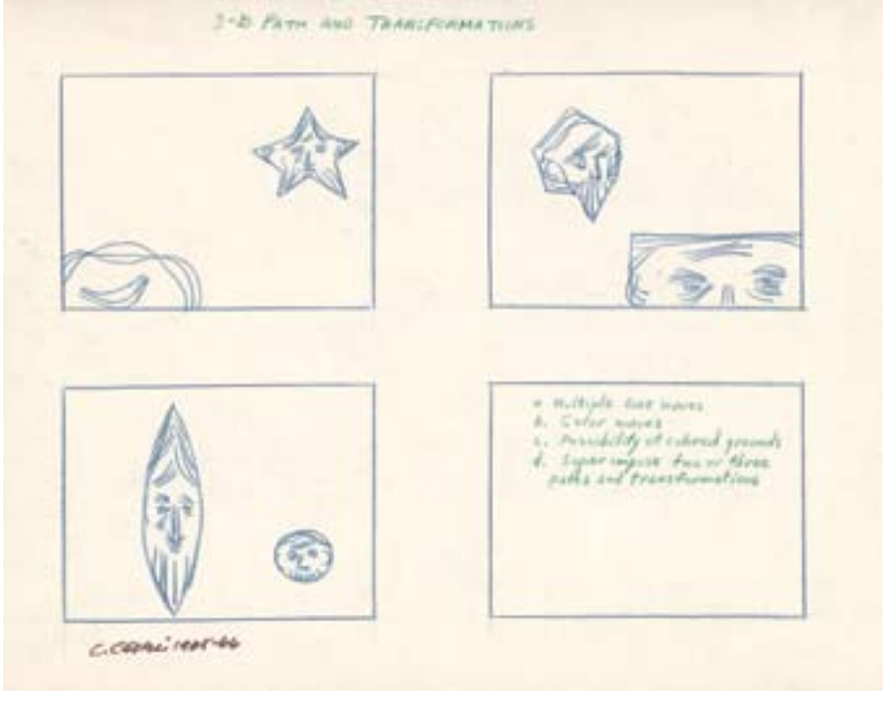




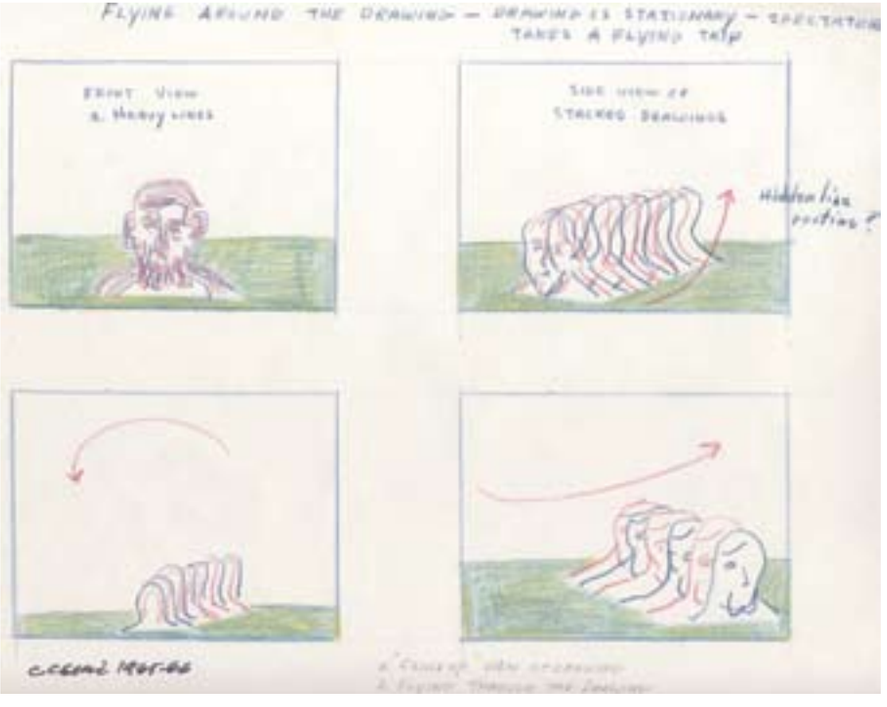
Six Pages from the Artist's Sketchbook

These sketchbook drawings were made when Csuri first started using the computer. They demonstrate ideas and issues that he was struggling with in the context of a drum plotter, a slow computer and punch cards. Csuri asked himself, "What can I do with this process or approach that would be different from my traditional work?" According to Csuri, it was a time of great speculation, and the drawings illustrate that he was thinking in terms of three-dimensional space, with some notion of stereo pairs and flying through a drawing. In the sketchbook, he comments about a three-dimensional path for an object, sine waves, and various transformations. Csuri's comments about the drawings, made in 2006, are noted below the images.

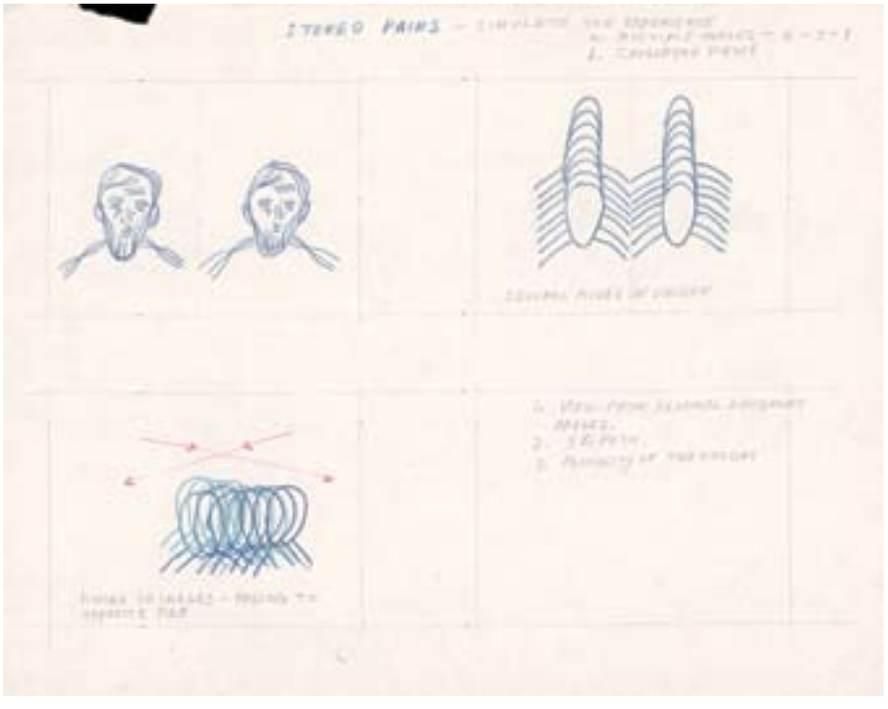
16. **Six Pages from the Artist's Sketchbook.** 1965–66. Color pencil on paper. 165 x 203 cm (65 x 80 in.).



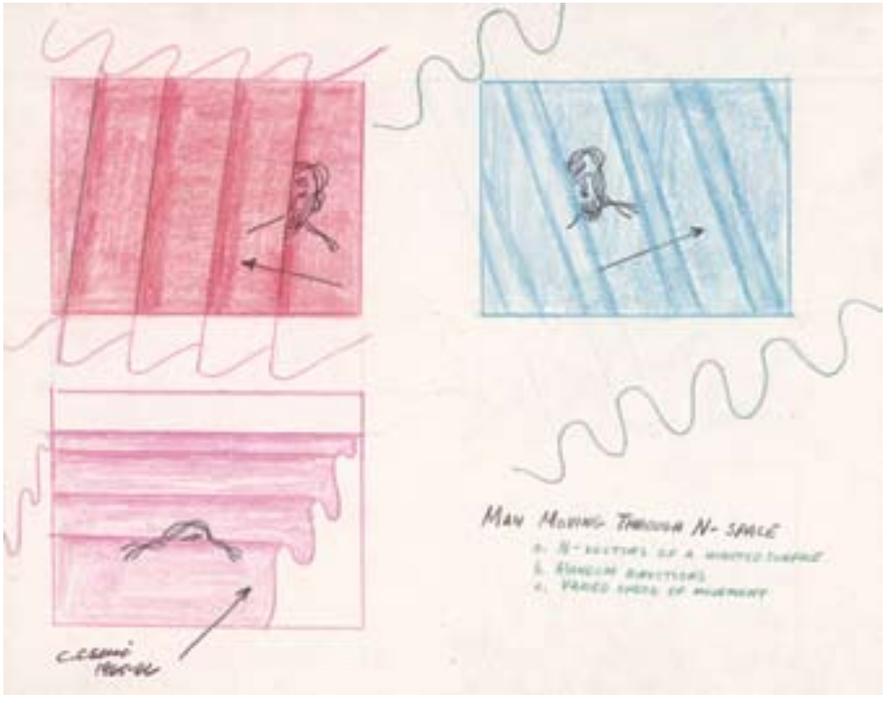
3D Path and Transformations
Here, I explore a drawing in a three-dimensional space and the idea of three-dimensional paths. Leslie Miller, a Professor of Mathematics, introduced me to a broader viewpoint about transformations—transformations on the original drawing that would make the overall shape look abstracted or like a star.



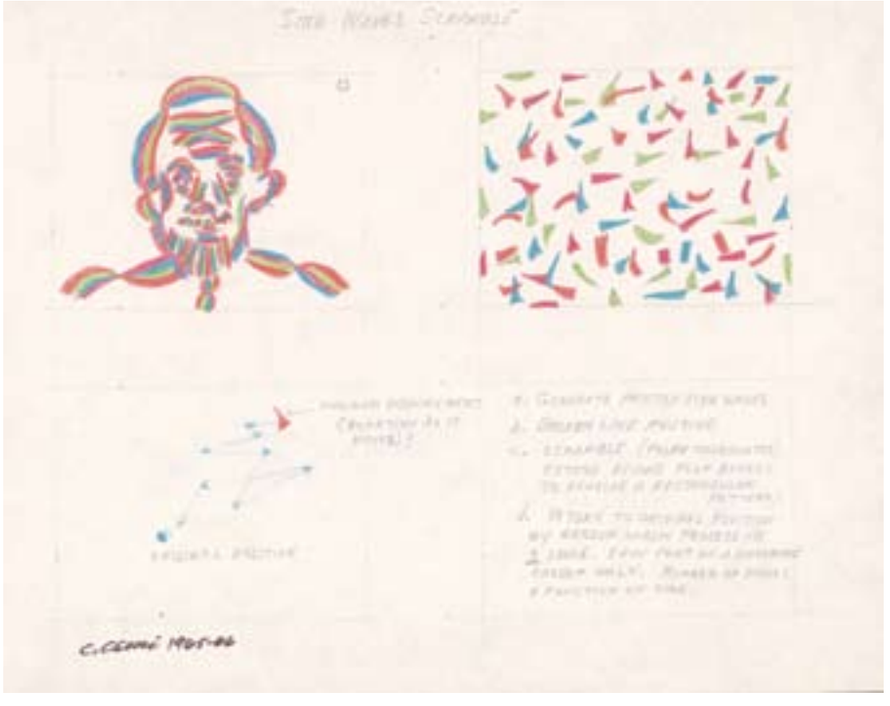
Sketch Flying Around the Drawing
I thought of the drawing as a three-dimensional piece of sculpture. I envisioned the drawings like layers in three-dimensional. My fantasy was to be able to fly around and through my own drawing. Or, the spectator could take a flying trip. I was concerned about a hidden line routine, as I learned more about three-dimensional computer graphics.



Stereo Pairs
The notion of working in three-dimensional space fascinated me. I thought of art objects as a three-dimensional entity that could be viewed by means of stereo pairs. Also, there could be a three-dimensional path that controlled one's movement in relationship to the drawings. But, there were a number of technical issues that kept me from fully realizing this idea.



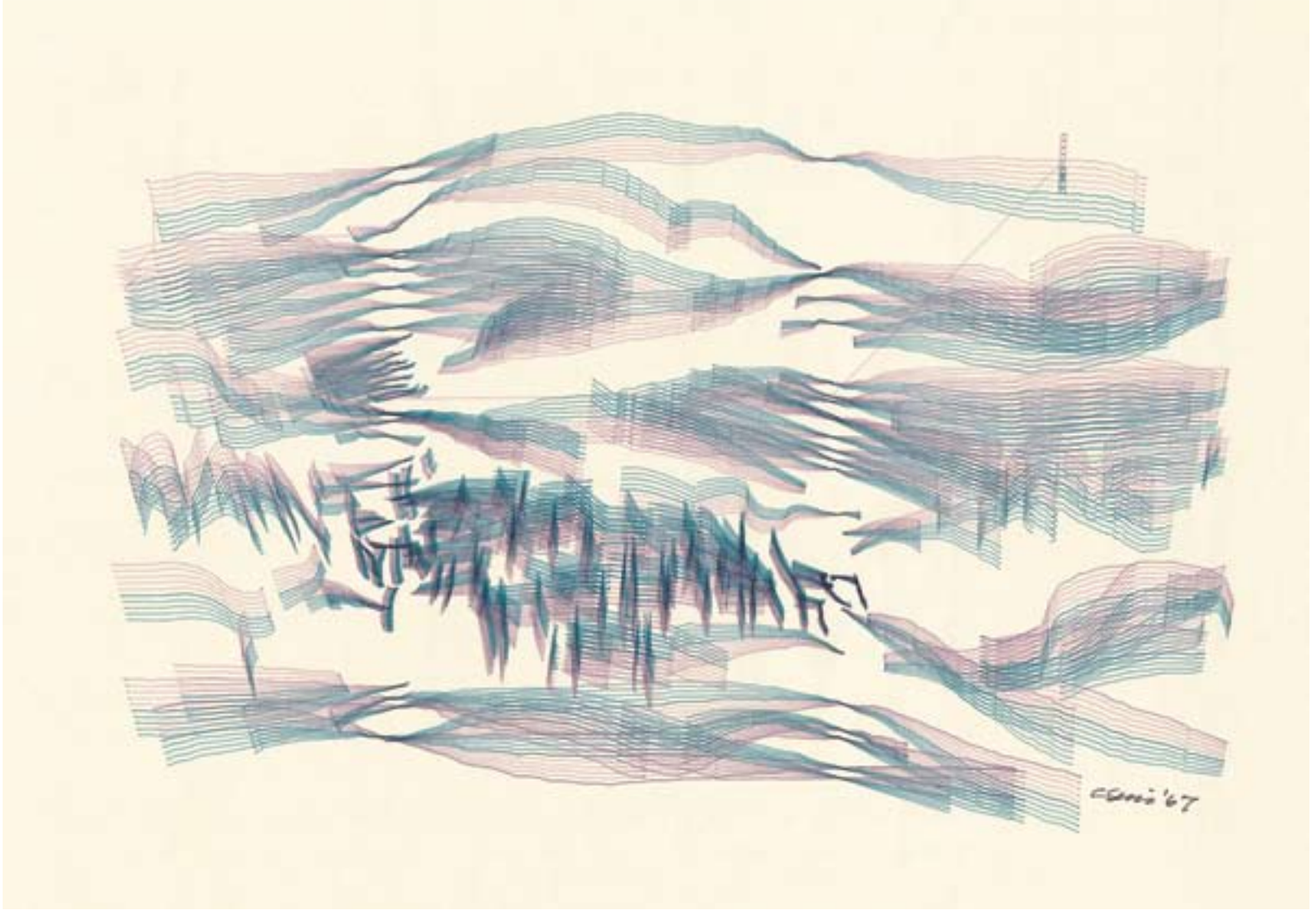
Man Moving Through N-Space
Now you see me now you don't. The drawing is moving into and out of various spaces. The decisions about direction and speed were to be made by a random number generator. The camera angle was to be positioned so that it would look like the drawing was sliding over a three-dimensional surface and out of view.



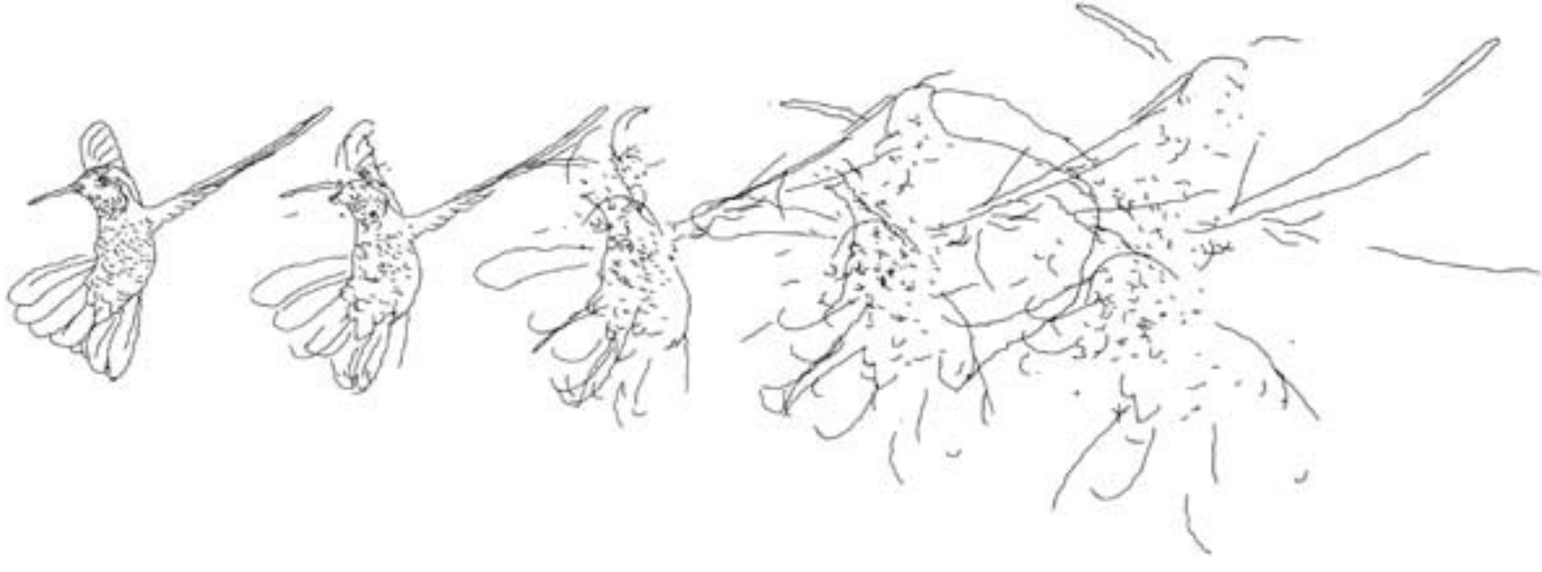
Sine Waves Scramble
Quickly I found that I wanted to find ways to deal with color, even though I was limited to a single plotting pen at a time. The sketch of the bearded man on the left was to be broken into fragments, using what we called "a broken line" routine. The lines would be displaced by means of a random walk process, then brought back together again. Animation was on my mind when I considered this idea.

Sine Curve Man
In this sketch, I was looking at how frequency and phase changes might effect my original drawing. A more graphic quality might be achieved by repetition and a slight shift in the drawing. Also, I considered how I might use colored ink.

17. ***Sine Curve Man.***
1967.
Ink on paper.
IBM 7094 and
drum plotter.
104 x 104 cm
(41 x 41 in.).



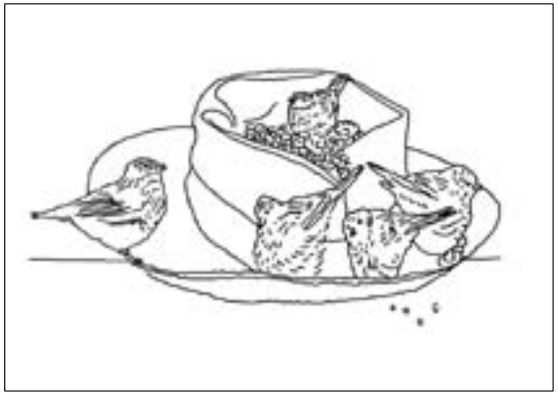
18. ***Sinescape.***
1967.
Color ink on paper.
IBM 7094 and
drum plotter.
61 x 76 cm
(24 x 30 in.).
Collection of Mr. and
Mrs. Kevin Reagh.

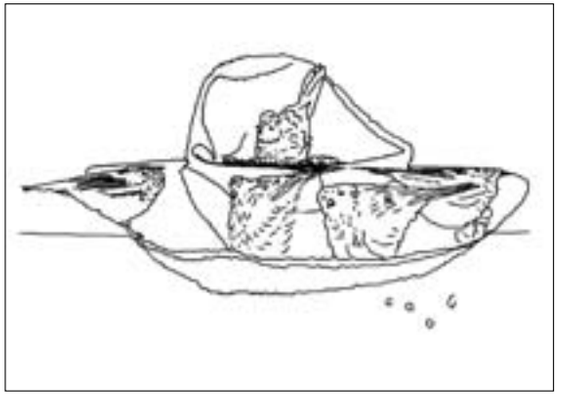


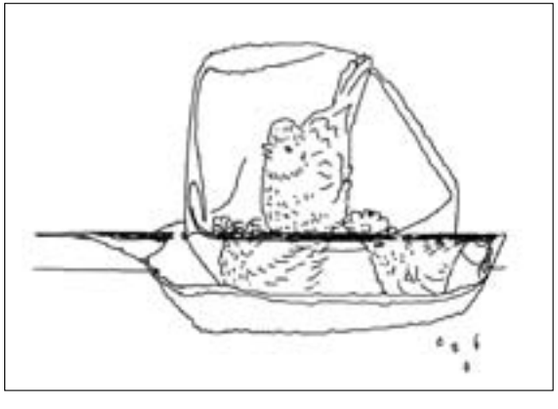
19. ***Hummingbird II.*** 1969. Photo screen on Plexiglas. IBM1130 and drum plotter. 46 x 76 cm (18 x 30 in.).

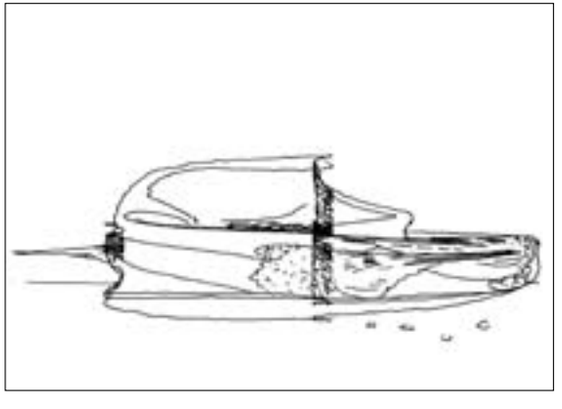
20. ***Aging Process.***
1967.
Ink on paper.
IBM 7094 and
drum plotter.
64 x 140 cm
(25 x 55 in.).

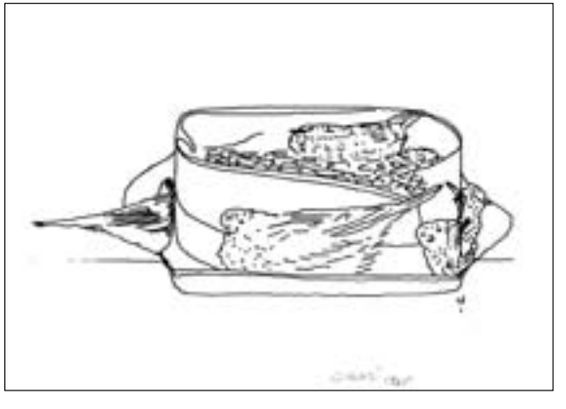
21. ***Birds in a Hat.***
1968.
Ink on paper.
IBM 7094 and
drum plotter.
38 x 155 cm
(15 x 61 in.).
Collection of Mr. and
Mrs. Kevin Reagh.





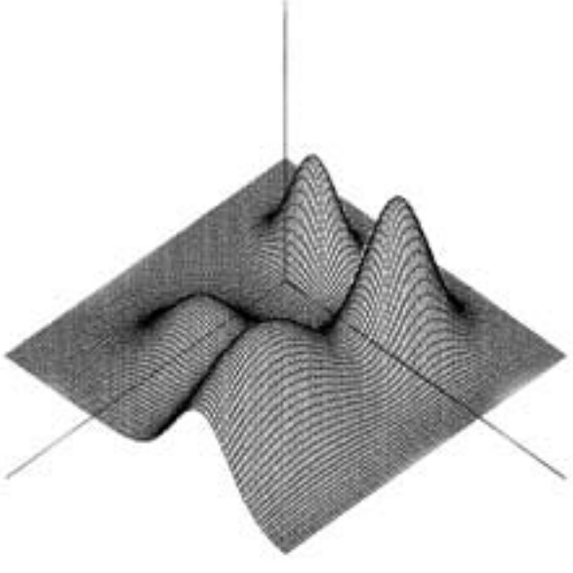


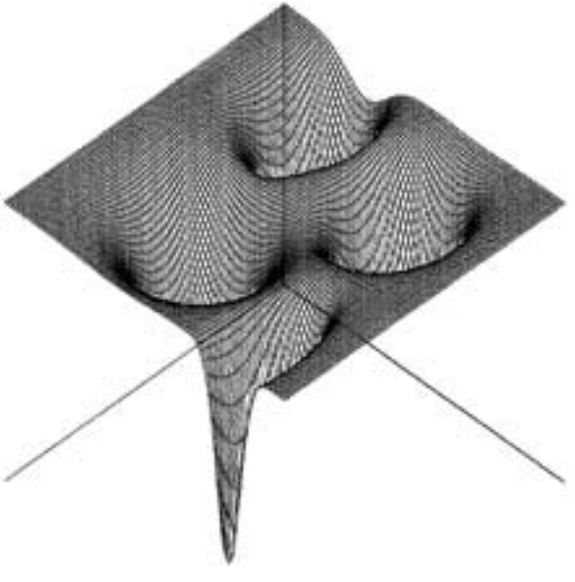




Birds in a Hat *(details)*

22. ***Numeric Milling.***
1968.
Wood.
3-Axis Milling
Machine.
33 x 56 x 22 cm
(13 x 22 x 8.5 in.).
Collection of Mr. and
Mrs. Kevin Reagh.





23. **Plotter Drawing of *Numeric Milling.*** 1968. Ink on paper. IBM 7094 and drum plotter. 64 x 38 cm (25 x 15 in.).

Random War

Scattered randomly across an expansive white ground, identically formed soldiers coded in red and black diminish into a continuous vertical ground plane. In places, figures stand upright in vacuous isolation. Elsewhere, they crowd together, the falling toppled onto clusters of the fallen. Two lists of serial numbers and names, one for each army, stretch across the upper register. The lists indicate which soldiers have died, which were wounded, which remain missing, and which survive. One hero is recognized on each side and is listed above the medals awarded for valor, good conduct, and efficiency.

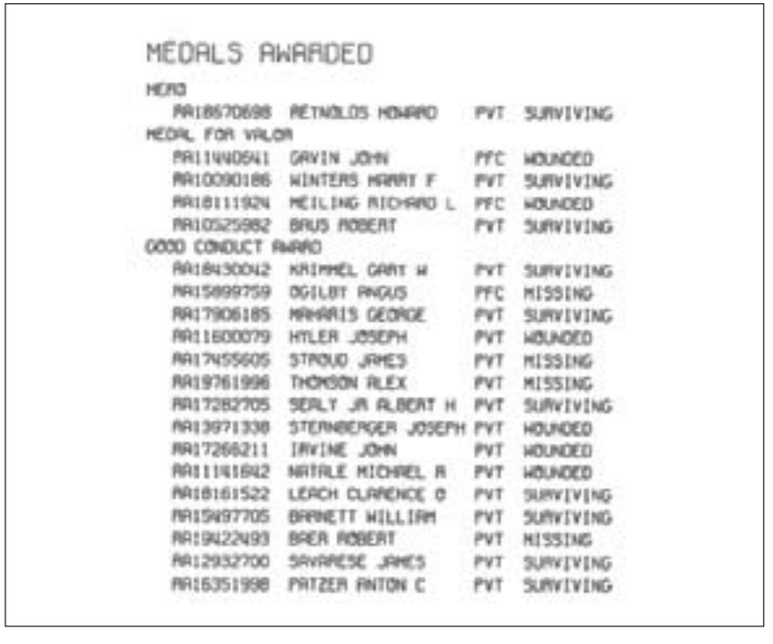
Random War, arguably one of the most important works of the twentieth century, stands at the convergence of Csuri's life experiences and the American social upheaval that predominated at the time of its creation. While the Vietnam War raged in Southeast Asia, antiwar sentiments divided the country. Generations of Americans struggled against each other at unprecedented levels. Technology was enthusiastically embraced in suburban households and touted by many as the savior of countless social and medical ills. Simultaneously, many perceived it as a demonic force that introduced chaos, depersonalizing and degrading human beings. To many in the art community, creating art with a computer was an act of evil in itself.

Csuri was uniquely poised to conceive and render an aesthetic object of this scale and significance. A soldier and decorated veteran of World War II's Battle of the Bulge, Csuri knew the battlefield and the horrors of war. As a fine artist, he understood the power of visual communication and the aesthetic object. As one naturally skilled in discourse and interdisciplinary collaboration, he could harness the computer's potential and use it to advance the world of art.

The "little green army man"—the model for Csuri's drawing of a soldier—has iconic status in the American psyche of those born before the mid-1970s. These two-inch-tall, green plastic figurines, shown wearing army fatigues and helmets and poised to shoot their enemies, were an integral part of most boys' toy sets until the late 1970s (Figure 1). Childhood memories of games played are permeated by adult sensibilities of the greater victories and losses that the figurines represent. Csuri heightens this social tension and captures the chaos of the battlefield, where one often cannot differentiate between friend and foe, by using a random number generator to place the forms on battlefield coordinates and to rotate the absurdly rigid bodies in two-dimensional space. The soldiers' names, recorded in lists across a horizontal space, personalize the realities and randomness of war. A work brilliantly conceived, Csuri entered into the random number generator the names of the living, many of whom would view the work in its final form. Ohio State University administrators, faculty, and staff, as well as famous people of the time, such as Ronald Reagan and Gerald Ford, become soldiers in Csuri's *Random War*, clearly suggesting war's indiscriminate nature. Csuri even entered his own name into the random number generator, and it was ultimately assigned to the list of the wounded. *Random War* predates Maya Lin's Vietnam War Memorial, *The Wall* (1982),

which honors Vietnam War veterans with carvings into granite of the names of those lost in battle. Csuri's use of names underscores and personalizes the randomness and chaos of all wars, while Lin's work shows the grim outcome and historical reality of Csuri's predictions. Lin never met Csuri, and it is unlikely that she saw the original *Random War,* the whereabouts of which are unknown today. Nevertheless, the two works create a powerful juxtaposition, demonstrating both the historical evolution of conceptual art that incorporates language and the historical and sociological realities of cause and effect. [JMG]

Random War *(detail of soldiers)*



Random War *(detail of names)*

24. ***Random War***
1967
IBM 7094 and
drum plotter
104 x 229 cm
(41 x 90 in.)
Recreation: Lightjet
with lamination, 2006

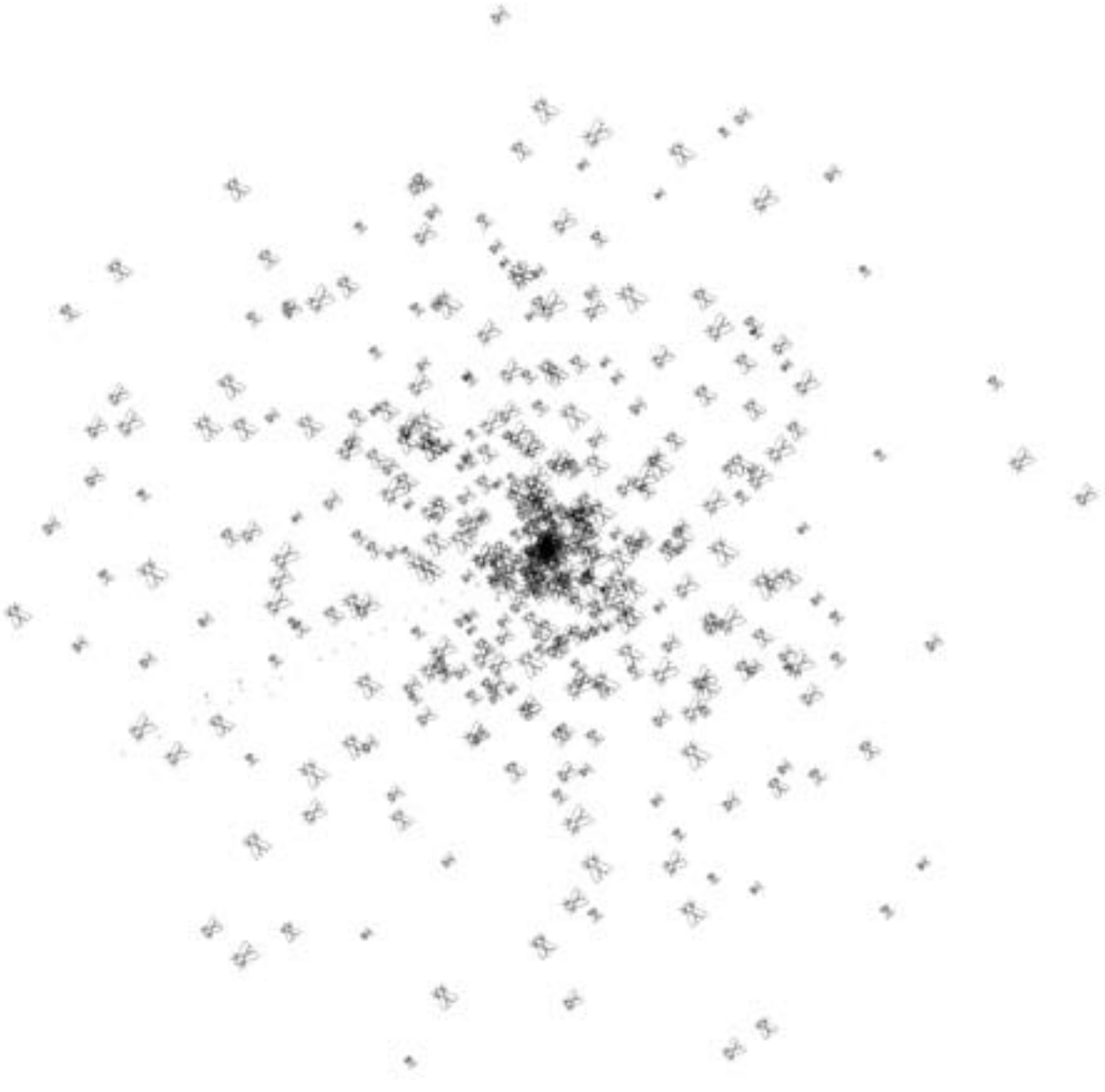
DEAD

WOUNDED

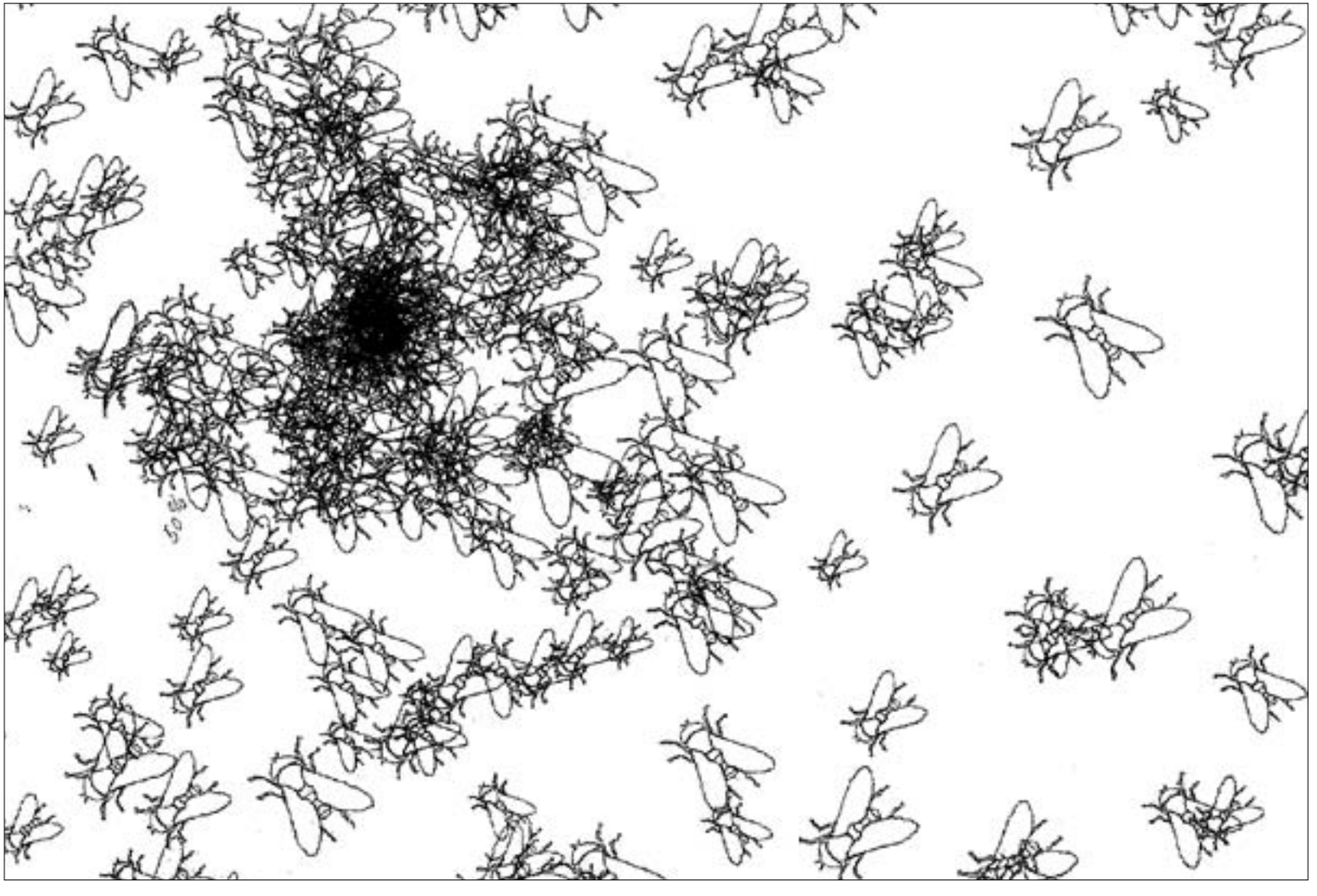
MISSING

SURVIVING

MEDALS AWARDED



25. ***Feeding Time.*** 1966. Ink on paper. IBM 7094 and drum plotter. 76 x 127 cm (30 x 50 in.).



Feeding Time *(detail)*

From Object To Object Transformed

Thomas E. Linehan

While it is often difficult to fully attribute the origins of an idea, the advancement of an idea is more easily identified. Charles Csuri's professional career as an artist and computer scientist parallels the advancement of our understanding of the nature of objects. Csuri's early work implies the transformation of stable, aesthetic objects into virtual objects. These virtual objects now inhabit virtual worlds and are endowed with multidimensional spatial and temporal attributes. These objects are filled with possibility.

Csuri's work has always had this vision. It is concerned with multidimensionality, contingency, temporality, and evolving forms. His work is liberated from the snapshot or decisive moment of early photographic and narrative art. It reaches toward an iterative transparency of the process used in its formation. Looking back on Csuri's work in the mid- to late-1960s, we see his early concern with possibility space as described by Will Wright (developer of *The Sims* strategic life-simulation computer game) (*WIRED*, April 2006, p.112). Csuri's works cultivate and exploit this possibility space. The *Random War* series used a rule-governed, gamelike, generative process to depict possible battlefield outcomes (Catalogue 24). The object space becomes a battlefield, and the possible outcomes become the aesthetic objects. This work prefigures in both content and method much of the modeling and simulation so widely used today for after-battle assessment. Csuri surely hoped, when he created the work, that the iterative display of possible battlefield outcomes could have an impact on real-world war decisions at the time.

Csuri's *Feeding Time* presents a more playful view of a new virtual battlefield, one in our environment (Catalogue 25). The viewer sees the virtual space as filled with possible landing targets for the common housefly. A single fly leaves a record of its landing coordinates by causing a plotter to successively redraw the fly in the possibility space. This work prefigures much of the current and future work being done in algorithmic control software used to guide robotic systems. These guidance-control algorithms use mathematical models to describe flocking, herding, and schooling. Csuri's use of the fly prefigures the use of birds, sheep, and fish as behavioral models for controlling large populations of animated or robotic objects.

Csuri anticipated the advances in memory and computation speed that would enable the complex models of today. In 1964, he envisioned a space filled with objects with their own history, predispositions, attributes, and capabilities. These were to become our virtual objects of today. These objects were to be richly related to the theories of aesthetic objects. The implied object attributes of the art of the past became present in Csuri's newer experiments. In these works, objects took on an animated, sculptural form. Repeatedly, Csuri considered replacing the concept of object with that of system. The word *system* could account for the dynamic, evolutionary, and expansive character that better represented his concept of an evolving object. In the end, he maintained his view of the evolving aesthetic object. It was important to maintain a connection to the aesthetic objects of the past in his new work. He admired the artists who came before him and felt that he was working in a well-established, artistic tradition of the object transformed.

Csuri's newer work maintains the possibility space of earlier two-dimensional works, but in a three-dimensional stage. The events of his aesthetic ideas play across and about this stage with the quality of thoughtful experiment.

Csuri created a workshop and a laboratory designed to further the object's transformation and the complex models to be used for its management and control. The Ohio State University's Computer Graphics Research Group (CGRG) and, later, the Advanced Computing Center for the Arts and Design (ACCAD) became the vehicles for this exploration. He recruited students and professionals to work as a community dedicated to experiment and investigate possibility space and the objects and actors that populate it. The experiments have continued in Csuri's workshop for more than thirty-five years. He continued his own work daily and directed the work of hundreds of computer graphics and animation professionals during that time. The industry is populated with CGRG and ACCAD alumni. Csuri's work and the work of colleagues and students have set the standard for the study of art in the context of advanced technology. His workshop has become the model for both art and computer science education for this century. It is dedicated to the object's transformation and the full immersion of the audience in the mind of both artist and scientist.

Charles Csuri envisioned and helped create the virtual object environment of today. He also created the model environment for its cultivation, study, and innovation. Few artist workshops or science laboratories of the past can match this contribution for relevance and impact on the world of their times.

Dialogue and Creativity: The Faces of Collaboration

Wayne Carlson

Chuck Csuri was a painter. He was a painter with more than a passing interest in computers, and, in particular, in how a computer might be used as a tool to express his artistic message. Jim Shaffer was a mathematician. He was a scientist who was intrigued by the fact that this art professor had a vision for how he could use an electronic device to create and manipulate images. Together, these two started what would turn out to be a legacy of two divergent backgrounds coming together to press the boundaries of their research areas, and to make art with a computer.

When people speak of Csuri's academic career and his art, the term *collaboration* is often used. This isn't surprising, but what is meant by collaboration when referring to Csuri's art? How did the collaborative process function for Csuri and his colleagues? Moreover, how does this process compare with collaboration in the history of art and in academia? While a thorough discussion of this topic is beyond the scope of this essay, it is significant to note that collaboration is an established tradition in the history of art. Further, a brief comparison between traditional artists' workshops and Csuri's work with computers sheds light on the collaborative processes at hand in his work.

During the Italian and Northern Renaissance Periods (the fourteenth through the late-sixteenth centuries), for example, master artists oversaw great workshops that employed numerous apprentices. These novices toiled, sometimes for decades, under great masters, stretching canvases, mixing pigments, cleaning brushes, and hauling stones for sculptures. Apprentices who showed artistic skill and promise eventually helped to create works of art, which were envisioned by the master artist and commissioned by patrons. The specifics of these collaborations varied, as one might expect, with the coming together of individual personalities and particular historical circumstances. In general, however, the early art workshops were populated by individuals working to gain artistic skills. As artists, or aspiring artists, they were trained in a similar fashion and shared comparable historical reference points. The goals and the trajectories of their artistic lives were, therefore, shared to some extent. The workshop of modern glass artist Dale Chihuly resembles this form of collaboration, in which most of the employees are artists creating glassworks under the guidance of a recognized master.

While Csuri, like the great masters of old, is easily recognized as

the senior artist and creative director in his collaborative efforts, the constitution and process in his workshop was significantly different. Csuri's research groups brought together individuals with dramatically different skill sets and redefined the history of collaboration in creating art. Csuri learned the programming language of FORTRAN, was schooled in other technical processes, and, today, continues to write code. However, he recognized early on that bringing together experts from various fields would allow for the greatest creative potential. In short, a closer look at the history and dynamics of Csuri's art and technology groups reveals a significant departure from the traditional, historical collaborative process of art creation.

I arrived at The Ohio State University (OSU) for graduate school in 1974. Like Jim Shaffer, I was trained in mathematics, but I really wanted to learn more about the theories and practice of computer science. One day, I responded to a poster advertising a lecture by a professor of art who was using a computer to make moving images. I was introduced to Csuri's world of magic, which, by this time, included the production of works such as *Sine Curve Man* (Catalogue 17), *Sinescape* (Catalogue 18), and *Random War* (Catalogue 24). I was hooked. He later reeled me in when he asked me to join his research group as a participant in a new project that was awarded by the Air Force Office of Scientific Research. (Imagine…a professor of art attracting federal research grants from agencies such as The National Science Foundation, the Navy Weapons Training Center, and the Air Force!) Csuri's research group included Rick Parent, another computer scientist, Ron Hackathorn, a glassblower, and several other artistic types who were working together to define what would become the discipline of computer animation. When compared with art studios of the past, within Csuri's Computer Graphics Research Group (CGRG), there was a marked distinction between both the background of the individuals and the collaborative process.

In the case of Csuri's work, one can think of the collaborative process as occurring in spheres of practical experience. Csuri, as an artist, would have an idea about how he wished to represent something. He would approach the scientists and make inquiries. When engaged with requests for computer code that could transform Csuri's mental images into reality, a dialogue between artist and scientist would ensue. Csuri would press on with questions. The scientists would attempt to envision his words and to explain to him the current state of technological capabilities. After numerous discussions, it was time for the scientists to explore the creative boundaries of technology within the realm of their skills and knowledge base. Through such ongoing dialogue, creativity exploded within the different disciplinary spheres, eventually coming together in the form of artistic tools that allowed computer art to be made.

There are numerous examples of this collaborative dialogue between experts from different fields in Csuri's research groups over the years. An excellent representational example can be found in the interaction of Csuri with Dr. Steve May, who was

then a doctoral student in computer science. This collaboration is mentioned frequently, because many of Csuri's artworks draw on tools developed through their dialogue. Their creative collaboration looked something like this: In the early 1990s, Csuri approached May with inquiries into the notion of drawing in three-dimensional space. As a student of art history, Csuri had studied the works of the great Japanese painter, calligrapher and woodblock printer, Kitagawa Utamaro (1753–1806). He was interested in Utamaro's use of bold, flowing, yet elegantly controlled lines to render form. As someone in love with drawing, Csuri wanted to explore the use of calligraphic lines in three-dimensional space. Csuri remembers his conversation with May and recalls how he told May that he wanted to use lines that had depth and width. He also wanted these lines to reflect light and cast shadows. May noted, as any competent computer scientist of the time would, that a line, by definition, is a two-dimensional concept, with no breadth or depth and, therefore, no ability to interact with a light source in three-dimensional space. Csuri pressed on with his inquiries, in his usual fashion, asking "But what if it could? What if line had depth and could be rendered in three-dimensional space?" Then came the familiar request, "I want to be able to do this. Can you help me?" Such dialogue opened a space into which May could engage his creative process with a computer code. Choosing the respected language of Scheme, he embarked on the development of scripts that would create a line in three-dimensional space. Csuri now refers to the code as the "ribbon tool." Csuri can adjust the width, length, and movement of the line by varying the parameters in May's code. Csuri has used this tool to create some of his most engaging works, such as *Entanglement* (Catalogue 56), *Horse Play* (Catalogue 42) and *texturePerhaps* (Catalogue 54).

Today, we would identify such collaboration as interdisciplinary. Interdisciplinary collaboration has always been difficult; in academia in the 1960s, it was nearly impossible. Professors were taught and encouraged to focus on their individual areas of expertise, and to work tirelessly and alone on a problem that could define them as the expert in that area. Promotion and tenure guidelines often required sole authorship on papers that were published on a given topic, and the rewards structure in universities gave more favor to those who could demonstrate such an individualized effort. Art and technology stood apart from this norm. Maybe it was because of the need for artists to access the esoteric and seemingly magical components of computers and other technological innovations, and maybe it was a desire on the part of the "gear-heads" to express their creative thoughts with the vocabulary of the arts. For whatever reason, there are numerous examples of successful partnerships between an artist and a mathematician or an artist and a computer scientist during this period.[1,2,3,4,5,6,7,8]

Over the next four or five years, under Csuri's direction, this disparate group of creative people designed and developed new hardware and software, and honed the approach to defining time-based image displays. Federal funding continued, and support from the university followed.

All the while, Csuri envisioned an academic program that embraced this marriage of art and technology, and he also foresaw a commercialization that could take the technology from his lab and apply it to the emerging world of computer-animated motion-picture special effects, television promotions, and advertising. Both of these directions required that unique and successful spirit of collab oration across the vertical boundaries of dramatically different disciplines.

Half of his dream was realized in late 1980 and early 1981, after a mutual friend and business associate introduced Csuri to Robert Kanuth, a serial entrepreneur and financial securities investor. Csuri emphasized to his future business partner the need to continue the interdisciplinary approaches to the problems associated with image making, and a core group of the research staff was recruited to join Kanuth's new company, Cranston/Csuri Productions, Inc. CCP, as it became known, joined an elite group as one of the premier companies of the time that were producing computer-generated imagery for the small and big screens.

I was fortunate enough to join the company and work over the entire life of this pioneering commercial enterprise. As a member of the management team involved with defining and running the company, I experienced firsthand Csuri's commitment to the continuing marriage of art and science, but now with the *ménage à trois* style relationship demanded by the introduction of business to the mix. As such, the business client's role somewhat echoed the role of the patron, who financially supported a master artist's workshop by commissioning works. Within this dialogue, the customer's often vague vision was to be creatively exceeded, engendering delight and awe in the mastery of production. On the strength of Csuri's reputation and the investment savvy of Kanuth, this privately held company was able to secure Ohio development funds and the backing of several large institutional and private investors. On the strength of the creative team of software developers and artists, the company attracted over 400 international clients representing many different business activities. At its peak, CCP employed over seventy people who were involved in the realization of over 150 creative and innovative products each year.

At the same time, a new kind of collaboration was beginning. While CCP was growing and succeeding, Csuri remained involved with the activities of his research lab and its new penetration into the teaching and learning academic arena. The original Computer Graphics Research Group (CGRG), started as a research collective and was evolving to become the Advanced Computing Center for the Arts and Design (ACCAD). This new venture was designed to bring together undergraduate and graduate students from art, photography and cinema, design, art education and computer science to learn together in an environment that represented the state-of-the-art in this new and emerging field of study. It happened to be co-located in the same campus-area facility as CCP, which provided the opportunity for OSU students and faculty and the professionals from CCP to get

together socially and more formally in the pursuit of knowledge that would eventually advance the computer animation field and cement The Ohio State University and CCP as two of the more important contributing institutions in the history of CGI.

As noted, interdisciplinary collaboration is often difficult. In particular, when one considers the intense demands of taking an intellectual activity from the theoretical to the practical, and add the need to turn a profit to meet the expectations of an increasingly competitive business market, the net that holds this collaboration together can become strained. Such was the case with Csuri's involvement with CCP. He justifiably felt very strongly that a share of the financial success of the company should be reinvested in the experimental pursuit of research; this was what he brought to the venture, after all. Although the leadership of the company agreed that research was necessary to maintain the competitive edge that defined the company in the first place, the financial expectations of the investors coupled with the need to make a growing payroll relegated this desire to a secondary priority, and this put Csuri and the board of CCP at odds. Csuri stepped down from the day-to-day operations of CCP and turned his attention back to making ACCAD a viable entity within the university.

CCP continued to impact the CGI production market for the next two years. However, Csuri's presentiment of the difficulty they would have in the changing market proved to be at least partially accurate. While CCP was directing much of its investment capital to the mainframe technology that was available at the time, the computer hardware industry was introducing the workstation, and the per-cycle cost was dropping dramatically. In addition, while the conversion from the lab-oriented software base to dependable commercial software was eating its share of the company assets, the computer software industry was introducing licenses for integrated CG software that was designed from the contributions we and other pioneers made, but it was also built on very significant and ongoing research efforts of others. In a sense, we sired the progeny that eventually would portend our demise. At the end of 1987, CCP closed its doors and Csuri's dream of commercial success came to an end.

The circle was completed when ACCAD was established and the goal of a research and teaching center, founded on the concept of interdisciplinary collaboration, became a reality. In my own transition from a narrowly focused mathematician, I marveled at the ability of this polymathic man who had the vision and desire to bring these so different, yet so similar areas of knowledge together in the pursuit of a new art and science. My own circle was completed when I had the opportunity and honor to assume a new role as Csuri's successor as the Director of ACCAD[9] upon his retirement. I had no choice but to continue the strong commitment to interdisciplinary collaboration that built and still sustains this incredible resource.

[1] *The Museum As Seen at the End of the Mechanical Age.* New York: Museum of Modern Art, 1968.

[2] "Experiments in Art and Technology, Inc." *Journal of the Society of Motion Picture and Television Engineers*: 146 (1968).

[3] "E.A.T., Cogs, Gears, Transistors, and Art." *The Kingston Daily Freeman*. Kingston: 20 (1969).

[4] Brennan, P. J. "Art Meets Technology in New York: There Is No Winner." *Engineer* (Jan./Feb.) (1969): 12

[5] Christiansen, R. "Art and Technology." *The New York Times*: 26 (1966)

[6] Kluver, B., and J. Martin, et al. *Some More Beginnings: An Exhibition of Submitted Works Involving Technical Materials and Processes*. New York, Museum of Modern Art and Technology, 1968.

[7] O'Connor, J. J. "The Gallery: Art Meets Science." *The Wall Street Journal*. New York: 1966.

[8] Snyderman, N. "Mixing Technology with the Arts." *Electronic News*: 4 (1966).

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