Visual Resources

ISSN: 0197-3762 (Print) 1477-2809 (Online) Journal homepage: www.tandfonline.com/journals/gvir20

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To cite this article: Diane Kirkpatrick (2006) Sonia Landy Sheridan and the Evolution of Her Generative Systems Program, Visual Resources, 22:4, 343-361, DOI: 10.1080/01973760601010325

To link to this article: https://doi.org/10.1080/01973760601010325

Published online: 04 Jan 2011.

Visual Resources
Vol. XXII, No. 4, December 2006, pp. 343–361

Routledge
Taylor & Francis Group

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Diane Kirkpatrick

In 1970, the School of the Art Institute of Chicago added a new course of study to its curriculum. Sonia Landy Sheridan created this program (initially called "Energy Bank," and soon renamed "Generative Systems") as a learning environment in which students explored the processes and tools of new technology within a matrix of ideas about the nature of art and of science, and about the roles of each in society. The Generative Systems program occupies a distinctive place in the yeasty response of artist-educators to the burgeoning availability of enticing new tools from science and industry during the 1960s and 1970s. This article traces Sheridan's artistic journey to, through and beyond the decade when she headed the program.

Keywords: Copy machine art; Computer graphics; Art and science; Artist and society; Sheridan, Sonia Landy, 1925–; Generative Systems

> **The principal art of the teacher is to awaken joy in creation and knowledge.**
> (Albert Einstein)

In 1970, the School of the Art Institute of Chicago added a new course of study to its curriculum. Sonia Landy Sheridan created this program (initially called "Energy Bank," and soon renamed "Generative Systems") as a learning environment in which students explored the processes and tools of new technology within a matrix of ideas about the nature of art and of science, and about the roles of each in society.[1] Sheridan designed the program to encourage exploration into the expressive possibilities of the newest "communication tools," especially recently invented copy-machines, including 3M's Thermo-Fax and Color-In-Color.

Sheridan and her students carried out investigative research into the operations of the individual processes used in making copies within each system (heat, electrostatics, light, etc.). This was training not in the individual techniques of any

ISSN 0197-3762 (print)
DOI: 10.1080/01973760601010325

particular machine, but for developing a method for approaching and mastering future tools that might appear from industry. The Generative Systems program occupies a distinctive place in the yeasty response of artist-educators to the burgeoning availability of enticing new tools from science and industry during the 1960s and 1970s. This dynamic activity quietly challenged C. P. Snow's much-ballyhooed 1959 assertion of a seismic intellectual and cultural split between the "two cultures" of art and science.[2]

In retrospect, Sheridan had been preparing all her life to create a program like Generative Systems. She joined the faculty of the School of the Art Institute of Chicago (SAIC) in the early 1960s. To her new position she brought beliefs about connections between creativity in art and science, and about the role of the artist in society. The daughter of Avrom Mendel Landy and Goldie Hanon Landy, who devoted their lives to providing education for the working class, Sonia grew up in Cleveland, Ohio, and New York City. Her memories of childhood focus on the warmth of supportive elders who understood and encouraged her ambitions, while instilling in her a deep underlying goal to serve humankind:

> As far back as I can remember ... I was taught the artist had the most choice role to play in society. ... I was encouraged to draw, paint, act, sing, speak other languages. ... Every choice I've made has been governed by this early training, which emphasized the richness of man's heritage ... and made no fundamental distinction between scientists and artists. ... My family also taught me to be critical of your country if you loved it and that meant positive criticism—to try to make it a better society.[3]

After earning a BA degree at Hunter College, she worked briefly as a commercial artist and a social worker before marrying historian James (Jim) Edward Sheridan. She traveled with him to Illinois (where she did graduate study in art at the University of Illinois), then to France, before the family settled for a time in the San Francisco Bay area in California.[4] There, she taught in the public schools, drawing inspiration for her approach from Viktor Lowenfeld's ideas in books like *Creative and Mental Growth*, which argued that education is the civilizing, humanizing and socializing factor in any culture, and that art activities are a crucial part of education.[5] Lowenfeld also stressed the model of the educator serving students by inducing in them spiritual, mental, emotional and even physical growth. Inspired, Sonia created exercises that helped her California high-school students use their talents to design printed fabric for clothing, simple ceramic jewelry and tableware that could personalize and enhance their environments. Always interested in science, she had another group of art students doing medical illustration in collaboration with biology teacher John Urton's student research into cancer in rats.

The California years were interrupted by a two-and-a-half year stay in Taiwan for husband Jim Sheridan's research into Chinese History. During part of this time, Sonia studied Japanese woodcut printmaking with a master in Japan. Back in California, she completed an MFA at California College of Arts and Crafts in Oakland (1961), while teaching at the school. Her teaching now drew on some of Arthur Koestler's ideas on creativity, especially on his attempts to draw parallels between the

way both scientists and artists create.[6] Sheridan was contentedly mentoring her art students at this school when husband Jim Sheridan accepted a teaching position at Northwestern University, and the family relocated to Illinois. After a brief stint teaching in public schools in the Chicago area, Sonia moved to SAIC, where, initially, she taught Beginning Drawing and Color.

For Sheridan, art-making and teaching were interwoven. Ideas from her personal art always informed her teaching, and things gleaned from interaction with her students enriched her own creative activity. During the early years in California and in Chicago, Sonia Landy Sheridan's work most often captured scenes of family and home life, or scenes from the environment around her. Sometimes her students were her subjects, and sometimes she produced satiric visual comments on social inequities or injustice. The work was figurative, often with an expressionist bent. At first, in Chicago, this approach continued, but gradually the work opened out in new directions. Increasingly, drawings that reflected an inner vision appeared in the stream of satirical works that reflected the artist's skeptical view of aspects of Chicago life and politics. The new images seemed drawn from the deeper strata of her consciousness: Sheridan named them "Inner Landscapes."

Many of these drawings reflect inspiration from nature and science. Others express the artist's interest in transformation of form through time, and her growing fascination with time itself—its nature, its shaping of human perception and the challenge of representing visually our existence within time. In her Inner Landscape image, *The Red Curtain: Two Sides of Time Series*, 1964 (Figure 1), Sheridan presents a hallucinatory world, where a red curtain mouth opens to reveal a transparent clock face, with reversible numbers, through which we see an ocean stretching into the distance. The world in this image is not static. Our position as viewer shifts as we look.

In her classes, Sheridan shared insights and techniques from her work with students through lessons and bibliographies of recommended readings. Sheridan based many of her exercises for her Basic Drawing course on Kimon Nicolaides's *The Natural Way to Draw*, and assigned her Color students problems like those Johannes Itten had developed for his basic course at the German Bauhaus.[7] In 1964, Sheridan exchanged her Color class for one in 2-D Design. Finding no books that suited her needs, she "took the basic attitudes of the Bauhaus and reshaped them in terms of my own experience." One goal of her course was to have students explore the expressive content possible in non-objective art. She provided illustrations of non-Western art, like pictographic shapes on a Babylonian tablet, to remind the students that there have been many kinds of two-dimensional spatial order in the world's art. Then she set her students to investigate arrangements of color values and hues, inspired by Paul Klee, *The Thinking Eye*, which argued that the dynamic balance of opposites gives vitality in art as in nature and that the artist must ferret out the secrets of how forms come into being through metamorphic forces that produce the final entity.[8]

These ideas paralleled Sheridan's fascination with metamorphosis and the nature of change in time. She investigated processes of transformation in a suite of monoprints by creating a design on a litho plate and printing it on her press. Instead

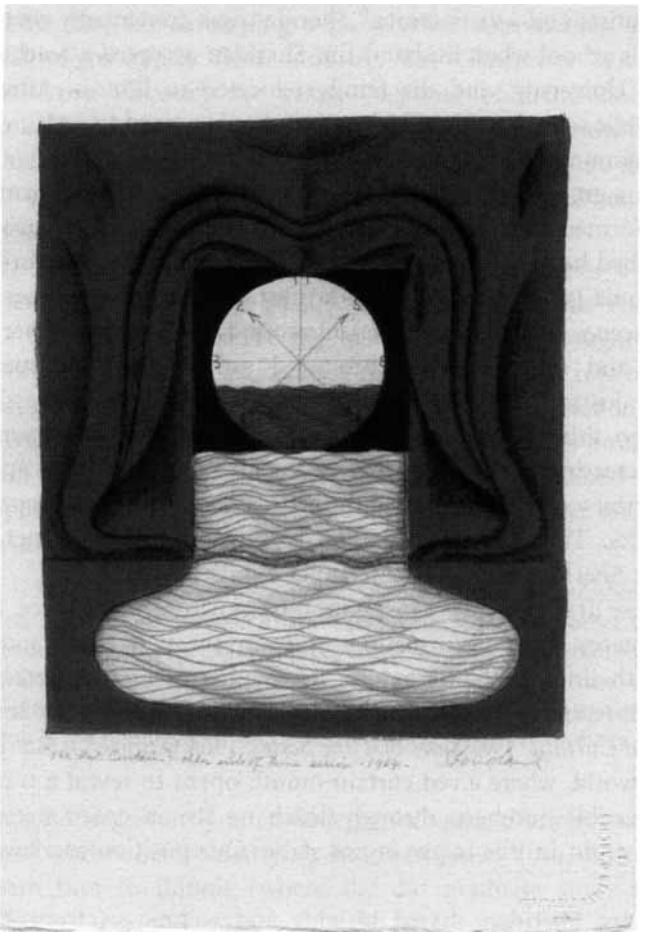

Figure 1 '*The Red Curtain*,' *The Other Side of Time series*, 1964. Ink and graphite on paper. Hood Museum of Art, Dartmouth College. Gift of the artist.

of cleaning the plate for a new work, she used the shadowy remnant of the first image as the starting point for a second print, then the second print's remnant as genesis of a third and so on, until the pressures of intuitive inspiration were exhausted, leaving the prints as records of serial compositional metamorphosis. This approach was linked to surrealist practice, which Sheridan first met at Hunter College through surrealist poetry. In Chicago, her interest in surrealist ideas and practice were reawakened by Aatis Lillstrom, first a student and later an Art Institute colleague, who introduced Sheridan to the surrealist vector that had been an important part of the Chicago art scene since the 1940s. In class exercises, Sheridan had her students explore metamorphosis in a multipart exercise that began with them transforming basic paper shapes, either cutting into one to open it out, or folding one down into itself to make a new shape. The students then made crayon or graphite rubbings of the relief shapes and grouped these into compositions that highlighted transformative change.

Early in 1965, Sheridan's scientific interests were sharpened by a television series on physics. She filled pages in her notebooks from this period with selective notes, diagrams and drawings about the nature of scientific research and theories of motion and energy. Some of her excitement entered the Understanding Art class she taught that year for the evening program at Northwestern University. Textbooks for the Northwestern course were Bates Lowry's *The Visual Experience* and Herbert Read's *The Meaning of Art.*[9] In class, Sheridan talked about contemporary art using an opaque projector and two piles of 8½ × 11 inch cards covered with images taken from a variety of mass media sources, with one set taken from art and the other from science. These she used to make students think about the nature of artistic creation: "I put the two packs of pictures side by side, in some sort of chronological order, and I asked the students to tell me which was the art and which was science." One "practicing art" exercise for the course explored metamorphosis. Each student began with a kneaded eraser, a stamp pad, a group of small found-objects and some sheets of dittoed grids, each containing nine empty boxes. Each person created a composition that suggested shape-shifts by filling the grid boxes with collections of ink-stamped records of selected objects and of pinched and reshaped eraser forms.

During this time, Sheridan was also preparing for her 1966–1967 SAIC travel grant to accompany Jim Sheridan on a research leave in Taiwan. Increasingly interested in the interaction of opposites, the yin-yang symbol held special meaning for her: "I was always using opposites: organic-inorganic, male-female, natural-unnatural. The balance of opposites is the key to everything." Sheridan increasingly used the grid as an underlying armature in her work at this time, and introduced metamorphosis into her grid-based paintings by constructing them with permutable parts that could be reassembled in different pattern combinations. Many of Sheridan's works from these years incorporated a geometric interlocking form related to mathematical tiling and chose-packing found in honeycombs or in Buckminster Fuller's geodesic domes. The inspiration for Sheridan's works was a series of interlocked block-Y's recorded in a July 1966 notebook sketch, with the accompanying note: "Yüan Dynasty cave mural. Pattern on horse's saddle. Metropolitan Museum of Art." Each block-Y was constructed from three L-shapes, positioned so that their backs interlocked. Coloration of the planes created the effect of oscillation between strong three-dimensional perspective and flat design, foreshadowing both Josef Albers' "flip-flop" compositions and 1960s Op Art. The Chinese Y-shape appealed to Sheridan as a compellingly appropriate symbol for herself. In her work, she used Y's to indicate flow, growth and flowering. Major lines in her left palm make a Y. Y is the initial letter for the female symbol in Tantra art, the Yoni. And Y's formed the female part of chromosome pairs in early 1960s notebook works.

During the 1966–1967 period in Taiwan, a deep friendship ripened by mail between Sheridan and former student, Keith Smith, who sent her supplies and news from home and initiated an exchange of ideas about art that would become very important to her in the years ahead. Throughout the time of their close association, which culminated in 1974 with a joint exhibition at the Museum of Modern Art, New

York, Smith served as an invaluable sounding board for Sheridan's concepts and acted as a perceptive and valued appreciator of her art.

On her return from Taiwan, Sheridan began teaching printmaking full-time at SAIC. At first she shared her rich experience of "traditional media"—etching, lithography and woodcut. Soon, she and her students transferred their energies to silkscreen—a medium rapidly adopted from commercial use for its ability to absorb content from mass media and its ability to make huge numbers of copies cheaply and with little loss of quality. Typically, Sheridan sought help from a technical expert, Melvin E. Green, President of Chicago's Advance Process Supply Company, a leading local screen-printing firm. The support of his company helped generate many of the interactive group projects Sheridan organized at SAIC, culminating in 1968–1970 with the creation of *Screenprint '70*: a portfolio in a box, with prints by students and other invited artists, plus an interactively produced double LP record.

The production years of *Screenprint '70* coincided with deepening political ferment in the nation, and at SAIC. By 1969, artists around the world were using mail-art as an alternative gallery system to help "democratize" art. Mail-artists produced a wide variety of low-cost, unpretentious, small-scale "original" or "multiple" art works designed to disseminate an anti-elitist aesthetic via the postal service. Images were variously witty, shocking and politically responsive to the turmoil of the late 1960s. Unaware of the burgeoning mail-art activities elsewhere, Sheridan and her students initiated their own version of correspondence art. The ground was paved by Sheridan's interactive *Portable Postcard Exhibition*, published in 1969: a mailable mini-gallery containing postcard reproductions of art works by thirty-one SAIC students and faculty. The "exhibition" items were in alphabetical order, from Harold Allen's composite photograph to James Zanzi's blueprint image. The Inner Landscape drawing that Sheridan chose to represent herself at number 26 was part of *The Y in the Landscape* series she produced as one effort to focus attention on creative activity during a 1968–1969 student strike. Conceived as a daily newspaper during the strike, Sheridan recreated special Inner Landscape line drawings on large screen-printing linen or on Hi-Filon, and printed many copies for each day's free distribution.

All this activity inspired additional image-sharing. In her search for a faster imaging system, Sheridan turned to a Xerox machine SAIC had acquired for "business use." Copy machines developed into viable reproduction tools for business during the 1950s. Two companies took the lead: 3M and Xerox Corporation.[10] Each found a different process to "duplicate" the dark-light patterns in a document. The evolution of 3M's Thermo-Fax began during the early 1940s, when a young 3M scientist, Carl Miller, won company support to develop for commercial use the copy process he had already patented and named "thermography" (from Greek for "writing with heat"). The process placed the sheet to be copied together with a sheet of heat-sensitive paper on the machine's imaging platen and exposed the two sheets to radiation, which was absorbed most intensely in the darkest areas of the subject, transmitting the heat to the heat-sensitive print surface and making a copy of the light-dark patterns of the original.

The Xerox story began in 1939 when American inventor and patent attorney Chester Carlson patented an electrostatic copy process as a quicker way of making multiple copies than the more costly mimeograph machine.[11] He called the process "Xerography" from the Greek for "dry writing." The Xerox process involved creating an electrostatic charge on a selenium-coated metal surface, which was exposed to light that reflected from a document and struck the charged plate most strongly in areas lightest in the original. A special toner powder was cascaded over the surface of the plate and stuck to those areas still electrostatically charged (the dark areas of the original). The toner-powder "image" was transferred to a lightly "charged" piece of paper and fused to it with heat to make the final copy.

3M got to market first, introducing a Thermo-Fax machine in 1950 (a desk-top model followed in 1955). The technology was early adopted by the Central Intelligence Agency, Dow Chemical Corporation and the New York Public Library to help cope with their massive need for document copying. Haloid-Xerox research scientist Robert Gundlach developed Carlson's Xerography into a commercially viable process. The commercial Xerography machine was introduced to the general public in 1960, initiating the slow displacement of the Thermo-Fax process.

Sheridan's use of the SAIC Xerox machine in 1969 was her first encounter with true high-speed imaging. It fed her long search for ways to follow more swiftly the serial metamorphosis of an image, as well as her desire for mass reproduction and distribution of ideas. She and her student Michael Schumacher began to discuss how the Xerox machine could join their struggle to undermine society's monetary attitude toward ideas: "We wanted to open up the system and pass out ideas free. ... We started making copies of selected ideas and sending them out to people in all kinds of colleges. ... We supplied our own paper for the Xerox machine and copied ideas by the droves." The noticeable increase in machine activity and its attendant operating cost caused a notice to appear on the machine banning its use by students. As copy numbers continued to burgeon, with Sheridan making copies for herself *and* the students, a sign appeared specifically barring Sheridan from using the machine.

When SAIC cut off access to their machine, Sheridan was driven to search the city for a high-speed copy machine she could afford to purchase for her own use. The quest led her to a broken 3M Thermo-Fax machine she found in an Evanston, Illinois, typewriter store. The owner sold it to her for US$20. She took it to a now defunct 3M office in neighboring Wilmette to get it repaired and to find out how it worked. The 3M man, whose name regrettably has been lost, ran through a demonstration of the machine's capabilities, which left Sheridan bursting with ideas she wanted to try with the machine, which could make stencils, prints and transparencies in warm sepia-tones or in added color. Quickly she went beyond its intended use of copying flat documents to "image" her hand and small objects. She manipulated the specially coated paper outside the machine and created eerie images, using a hand iron to copy images placed face-to-face with sheets of Thermo-Fax paper, in a process she called "thermage."

Naturally Sheridan could not keep such a juicy tool for herself alone. She took her Thermo-Fax to SAIC's screen-printing area, where she and her students immediately

began to cover large blank gummed postcards with Thermo-Fax transformations of family photographs, newspaper pictures and other things that struck their fancies. They turned their invitation to participate in a print-making exhibition (in February 1970 at Southern Illinois University in Carbondale) into the *Mail-In Mail-Out* project. Chicago people paid twenty-five cents and entered their address on a Rolodex file. This joined the Thermo-Fax machine, an image bank and two mail bags—one IN and one OUT—at the SAIC end. Students, faculty, staff and interested parties prepared and mailed items from Chicago to Carbondale. Sheridan and two student assistants, Robert Frontier and William McCabe, organized the creation of mail ideas sent from Carbondale. At each end of the circuit, works were exhibited as they were received to complete the "Information Exchange" between the two schools.

Chicago artist and scholar Jack Burnham received some of Sheridan's mail-out work. At this time, Burnham was organizing his *Software* exhibition, to be sponsored by American Motors Corporation and held at the Jewish Museum in New York City in fall 1970, followed by a showing at the Smithsonian Institution in Washington, DC. Burnham invited Sheridan to do a workshop version of *Mail-In Mail-Out* for the Jewish Museum show, and she accepted. By the time the exhibition occurred, Sheridan was deeply involved with another copy machine technology—3M's Color-In-Color I, which she began exploring extensively in 1970. In fall of that year, she joined Dr. Douglas Dybvig (co-inventor of the system) and Don Conlin (project manager) in introducing Color-In-Color I to the public at Burnham's *Software* exhibition in fall 1970.

Color-In-Color I was the first copy machine system that could copy something in full color. Like the Xerox system, Color-In-Color I used electrostatics and heat to "record" an image on an Intermediate Roll inside the machine. 3M followed the physics of color to make three successive exposures of each subject using a blue, a green and a red filter in succession (the primary colors of white light). Each exposure in turn was recorded on the Intermediate Roll's photoconductive surface, which faced the imaging platen. Light from each "record" discharged areas of the photoconductive surface on the Intermediate Roll in spaces lightest in the original, leaving charged the areas corresponding to the darkest areas of the subject. Magnetic iron-oxide toner powder was showered across the photoconductive surface and stuck to the "darkest" areas. On the "back" of the Intermediate Roll were panels impregnated with cyan, magenta and yellow dye (the secondary colors of white light), positioned back-to-back with the photoconductive surface areas that recorded the blue, green and red images. Heat was applied to release and overprint onto paper the cyan, yellow or magenta dye images, making the full-color copy.[12]

Sheridan found Color-In-Color I a bewitchingly interactive high-speed technology because its operation allowed: "conceptualization of a complex order. Ideas can be generated at a previously impossible speed ... for every push of the button brings some fresh insight, some new vision."[13] Her work with this technology inspired the founding of her Generative Systems program at SAIC in fall 1970. Discussion of the program and Sheridan's role in it are the subject of two other articles in this issue:

"Generative Systems: Sonia Landy Sheridan as Artist/Master of the Machine" and "Generative Systems at the Art Institute of Chicago, 1970–1980."

An example of Sheridan's early experimental Color-In-Color I work is *The Magic Finger*, early 1970s (Figure 2), a self-portrait in which the artist's upraised hand is in full color, but her face is mostly in cyan, with mysterious "rays" of magenta and yellow streaming from the tip of her upright finger. This is not a "normal" Color-In-Color I image. Sheridan never managed to reproduce the effect in another. Some quirk of machine process created a one-off color effect, so the artist considered this print a gift of her interaction with the technology. Like Sheridan's other pioneering work on copy machines, this print is unique. Unlike the "normal" copy process in which a document could be left for the machine to copy again and again until the desired number was reached, here Sheridan was imaging her live self with the copier lid raised and replaced by a covering cloth to confine the machine's light rays to their imaging task. Trying to repeat the process for a duplicate inevitably introduced shifts in position, lighting, etc. so the new image would be different. The artist could make a copy of her print on the machine, but a copy would differ from the original because copying-the-copy loses some information on any copy-machine system.

Color-In-Color I was the core system in the early years of Generative Systems, which she described as: "not primarily equipment, machines, but an idea, an

Figure 2 *"The Magic Finger" (Self-portrait with Pointing Finger)*, 1970. Color-In-Color I on paper. Hood Museum of Art, Dartmouth College. Gift of the artist.

approach and a process that provides new dimensions to our continuing attempts to probe and express the emotional and intellectual lives of human beings."[14] Sheridan's ideas about the program shared ideals with Walter Gropius's German Bauhaus training, brought in 1937 to the New Bauhaus in Chicago by Hungarian-born artist-educator, László Moholy-Nagy.[15] Under Walter Gropius, the Bauhaus had aspired to prepare "total architects" (persons trained in the ideas and practice of art and new industrial technologies).[16] Gropius's ideas grew out of nineteenth-century aesthetic beliefs that prized architectural environments in which each element was designed as part of a harmonious whole (William Morris, Art Nouveau, Jugenstil).

Moholy-Nagy taught at the German Bauhaus, working independently as painter, printmaker, sculptor, photographer, graphic designer, set designer and movie-maker. For him, art was ultimately connected to a social purpose. He believed that every human had both natural creative talent and a desire to develop and express this. In Chicago, he wanted "to work out an educational principle which strives for the closest connection between art, science, and technology."[17] He described a "new vision," which modern men and women must develop in order to live fully and creatively in a modern world, now understood to be governed by the "new relativity" of "time-space," as articulated by Albert Einstein. Above all, Moholy-Nagy believed that: "The problem of our generation is to bring the intellectual and emotional, the social and technological components into balanced play; to learn to see and feel them in relationship." Modern humans must develop "vision in motion ... seeing, feeling and thinking in relationship and not as a series of isolated phenomena."[18] These ideas resonated strongly with Sheridan as she built her Generative Systems program.

By the 1960s, the dream shared by Sheridan and Moholy-Nagy of the artist as creative social agent had been enriched by an expanding awareness of our planet as a living whole, which linked Norbert Wiener's cybernetic model of dynamic systems that changed continually in response to "feedback" from external environments to Buckminster Fuller's vision of "Spaceship Earth" and Marshall McLuhan's "Global Village." All urged a new consciousness of individual responsibility for the health of the living earth and its future. Artists responded with a variety of strategies aimed at breaking down commercial and cultural barriers between art and life. Practice included performance events with both higher and lower technological components. In New York City in 1966, Robert Rauschenberg and Bell Labs engineer Billy Klüver, organized *9 Evenings: Theatre and Engineering*, a series of varied performances created by artist-scientist teams and held at the 69th Street Armory in New York City, and soon after founded Experiments in Art and Technology (EAT) to link artists and engineers in new projects.[19] Separately, in 1967, Maurice Tuchman founded the Art and Technology program at the Los Angeles Country Art Museum (LACMA) to partner artists with technical experts in industry.[20] Also in 1967, Gyorgy Kepes (a former colleague of Moholy-Nagy) founded the Center for Advanced Visual Studies (CAVS) at Massachusetts Institute of Technology (MIT) as a research lab for collaborative work by artists and scientists.[21] Exhibitions like Jack Burnham's 1970 *Software* show showcased results of art-science collaborations.

Late in 1971, Dybvig and Conlin introduced Sheridan to a new system—Color-In-Color II—in a workshop the three were running at Nathan Lyons's Visual Studies Workshop in Rochester, New York. The new system produced color print enlargements from 8mm, 16mm, 35mm or 2×2 inch transparencies. Sheridan immediately wanted to generate giant works from images created on a Color-In-Color I machine. She made a Color-In-Color I self-portrait and copied the print on transparency material. Over the surface of the original paper print, she laid a white grid, numbering each of the squares in consecutive order. She placed the transparency print over the gridded paper print and lightly marked the grid borders. Using these as guide, Sheridan cut the transparency into sections, which she mounted in 35mm slide mounts. Each slide was placed in turn in the Color-In-Color II machine and enlarged. Using the original gridded image as a reference, the enlarged pieces were reassembled into a huge new work (Figure 3). This triggered memories of a never-realized 1965 project in which sections of a large nude figure would have covered the ceiling and two side walls of a room. Now Sheridan wanted to create a giant male nude. Her ex-student and friend Keith Smith was helping with the Rochester workshop. He and Dybvig were as excited as she was over the project and agreed to help. Generative Systems student, Ric Puls, volunteered as subject and the results were the three huge "man-scans" shown in *Projects: Sonia Sheridan and Keith Smith* at the Museum of Modern Art in New York City in summer 1974.

Figure 3 Sonia Landy Sheridan videotaping installation of her *Energized Artscience* exhibition at the Museum of Science and Industry, Chicago, 1978, with large *Self Portrait*, 1971, Color-In-Color II, and two Color-In-Color I smaller related works behind her. Courtesy of the author.

In autumn 1972, the Color-In-Color I system disappeared from Generative Systems for several years. Sheridan personally owned the machine, but SAIC paid for maintenance. At the end of the 1971–1972 academic year, SAIC administration announced they would not continue to provide support funds for the Color-In-Color I system because the projected cost was proportionately too high for the number of students officially enrolled in the Generative Systems program. Without Color-In-Color I, Sheridan concentrated on having her students make images without machines, including creating works with separate Color-In-Color I dye sheets, using a hand iron to transfer iron-oxide-powder images from "used" Color-In-Color Intermediate Rolls to ceramic tiles and polyester fabric, making "thermage" images, and creating elegant Thermo-Fax artifacts by folding or punching holes in sheets of Thermo-Fax paper.

Sheridan also began to seek other technologies that might help fill the void left by Color-In-Color I's departure. In fall 1972, she rented two desktop Xerox 400 Telecopiers at the suggestion of her friend Stan Vanderbeek. In operation, the Telecopier system used a telephone receiver and the system itself, with its controls, paper supplies and a slot into which the operator fed the document to be transmitted.[22] In sending mode, the document passed around a drum in front of a scanning light and lens system, which converted the pattern of light waves from the subject into a pattern of sound waves that could be carried over telephone lines. When the machine was set to receive data, the transmitted sound was transformed back into a pattern of light, which activated a needle to "draw" an image on the system's paper. Initially Sheridan and her students sent information back and forth between one machine at SAIC and the other in Sheridan's home studio. The artist and her students were soon experimenting with non-usual ways of utilizing the equipment. They stretched images in a number of ways by altering various parts of the operation, like manipulating the imaging needle to lengthen or delay the transmission. Soon Generative Systems established "Inter-university Tele-linkup," an inter-city conference-call hook-up that exchanged information between SAIC, Wes Thomas of the Committee for the Future, former student Leif Brush and his students at the University of Iowa, Stan Vanderbeek and his students at the University of South Florida, Willard VanderBogart at the University of Pittsburgh, and Tom Willlis at *The Chicago Tribune.*

In 1973, Sheridan found a piece of Xerox equipment in a government surplus store and bought it for US$35. She took it to a Xerox center to find out what she had. There, Ed Kobs identified the Processor Unit for a Haloid Xerox process camera system. To make images, she would also need the camera and the fuser. Kobs located a used Model 4 Camera and Vapor Fuser for her, and Sheridan set to work. This Haloid Xerox system recalled the operation of early studio cameras in many ways. Haloid Xerox images began with selenium-coated Xerographic plates, which were placed in a plate holder and given an electrostatic charge in the Processor Unit. A dark slide was inserted to protect the plate from light and the plate holder was placed in the upright camera, facing a copy board illuminated by four swivel-mounted photo-floods. By lowering the copy board, one could make images from live subjects

placed in the vacated space. After exposure, the plate was developed in a method similar to that in other Xerox processes, but the toner-powder image was fused to the print paper by chemical vapor. Many of Sheridan's early Haloid Xerox works were portraits. To some she added touches of color by hand. Sheridan produced images that variously resembled soft-grained solarized photographs, delicate charcoal drawings or soft-focus photo-lithographs. She also experimented with capturing a subject "through itself in time," creating double or triple overprints by using white fabric or paper to block light from darkening "unused" parts of the image frame during successive exposures.

Late in 1974, Sheridan acquired another system—3M's VQC I, a thermal electrostatic desk-top machine. She found the new system so intuitively interactive that it allowed her to infuse her VQC I work with the free flow of fantasy and fact that inspired her Inner Landscapes work. As with those hand-drawn works, she created most of her best VQC I images at night. Sheridan rapidly discovered the delights of making double and triple exposure VQC I prints, exploiting the ongoing sensitivity to strong light of VQC paper by using a white cloth to cover "unused" areas during successive exposures on a sheet that was fed back into the machine after each "pass," during which an additional subject was positioned in what was a white part of the earlier exposure (see "Sonia Landy Sheridan as Artist/Master of the Machine" in this issue: Figure 2 *Sonia In Time—In Motion—In Time—One Minute Apart* and Figure 4 *Conversation: Student & Sonia*).

Convinced that the artist-scientist must systematically explore the potential of machine technology, Sheridan won grant support for extended periods of research time free from teaching. In 1974–1975, a grant from the Union of Independent Colleges of Art supported her "People's Fabric Project," which explored using Color-In-Color I machines to make personalized fabrics. In 1976, a National Endowment for the Arts "Public Media" grant enabled her to return to 3M for a second stint as Artist-in-Residence. The Color-In-Color I works that Sheridan produced during this stay are some of the most sumptuous color images in art; richest of all are her images with flowers, leaves and weeds.

In fall 1976, Sheridan returned to Chicago and her Generative Systems program, sharing techniques and insights gained during her leave. In the late 1970s, one of Sheridan's students, John Dunn, built a Zenith kit computer for Generative Systems' first serious computer course. Dunn is a composer, who taught himself about computers, seeking tools for his music. By this time, computers had become powerful tools for many artist-scientists.[23] In 1959, American computer-animation pioneer and composer John Whitney had constructed a mechanical analog computer from surplus machinery from an M-5 Antiaircraft Gun Director, and generated a series of "drawings" that became frames of a black-and-white movie, the first of a series of pioneering and path-breaking computer-animated films. In 1968, curator Jasia Reichardt drew attention to computer graphics as art in her exhibition *Cybernetic Serendipity: the Computer and the Arts* at the Institute of Contemporary Art (ICA) in London. Meanwhile, computer science programs arose, some training both artists and scientists.

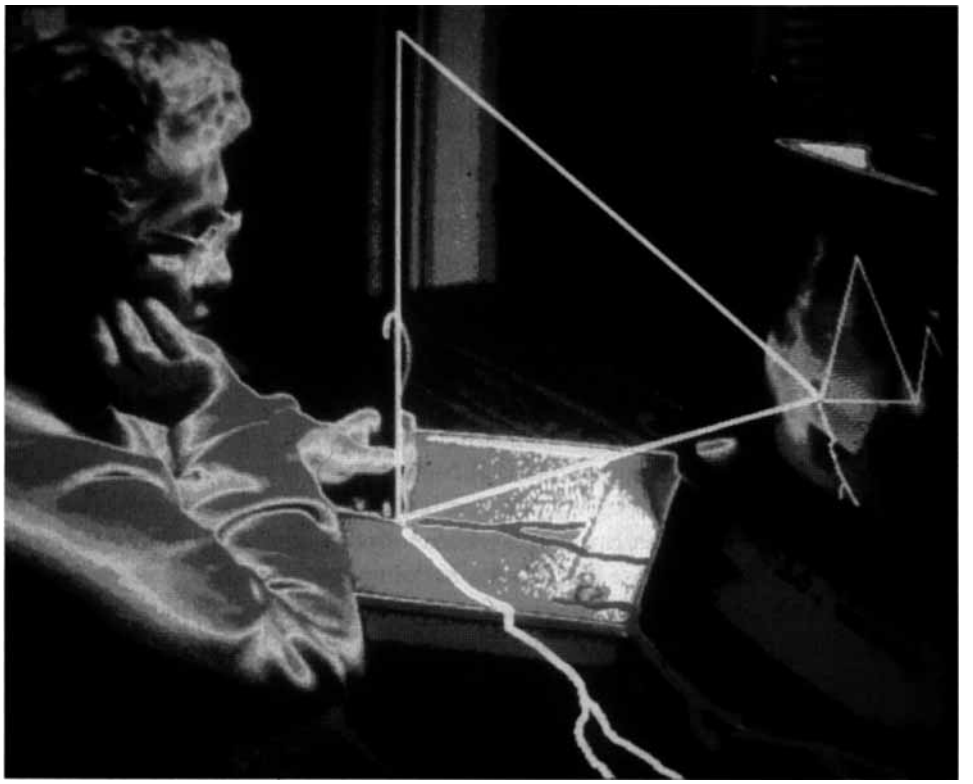

Figure 4 *Drawing in Time*, 1982. EASEL 4 software on Cromemco Z-2D computer. Courtesy of Sonia Landy Sheridan.

Among the students in the pioneering program at Ohio State University (OSU) was Tom DeFanti, who created a programming language, Graphics Symbiosis System (GRASS), for his PhD.[24] This he took with him when he joined the engineering faculty of the University of Illinois at Chicago (UIC) in 1973. There DeFanti met Dan Sandin, who had come to the art department at UIC in 1971 with an MS in physics plus art study at the University of Wisconsin, where he had become interested in portable video technology. Sandin had built an Image Processor (IP) from commonly available parts, using an array of modules, to colorize and otherwise manipulate incoming black-and-white video signals *in real-time.* Sandin made the design available free to all comers.[25] At SAIC, he partnered with DeFanti to create a program that helped students use video and computer tools in time-arts, including the presentation of Electronic Visualization Events (EVEs), which combined live performance with modulated images produced with the IP. SAIC video professor Phil Morton participated in some EVEs at UIC, and built an IP for his classes.

Sheridan's leadership of her Generative Systems program ended with her retirement from SAIC in 1980. The legacy of the program lives on in the activities of many of her students. Some have carried her ideals into teaching programs of their

own. Others have invented new technologies. Sheridan's teaching did not cease with her retirement, simply moving sideways into her involvement with intensive workshops that continue to share with students her enthusiasm, insights and experience with new technologies.

By the time of her retirement, John Dunn had developed his first computer graphic paint program (DAZZLER), whose operating characteristics were inspired in part by the way he knew Sheridan liked to work when she made her Inner Landscape paintings and drawings, and in part inspired by seeing the Sandin IP in action in Phil Morton's video space just down the corridor from Sheridan's Generative Systems room. In short order, DAZZLER became SLIDE MASTER, then EASEL 4, and finally LUMENA. Sheridan loved EASEL 4—a DOS program that ran on a Cromemco Z-2D mid-size computer. It let the artist capture a frame from a basic black-and-white video surveillance camera and manipulate its appearance using a stylus on a graphic tablet. Sheridan could add color, create distortions, alter contrast, create positive and

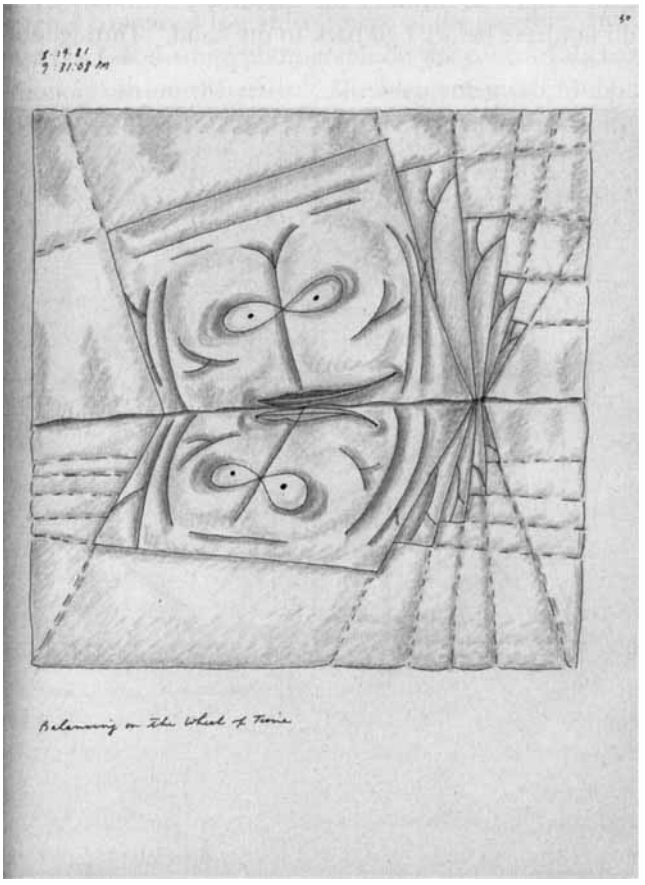

Figure 5 *Balancing on the Wheel of Time*, 1981. Ink and mixed media. Courtesy of Sonia Landy Sheridan.

negative effects, and combine the results, all in virtual real-time, viewing the images on a monitor. They were then saved as computer files and/or captured with a film camera on a tripod to create paper-based images for exhibitions.[26]

In the early 1980s, Sheridan spent long hours working in the heady environment of Dunn's imaging tools, drawing on the interests and experiences of a lifetime to create innovative images from glowing light. *Drawing in Time*, 1982 (Figure 4), is simultaneously a representative image from this period and a depiction of Sheridan at work with the new technology. In the years since, she has exhibited her computer work widely, including in the seminal *Electra: Electricity and Electronics in Twentieth-century Art*, mounted at Musée d'art moderne de la Ville de Paris (MAM de Paris), 10 December– 5 February 1984, where Sheridan was one of the artists-in-residence who provided demonstrations and quasi-workshops for visitors to the extended exhibit.

All through her career, Sheridan took insights from her work with machines into her Inner Landscapes, saying: "I want to go through the machine and out, coming back to the hand. I can't do without the machines, because they keep giving me information I do not have before I go back to my hand." Throughout the 1970s and

Figure 6 *Hattula and Moholy*, 1986. LUMENA software on IBM PCAT. Hood Museum of Art, Dartmouth College. Gift of the artist.

early 1980s, many of the Inner Landscape images filling her notebooks were complex images of time, like that in *Balancing on the Wheel of Time*, 1981(Figure 5). Time now has many shapes: transparent plane, foldable sheet of fabric or paper and a series of time-plane cards revolving on a Rolodex. The cards have "faces," with symbols linked to the artist. Here, infinity-loop eyes reference a Möbius strip, which Sheridan used as a model for the Generative Systems process. Y-shapes, long a Sheridan self-symbol, cross the cheeks and mark the borders. Time in this vision is eternally in motion through more than three dimensions in a concept deepened from that in her 1964 *The Red Curtain* through Sheridan's long hours spent capturing images on her machines.

In 1986, Sheridan brought her Generative Systems years and her post-program creative energy together. At her home studio in Evanston, she used John Dunn's LUMENA program to invent an image in homage to László Moholy-Nagy during a visit by the Hungarian artist's daughter, Hattula. Moholy-Nagy had died when Hattula was 12. In 1986, Hattula was approximately the same age her father had been when he died. Now father and adult daughter were united in *Hattula and Moholy* (Figure 6) through a combined live video image of the daughter and a video shot of the father from a black-and-white photograph on the cover of Richard Kostelanetz's documentary monograph on the artist.[27] Sheridan enhanced Moholy-Nagy's image with color and stretched the result "in time" behind his daughter—a fitting emblem of the continuity and community of both family and artistic generations.

Notes

[1] Most information on the Generative Systems program and on the work and ideas of Sonia Landy Sheridan comes from the author's unpublished monograph, "Patterns in the Flow: The Amazing Work and Ideas of Sonia Landy Sheridan," from materials in the artist's personal files and from material gathered in a series of interviews with the artist carried out by the author of this article beginning in the 1970s and continuing into 2005.

[2] The art-science activity extended throughout much of North America and Europe, with many pockets elsewhere. Snow may have been correct in decrying the mutual ignorance of each other's fields present in the majority of theoretical scientists and denizens of literature and "high art." However, he ignored the energetic dialogue taking place between applied scientists, who were inventing new technologies for industry, and young artists, who eagerly sought to explore these technologies for their own work.

[3] Sonia Landy Sheridan, unpublished 1973 manuscript.

[4] Son Jamy Sheridan, now an artist himself, was born in 1948 in Illinois.

[5] Lowenfeld, a popular educator in the late 1940s and 1950s, incorporated the visual arts into his ideas about education. Viktor Lowenfeld, *Creative and Mental Growth* (New York: Macmillan, 1947), republished in 1952 and 1957.

[6] Koestler published his ideas in book form in 1964 as: Arthur Koestler (*The Act of Creation.* London: Hutchinson, republished in 1976).

[7] Kimon Nicolaides, *The Natural Way to Draw* (Boston, MA: Houghton, Mifflin, 1941); Johannes Itten, *The Art of Color: The Subjective Experience and Objective Rationale of Color.* Trans. Ernst von Haeger (New York: Van Nostrand Reinhold, 1961). Itten's book was the text for the Color class as well.

[8] Paul Klee, *The Thinking Eye*, Ed. Jürg Spiller. Trans. by Ralph Manheim (New York: George Wittenborn, 1961).

[9] Bates Lowry, *The Visual Experience: An Introduction to Art* (Englewood Cliffs, NJ: Prentice Hall, 1961); Herbert Read, *The Meaning of Art* (Baltimore, MD: Penguin Books, 1959, first published in 1931).

[10] A special report published in 1964 summarizes the history of this search from its beginnings near the birth of photography through the wet-process duplicating systems of the first half of the twentieth century to the development of modern dry-process copy-systems. "The Revolution in Office Copying: Special Report." *Chemical and Engineering News*, Pt. I (13 July 1964), 114–129; Pt. II (20 July 1964): 84–96. Additional information on the Thermo-Fax process comes from a conversation of the author with Carl Miller, and from discussions with Sonia Landy Sheridan.

[11] Information on Xerox copy machines is taken from the Special Report cited in the previous footnote, from John H. Dessauer and H.E. Clark, eds., *Xerography and Related Processes.* (London/New York: Focal Press, 1965), and from two Xerox Corporation publications: "Operating Instructions: Standard Xerographic Master-Making Equipment" and "Standard Xerox and 1218 Copying Equipment Service Manual." The Xerox Corporation website includes an extensive timeline of the company's history.

[12] Information on Color-In-Color operation is based on *Color-In-Color Customer Operating Instruction Model 133787* (St. Paul, MN: 3M, 1972).

[13] Sonia Landy Sheridan, "Generative Systems," *Afterimage* (April 1972): 2.

[14] Sheridan, "Generative Systems."

[15] The school later reopened with new patronage as the School of Design (now the Institute of Design). Moholy-Nagy headed the institute until his death in 1946.

[16] A key source on Gropius and the German Bauhaus is: *Bauhaus, 1919–1929*, H. Bayer, Walter Gropius and Ise Gropius eds. (New York: Museum of Modern Art, 1938). A more recent source for information on the relationship of the German Bauhaus to its American descendents is: *Albers and Moholy-Nagy: From the Bauhaus to the New World*, Achim Borchardt-Hume, ed. (London: Tate Modern, 2006).

[17] László Moholy-Nagy. *The New Vision 1928*, 4th rev ed and *Abstract of an Artist* (New York: George Wittenborn, 1947), 10.

[18] László Moholy-Nagy. *Vision in Motion*, (Chicago, IL: Paul Theobald, 1969), 12.

[19] Information on *9 Evenings*, Klüver and EAT include an interview with Klüver at: http://www.conceptlab.com/interviews/kluver.html, and Billy Klüver et al. *Pavilion.* (New York: Praeger, 1971).

[20] Maurice Tuchman. *A Report on the Art and Technology Program of the Los Angeles County Art Museum, 1967–1971* (Los Angeles, CA: LACMA, 1971).

[21] A summary report on Kepes and CAVS is on the MIT website at: http://web.mit.edu/newsoffice/2002/kepes-0116.html.

[22] Information on Telecopier operation is based on the operating booklet published by Xerox Corporation for the 400 Telecopier and on conversations with the artist.

[23] A timeline of the history of invention related to computer graphics is on the Ohio State University website at: http://accad.osu.edu/~waynec/history/timeline.html.

[24] The first computer department was established in 1965 at the University of Utah, with a computer graphic department added in 1968. Other programs followed. Information on Tom DeFanti, Dan Sandin and Phil Morton is based on interviews with the author in the mid-1970s in preparation for the "Chicago: The City and Its Artists, 1945–1978" exhibition at the University of Michigan Museum of Art, which the author guest curated. Further interviews with DeFanti and Sandin (and with John Dunn) were carried out for the author's "Recent Art, Science and Technology Interactions in Chicago." In *Making Waves: An Interactive Art/Science Exhibition, October–November 1986* (Evanston, IL: Evanston Art Center, 1986), 8–24.

[25] Sandin did specify that he should receive a share of any money earned if the adopter used the IP in for-profit endeavors.

[26] Sheridan adopted EASEL 4's successor, LUMENA, when it was available. It operated similarly, but was created to run on an IBM PC-AT. Dunn never redeveloped his programs for Microsoft Windows so the programs live on only in the amazing images created with their tools.

[27] Richard Kostelanetz, ed. *Moholy-Nagy* (New York: Praeger, 1970).