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## The Quiet Circus: The Colorful, Complicated, Slightly Schizophrenic, History of Early Computer Art at Bell Labs

Alexander Jenseth  
*Bard College*

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The Quiet Circus:  
The Colorful, Complicated, Slightly Schizophrenic History of Early  
Computer Art at Bell Labs



Senior Project submitted to the  
Division of The Arts  
of Bard College

by  
Alexander Jenseth

Annandale-on-Hudson, NY  
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Dedicated to my family and mentors for their tireless efforts in  
keeping me sane throughout my time in college

Also dedicated to all those who participated in the tremendous  
discoveries made at Bell Labs

And finally a special thanks to my three interview subjects, this  
project would have been next to nothing without their insights

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# Forward

## Computer Art?

Debates have traversed the centuries about what exactly defines art, the artist, and how each is to be analyzed or approached by a scholarly audience. For the entire history of what we refer to as “Art”, there existed a periodic confusion about *who* was creating the work of art; there was the individual who sought out a personal vision, perhaps a collaborative effort on the part of many creative people, or in some cases just a large group of strangers/friends/artists who worked in common. Andy Warhol was a prominent figure to really challenge the notion of authorship in art, creating a paradigm of detached ownership and responsibility for the work he is attributed with producing.

Not surprisingly, but purely circumstantial, there was a movement concurrent with Warhol, who himself could be considered a movement. In the late fifties and early sixties, away from the bohemian studios and art schools of New York City and other artistic hubs, scientists in large corporate research labs were discovering that a relatively new device was about to change the very basis for understanding art and the role of the artist. It seems a cliché to say that computers permanently changed society in ways that are still being discovered and theorized about. That being said, in the specific instance of art and computers, the post-digital age was one that turned previous accepted theories about art on their head and brought on a new generation of Computer Artists. But I will stop there for a

moment, as such a term like “Computer Artist” and even the simple sounding title of Computer Art are very unstable phenomena; this was the case when a handful of programmers from several spots throughout the world concurrently made the discovery of computer-generated images, and it remains the case today, although a great amount of thought has gone into the field subsequently.

What has been less thoroughly examined in this interesting and influential history is the story and facts of the early innovators who first coined the term Computer Art to begin with, and who were first to confront the question of what defines the new medium of computers, and how, if at all, the work essentially differs from previous ones. The story of these early innovators is a fascinating one, full of heady philosophical questions, as well as petty rivalries, men and women who would go on to become some of the most famous artists of their day, and others who would fade into the backlogs of the movement. In any case, each person played a role and the work and creativity of everyone involved must not be overlooked, despite the exact nature or relevance of the particular person’s role in the history.

After all, the thought of a machine that can recreate an infinite number of ‘perfect’ copies of an image, including an existing work of art is a phenomena as radical as they come. If one can take, to use a famous example that will be discussed further, Lillian Schwartz’s *Leonardo*, which, through the use of computers, creates a split image of DaVinci’s self portrait and his *Mona Lisa*, creating the sense of the two sharing a common physicality; in doing so Schwartz is appropriating (or re-appropriating) the two works in question for use on a computer to the end of

making a work of Computer Art. Already we have encountered several important areas of inquiry.

Is this a new work of art if it just reuses two previous ones? (this question has been dealt with outside the realm of computer art, as it were, such as certain works by Duchamp etc. that question ownership and authenticity, I suppose the difference being that with computer art, those questions are built into the medium itself, whereas with an example like the *Mona Lisa* with the Mustache dealy, both the “original” and re-appropriation are man made through and through, despite the very arguable question of whether or not such a work is art). Thus, a work like *Leonardo* raises the issue of authenticity and originality as it would if Lillian Schwartz had simply repainted/redrawn both works and then combined them, but then adds a bizarre second layer of discourse regarding the composition or reproduction of the images by a computer, and what that says about its authenticity and its status.

Further complicating the question of whether a computer-generated reproduction of the *Mona Lisa* is authentic or is still the *Mona Lisa* in any real sense, there is the question of who (or what) created this ostensibly “new” image. If the image is essentially a series of digits put together in a series of algorithms to form pixels of a certain color at a certain point on the screen to then make a cyber-*Mona Lisa*, is it still her? The question of mediation, especially mediation of the instruments, has been a crucial to theorizing creative expression, but here mediation takes on a whole new meaning. Not only was the expression moving from the brain of an individual having the thought and envisioning the final product,

but it was having to be inputted into a machine through the use of punch cards to then be calculated and rendered. This being the case, what role was the human playing?

Finally, there is the new question brought to light by the advent of computer-generated images and the films that were made from the images: who was the artist? In the early paradigm of Computer Art, several people were usually needed to render an image and make it into something that one would or could call “art”. This made for the immediate dichotomy of the artist and scientist, a fact that would haunt the medium for years to come, despite being the only reason computer art developed in the first place. As Ken Knowlton, one of the major figures to come out of the Bell Labs computer art scene, eloquently puts it:

[Artists and Programmers] are [both] creative, imaginative, intelligent, energetic, industrious, competitive and driven. But programmers, in my [vast world-embracing] (*not my addition*) experience, tend to be painstaking, logical, inhibited, cautious, restrained, defensive, methodical, and ritualistic. Their exterior actions are separated from their emotions by enough layers of logical defenses that they can always say "why" they did something. Artists, on the other hand, seem to be freer, alogical, intuitive, impulsive, implicit, perceptive, sensitive, and vulnerable. They often do things without being able to say why they do them, and one usually is polite enough not to ask. (Collaborations)

Although the first graphics and moving pictures to be created did indeed come from those working in the field of computer science and programming, it is arguably the artists who pushed it beyond the experimental phase. The way it worked with



collaboration was an artist would come to a programmer with an idea that may be uniquely suited to use of a computer. Once the idea had been plotted out, the programmer would then see to the actual creation of the images or sounds, depending on the “old media” that particular artist was working in. This made for a difficult scenario of pairing people from completely different worlds, with seemingly unrelated interests, for the purpose of both experimenting with a new technology and developing a new medium.

That being said, the experimentation and new discoveries in computer graphics/art became the shared interest of the research-scientist and the artist. This unique point in the history of computers, science, research, and art, made for a confluence of people and ideas that pushed the boundaries of computer technology.

The timeline of computer art is sketchy after going somewhat unnoticed for many years. A. Michael Noll, another major figure in the early days, refers to several different stages or periods within computer art, although it should be noted that he does so in the context of rebuking another pioneer in the field for the use of the term “pioneer” in a press release. Regardless, the timeline does make a great deal of sense and can be added to for the purposes of defining the stages computer art went through in its first years. Paraphrasing Noll, I would put the timeline as follows:

- **1961-1963** would be the “First Wave” of computer art, and I refer to this stage as the “Experimentation Phase”, defined largely by the scientific and research-oriented graphics/films at its center;
- **1964-1967** would be the “Second Wave”, an intermediary period in which Ken Knowlton made his first research films

and began research into perception using computer graphics. This period could also be thought of as the beginning of collaboration, as Knowlton first worked with his colleague Leon Harmon to create mosaics using computers (although their artist-scientist duality was a necessity for entering a show as opposed to a reflection of their respective abilities). It also marked the first major arrival of an artist at Bell Labs, Stan Vanderbeek, with whom Knowlton created a series of films.

- **1968-1972** would then be the “Third Wave” of the period. This was the period in which Lillian Schwartz arrived at Bell Labs, and also the period that marked the explosion of the medium, largely due to Schwartz’s contributions and ideas.

As I said, this timeline is rough at best, but is helpful for considering the controversy concerning the disputed categories of computer art and artist. Also worth mentioning is that by no means am I making any kind of value judgment in using the categories of first, second, and third; innovations occurred in all three periods and every person discussed here shares the credit for the advent of computer art.

The term computer graphics finds its origins at Boeing, one of the locations for early developments in the field. William A. Fetter coined the phrase in 1960 “to describe the new computer aided design” being used in their research. This involved, “animating the human figure as it appears in various cockpit positions and to simulate an airport runway environment...” (Noll, *Computers and Creativity*, 60) These were the very first digitally created graphic approximations of the human body, and are an important landmark in early computer graphics research. Fetter

also made one of the more useful and insightful observations about computer graphics, which he saw as an astonishingly powerful tool:

The techniques of typesetting and the photomechanical process fulfill the role of translating thought into visual form. Computer graphics represent a further stage in this process involving the skills of a designer, programmer and an animation specialist... There are three important stages which have to be considered in making computer graphics: first comes the communicator who has an idea or message to communicate; second, the communication specialist who decides on the best way to solve the problems [of realizing the idea]; third, the computer specialist who selects the computer equipment interprets the problem so it can be dealt with by the computer. It frequently happens, of course, that the communicator, the communication specialist and the computer specialist are one and the same person (Reichardt 15).

These sentiments touch on more or less all the issues at hand in the discussions of computer art and graphics. The division of labor, for instance, is made clear in his description of how an idea is realized through the use of the computer. He endorses the idea of a multi-pronged approach to such creation, but also notes that it is possible for all the work to be done by one person. Nonetheless, the idea of the “communicator” implicitly points to the involvement of a creative person in the initial stages of making computer graphics. All the innovators discussed here touch on this concept in their opinions and reflections, some seeing it as a necessity to create anything that could really be called “art”, and others patently rejecting it in favor of the “one man” arrangement.

Concurrently with the innovations at Bell Labs and Boeing, John Whitney was “working with Dr. Jack Citron of IBM Scientific Center, Los Angeles.” (Reichardt, 67). His work was mainly done on an analogue computer, as opposed to the work I discuss, which is all done with digital computers. In terms of the historical timeline, though, Whitney would certainly be one of the very first computer artists, preceding even my periodization of the work done at Bell Labs. He would continue his work throughout the time I am discussing.

Although it is no coincidence, due to the historical moment of computers entering the research and development field in a major way, a sort of *convergent evolution* occurred in the field of computer graphics, animation, and film. Convergent evolution, its worth noting, is the biological phenomenon of two species developing the same or similar traits while geographically separated or completely unrelated by lineage. Computer art developed internationally in the same manner; while the above American examples were taking place, the computer scientists Herbert Frake and George Nees were making discoveries of their own at the University of Stuttgart, Germany.

In addition to the work in Germany, the magazine BIT International was just beginning to take shape in the Soviet Bloc nation of Czechoslovakia. As much as I would love to delve more deeply into these concurrent movements, such an endeavor could occupy the entire space of my paper, and then some. Margit Rosen has written a fascinating and impressively complete history and analysis of the BIT story that I would highly recommend for further inquiry.

Thus, we are left with a variety of terms associated with these developments with computers: graphics, animation, film, images, and, perhaps most difficult, *art*. Why the term art is so inherently difficult in this context will become abundantly clear.

## Computer Artist?

Although someone, usually the artist, devises the original creative idea, the result after the artist-machine-technician collaboration is really a modern form of art by committee. It is an arts task force, so to speak, that requires the group dynamics skill of any cooperative human endeavor (McCauley 59).

The question of what defines an artist or one practicing art is as complex and oft spoken of as the initial question of *What is Art?* As I mentioned above, Andy Warhol brought this question to an extreme by removing himself in some ways from the process of creation. He made an assembly line of art in his Factory and thumbed his nose at the art community when accused of simply being a figurehead to what was arguably a printing press of sorts. Regardless of how one feels about Warhol, he is one of the most effective provocateurs at raising the difficult questions in art. These questions-- like the basic one of *What is Art?*--are at the core of the history and debates surrounding computer art, making it an excellent test-ground for inquiry.

As Caroline McCauley speaks to above, the question of what a computer artist was had far more ramifications in the early days of the medium. Today, of course,

everyone is a potential computer artist; after all, anyone can (theoretically) get a computer, anyone can purchase software, and anyone can execute the relatively simple commands involved. Thus, the computer artist is, by working definition, ostensibly anyone. Though there still exists a vast array of talent, originality, and the other factors required in becoming an artist of any kind, to compare today's computer design world with the early days would be a grave error.

On top of raising questions as to the collaborative nature of computer art in the early days of the medium, there was always the question of the computer's roll itself. This question is perhaps even more relevant today, as so little of the actual technical side of the equation is necessary to create computer art:

The instructions must be within the realm of those executable by the computer. One cannot simply say, "Draw a circle" and expect the computer to do it. The most basic language for the computer consists of nothing but 0's and 1's which directly represent on and off for the computer's electrical circuits. Fortunately the programmer does not have to write his instructions at this level" (McCauley, 54)

This aspect of early computer art is just one of many to create a somewhat contentious history, particularly at Bell Labs. To this day, several members of the early staff to experiment with visual phenomena on the computer maintain that a more thorough and true "artist" of the computer is one who can both program and create; the "one man" imagined by William Fetter, if you will.

One of the main characters in the story of Bell Labs, Dr. A. Michael Noll, is among the first people to create a graphic image with a digital computer. He holds a

more conservative view of what defines a computer artist. As he envisioned it: “The most creative engineers and scientists have their own artistic ideas and aesthetic sensitivities... [and] I have always looked on the artist as a master craftsman in complete control of his medium” (*Machina* 13). Noll’s concept of a “complete” artist is an interesting, albeit idealized, one. It harkens back to the Bazinian concept of the auteur; that is to say, one who is in total control of his artistic vision.

The artist can then claim complete responsibility for the final product, despite the collaborative effort that may have been a part of the inception. Since the making of a film requires more than just an artistic vision, this concept remains up for debate. Similarly, the collaborative efforts of certain early computer artists could nonetheless be considered the work of one person, insofar as they had the “vision” and the ability to communicate that vision. Noll and early computer programmer Herbert Franke would take exception with this of course, envisioning a “purer” computer artist, in total control of the aesthetic and technical components of making the computer art.

On the flipside of this debate would be another of the pioneers of computer graphics discussed here, Lillian Schwartz. In her time at Bell Labs, Schwartz created a number of artworks, including over a dozen films made in coordination with Ken Knowlton and other computer scientists. She maintains that the pieces are her creations, and that, similar to a cinematographer in the filmmaking process, the programmer(s) for her films played an essential role but cannot claim artistic ownership of the works beyond the credit given; and to be fair to all parties,

Schwartz's movies do almost always contain a "programmer" credit, something Schwartz said she was not necessarily obligated to include.

Ken Knowlton, a programmer on dozens of artistic works to come out of Bell Labs, has made modest efforts over the years to ensure a record of his contributions to the medium. He has often referred to a "pattern of misrepresentation" in the history of computer art, particularly in regard to certain instances where those responsible for writing the abstracts for art openings and shows featuring Lillian Schwartz have made slightly tenuous claims. One example can be found in a flyer for an exhibition at London's Tate Modern, here quoted in a personal email sent by Knowlton, asking the Tate to credit his role in the creation of the film GOOGOPLEX:

*Lillian Schwartz, a recognized artist, sculptor and filmmaker for many years, started the computer revolution in 1968 that we now know as computer art.*

In speaking to Schwartz, she was largely confused by Knowlton, and especially Noll's, objections over the years to what they perceived as the omission of their contributions to computer art at Bell Labs. She stated that each of them has been given a great deal of credit and remain official "pioneers" in the medium, a designation that, as I will demonstrate, each of the participants covered here is deserving of.

This debate has naturally created tension among the team of contributors to computer graphics who were present at Bell Labs. To this day, they each remain steadfast in their views on the subject, though the rhetoric, with a few exceptions, has calmed over time due in part to the historical record becoming clearer. Given



this climate of uncertainty and the lack of definitive existing analysis of these questions, I have elected to take an approach to the history that reflects the underlying cracks in the narrative. Although the names and dates are largely clear as to who did what and when, the question of who or what a computer artist is, what computer art is, and how much of a role the creator's intention plays, remains open.

Thus, to claim an authoritative answer would be not only arrogant, but historically irresponsible. My technique will therefore be to explain each view held by the subjects of this cultural history from their own perspective, something akin to the narrative device used in the film *Rashomon* (1950), often aptly referred to as the "Rashomon Effect"; this effect is necessary as it gives total credence to the subjective nature of memory and, in turn, history itself. This will allow me leeway to approach each recollection and opinion with a paradoxical method of both skepticism and certainty; that is to say, I can allow the subjects to both speak through me, with their authoritative claims, and also receive intense scrutiny from my interrogation of each said claim.

The deepest, the only theme of human history, compared to which all others are of subordinate importance, is the conflict of skepticism with faith.

Goethe (Israel in the Desert)

## A Brief History of all things Bell:

Bell Labs had been around long before the advent of the computer and, in turn, computer graphics. Founded in 1925 by the American Telephone and Telegraph Company (AT&T), Bell Labs was in fact a series of different buildings,

thirteen of which were located in New Jersey, with seven additional facilities out of state (Three Degrees, Bernstein). The labs consisted of over 25,000 employees scattered throughout these facilities up until the divestiture of AT&T in 1984, breaking the conglomerate into eight different small functionaries of the initial monopoly founded by Alexander Graham Bell in 1875 as The American Bell Telephone Company, the subsidiary of which was AT&T itself, incorporated in 1885 in New York (AT&T website). Initially, Bell Telephone and AT&T were meant to be a regulated and legally sanctioned monopoly, operating almost as a government body rather than a company seeking growth in the traditional sense. This was decided in the 1913 arrangement known as the Kingsbury Commitment, the thought being that a monopoly could more easily provide a consistent and universal service than a scattered market of small companies, as we see today.

The labs were meant as the research wing of the company, looking into nearly every aspect of scientific research, with an emphasis on communications technology. In 1956 the Justice Department, in an effort to reign in monopoly, took AT&T to task over their research into matters that the Justice Department felt had no relevance to their business, and implied the company was attempting to expand into other areas of business. Thus, AT&T decided that their subsidiary, Bell Labs, was to involve itself exclusively in the research of communications. Naturally, this could be considered very broadly and indeed Bell Labs, despite their concern over scrutiny from the government, remained committed to research in a variety of fields. As with several other large research facilities in the early days of computer technology, Bell Labs was the owner of several early digital computers, as well as a

number of analogue systems. The IBM 7090 was an early computer widely used by research scientists at the Bell Labs facilities in Murray Hill, NJ. It was Dr. William Baker who Michael Noll, one of the focuses of this history, attributes the unique atmosphere and arrangement that the Murray Hill portion of Bell Labs had. As Vice President of Research from 1956-1973, Baker oversaw and largely allowed all of the advances and milestones covered in this paper. Noll often commented on the unique nature of Bell Labs, and how the practice of what is called “general research” in a corporate setting is so essential and serves a greater good.

After the break-up of the Labs into the “Baby Bells”, as Noll calls them, the research at the Labs became increasingly focused on specific projects to further the interests of the company, as opposed to the practice before of pursuing a wide array of research topics. Noll and others lament the loss of Bell Labs, and the loss of rewarding research of the kind they had been involved in, not to mention the new streamlined model of the corporate research development facility. In time, as Noll had predicted, the Baby Bells research facilities increasingly emphasized applied research rather than basic research. And thus, with the breakup of AT&T came an end to the unusual period of time that created the circumstances under which some of the greatest innovations of the twentieth century took place, computer graphics being only one of many.



## Part II: The Players



**Ken Knowlton, Bell Labs in the 1960's**



**Michael Noll**



**Lillian Schwartz**



**Stan Vanderbeek**

## Lillian Schwartz



“... I dreamed only of using the machine.”

Lillian Schwartz was a practicing artist several years prior to ever hearing about a place called Bell Labs. She had been sculpting and creating various works of art since an early age, and recalls her childhood home being one of free-spirited creativity. In the early sixties, she was a sculptor working in the field of “kinetic sculpture”; such works generally involved the employment of sculpted form in coordination with electronics, human interaction, and movement. Although her

schooling background was in nursing, having received a Bachelor of Science, she was always drawn to art and began working with found objects in the late 1950's. She would seek out junk depositories and other locations in the interest of finding pieces of discarded trash to re-imagine as sculptures. Often, her work would be composed of objects formerly used in machinery of varying sorts, including medical equipment, defunct machinery, and other odds and ends left over from a fading industrial age.

While serving as a nurse during World War II, Schwartz was stationed in a small town between Hiroshima and Nagasaki, and participated in the recovery of the fallout from the bombings. Although the expectation of a person working in the medical field was to be unfazed by any degree of medical calamity, Schwartz found herself unable to contend with the extent of injuries stemming from the nuclear radiation. Later in life, she discovered that she, too, had been a victim of the radiation; at a certain point she was diagnosed with a tumor in her endocrine system and remains affected by the injuries to this day. Although seemingly unrelated to her future work with computers, this period of time actually began a fascination that would follow her right up to her arrival at Bell Labs in 1968.

At the various bases she worked at during the war, Schwartz was exposed to the newly implemented use of computers. Although she never had a particular job-related impetus for doing so, she began casually studying the computers and asking questions about how they worked. At the same time, she was aware on an artistic level of "the tools available to [her]," noting how during the Great Depression, "I experimented with slate, mud, sticks, and chalk because they were free. Later, I

attended college under a World War II education program, training to become a Navy nurse. The courses in anatomy and biology, the technique in fashioning plaster casts, and the ability to entertain sick children through on-the-spot sketches became invaluable lessons in art. I was a complete disaster as an apprentice nurse.”

(Schwartz 4) These experiences would help to shape her interest in years to come.

She also notes an influential experience that occurred during her time in Japan, when she was diagnosed with polio:

My next lesson in art occurred in Japan during the post-war occupation. I contracted polio—my limbs were paralyzed, and the conclusion of Western science was that nothing could be done. I was a right-handed artist with a dead right arm.

A Japanese attendant who had taken a liking to me induced a Zen master to teach me to move again. His approach was philosophical, although Western science would now classify it as biofeedback. Since I had been an artist, he began the therapy by showing me calligraphy brushes...

I studied these brushes for weeks. I had to isolate each brush and contemplate its peculiar function, its shape, and how I would hold it (Handbook, 34).

Back in the United States, Schwartz’s interest in art never ceased. She married a pediatrician and had several children, moving to a suburb of Newark, New Jersey. Although it took some time for her to get a footing in the art world, she did achieve success as a featured artist before she ever found herself at Bell Labs. In 1968, the Museum of Modern Art held an exhibition entitled “The machine as seen at the end of the mechanical age”, which featured a work by Schwartz entitled



*Proxima Centauri*. This kinetic sculpture featured a globe that would rise out of a black box when spectators approached. Schwartz describes her sculpture:

The concept was for the observer to see at first a highly polished black box. As he approached the observer stepped on a pressure-sensitive pad, triggering motors that generated a number of vigorously dramatic effects. A ripple tank (a plastic container filled with fluid) was agitated every thirty seconds, causing wave patterns through which a sequence of slides containing my abstract paintings was projected, as a translucent globe slowly rose from the depths of the box.” (Handbook 10)

The description of this sculpture goes on for some length, giving one the idea of how mechanically complex her kinetic sculptures were. One man in the crowd was particularly impressed by this sculpture, and his name was Leon Harmon.

Leon Harmon was an engineer at Bell Laboratories in Murray Hill, New Jersey. In the previous few years, Harmon had been instrumental in the creation of several works that had their origins in the computers available for use by the technicians and scientists at the Labs. One of these creations, on display at the same show as Schwartz’s *Proxima*, was what would become commonly known as “the Nude” by Bell Labs employees and a small slice of the art world at the time.

Schwartz recalls:

What initially intrigued me was that the image changed as I moved toward it or away of shifted my viewing angle—it had a sense of animation for which I was often striving in my own work. As I stepped back and forth, visually translating the nude into an abstract of blacks, grays, and whites, I suddenly realized that the art form had to have an appropriate name. I said aloud, “Technological pointillism!”

“No. That’s Deborah Hay, the dancer. We processed her,” a voice behind me responded. It belonged to Leon Harmon, who had collaborated with Ken Knowlton on the work they called *Studies in Perception 1*. The two scientists worked at Bell Laboratories. (Handbook 12)

This could be considered the introduction of Lillian Schwartz to Bell Laboratories. Harmon spoke to Schwartz at length about her work at the show and had been fascinated by it just as she had been by his work. The “Nude” on display was a work that would make the two men involved in its creation minor stars at the time. Ken Knowlton was the technician on this project (a title he earned after a coin toss to determine which one of them was the “artist” and which the “scientist”, a requirement for the show), and soon after Schwartz’s arrival at the Labs, would become her partner on a number of projects.

After seeing *Proxima Centauri* at the MoMA show, Harmon immediately sought Schwartz out. He said he was working at Bell Labs, where they were experimenting with perception and the newly discovered ability of computers to create graphic imagery. He invited her to come and see the Labs with the possibility of participating in one of the experiments he had mentioned. This immediately sparked her interest, as she had heard of Bell Labs and had seen some of the work coming out of there in passing during the previous years. With few expectations, insofar as she did not quite know what to expect of a large Research and Development laboratory of this type, she first visited the Labs in 1968.

Schwartz was immediately impressed by what she saw. She came to the front lobby of Bell Labs and was issued a visitor’s pass. This pass would accompany her for years to come, as she would remain an unofficial member of the staff until the

breakup of Bell Communications in 1984 that would lead to her “outing”, as it were, as a fixture at the Labs. Leon Harmon met her in the lobby and led her up into the Labs. She, like many others, described her initial reaction as one of awe and immediate fascination. Here, in the midst of a corporate research lab, seemingly only concerned with the greater interests of the stockholders and discoveries that could lead to practical developments in communications technology, a free-spirited energy appeared to be coursing through it. This was due largely to the fact that Bell Labs was concerned with *general research* as much as it was specific corporate research.

Early on in her time at Bell Labs, Schwartz was not necessarily expecting to be allowed an active role. She simply kept showing up, and remained a fly on the wall for quite some time before actively participating in anything. She attributes much of her acceptance at the Labs to Max Matthews, a researcher who was the head of the department under which most of the experiments she was interested in were taking place. Working under Matthews were more or less all the players who contributed to the creation/discovery of computer art at Bell: Ken Knowlton, A. Michael Noll, Leon Harmon, Bela Julesz, Billy Kluver, and Edward E. Zajac, among others. Matthews took Schwartz under his wing and protected her from any scrutiny from the higher-ups at the Labs. He managed to “hide” her in plain sight, allowing her to continue her presence at the Labs without necessarily having a distinct job there, or even getting compensated for her contributions.

Schwartz found herself thrust into a world of bustling creation and discovery. Every day at lunch, she would sit with the physicists and computer technicians

(their professional titles varied greatly, as scientists of all backgrounds were employed at the Labs and there was largely not a field known as “computer science” at this point). They would be talking in any manner of jargon about their ideas, discoveries, and intended experiments, and Schwartz took it all in, enjoying the challenge of gathering information and ideas from a scientific world with which she was largely unfamiliar. Schwartz was joining a wave that begun to swell over the previous few years, and that had yet to be fully imagined. The people involved in these discoveries were a mix of scientists, acting out of an interest in making advancements in communications; others maintain, to this day, that they were informed by their own creative impulses right from the start. Despite the open debates, it seems fair to say that Schwartz was instrumental in the further development of an already present trend.

Her first projects at the Labs were done with Ken Knowlton, a programmer who had already been involved in several projects, studying perception using the computers, including the Nude. He had written an early programming language for animation called BEFLIX (short for Bell Flicks) that was employed for rendering images with the computer.

Schwartz’s first forays into computer art were done with this language. Schwartz contends, recalling a recollection by Julie Frank (an employee of Ed Zajac’s department) that BEFLIX, was, “not originally designed... for presentation of artistic material. That is, working with Schwartz, Ken realized that his language was... scientifically oriented... and that... it is necessary to develop special facilities for the artists” (Handbook 151).

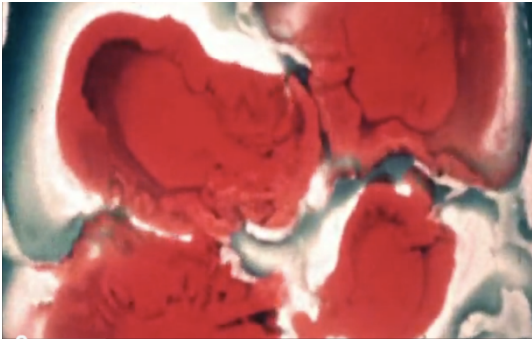


Title shot from Schwartz's *PIXILLATION*, programmed by Ken Knowlton

Although open to historical interpretation, even Knowlton has acknowledged that, indeed, he had not had art in mind when designing BEFLIX, and subsequently worked with Schwartz to make the program more “user-friendly” in the creation of imagery for artistic projects. Using BEFLIX, she and Knowlton began the lengthy process of first programming the images on the computer (abstractions of two dimensional shapes) and then animating them in coordination with hand-drawn techniques devised by Schwartz. She would set up a 16mm camera to film the black and white computer material, exposing the film one frame at a time, and, “repeating that procedure until [she] had a sequence of shapes related to the computer images.

Later [she] color-matched, by means of an optical bench, the [images] with the colors of the paints” (Handbook 153). The process of creating the frames took a total of two months and produced “eighty-five black-and-white frames on the computer...” (153). She then had to re-imagine all of the images into a continuous, colored, animation using both the computer images and her own animation. The result was *PIXILLATION* (1970), and would mark the first of many computer-animated films that she would be the creative force behind.

PIXILATION is composed of abstract patterns formed by the program as well as post-production colorization work done by Schwartz using traditional film techniques, both of which are demonstrated below.



Shot made using non-computer film technology



Shot programmed by a computer

This film is demonstrative of Schwartz's approach to the computer film. She sought to get certain components from the programming done by Knowlton, but also spent a great deal of time adding the after-effects. In this sense, her films have both digital and analogue features. The two forms featured in PIXILATION make for a marked contrast; this creates a visual collision of the two that is almost self-referential in and of itself. Even if it is subliminal in part, the recognition of the computer graphics on the one hand, and the animation on the other, points out the intervention of new media into a universally recognized form.

Although one could think of Lillian Schwartz as very fortunate to be in the presence of such ambitious scientists willing to venture into uncharted territory (an assertion made by a slighted Noll in an email), it is perhaps surprising to learn that she actually had to pay out of pocket for a lot of her use of the machines and equipment. The post-lab production was obviously within her purview and thus

demanded her own budget, but she was by no means a using the facilities for free, contrary to what some have said. These characterizations have often painted her as an opportunist who had an agenda from the start: to capitalize off of the fledgling medium already underway. Even if this were the case, which it is very arguably not, one might still wonder why this is a problem at all. Naturally, people seek fields of study where there might be a future for them, however things may play out.

Schwartz certainly capitalized off of her involvement in Bell Labs at this crucial juncture, but did so at great expense to herself, both in terms of time and money. She was barely recognized, by her own account, for her work until Bell was able to officially acknowledge her presence there. At the time that she first started there, the idea that a female artist was using the equipment for creative purposes would not likely have gone over well with upper management, and certainly not with stockholders. Schwartz even recalls being there when tours would come through for the stockholders. Max Matthews would introduce her as a “morphodynamicist”, a tongue-in-cheek title that Matthews conceived to briefly confuse the tour participants while Schwartz would demonstrate something related to computer graphics; Matthews would shuttle them away quickly thereafter, so as to avoid any further questioning of who she was and why she was there. Her official title, aside from Matthews’s invented one, was a “resident visitor” for some sixteen years before she became permanent staff.

In her years since Bell Labs, during which she left to pursue teaching and private artistic practice, Schwartz has been outspoken about her role in the early days of Computer Art (a term she does not approve of), as well as the theoretical

basis for what defines art made with computers, among other questions. Schwartz herself would be considered by a small group of more conservative practitioners from the period to be only one half of the “true” computer artist model. She has the artistic drive, creativity, and imagination needed to be a practicing artist in general, but does not have the technical skills required to see a project through from the creative inception, through the programming, to a final product.

This view is controversial and dismissed outright by Schwartz, who considers herself to absolutely be a Computer Artist (hmm...doesn't she disapprove of the term computer art?), having the raw talent and creative edge required to make artistic achievements. She has said in interviews and other places that programmers, who were scientists by trade at the time, often just did not have that creative edge needed to be a true practitioner of art. In retrospect, and even at the time, Schwartz felt that the programmers who fancied themselves artists were perhaps a bit envious or had an identity crisis of sorts once given the chance to define a new medium. She pointed to the project created by Robert Rauschenberg and Billy Kluver, among other artist-scientist teams, Experiments in Art and Technology (E.A.T.), saying:

I discovered at E.A.T. that scientists often wanted to be considered artists. A. Michael Noll, a scientist at Bell Labs, commented, 'the most creative engineers and scientists have their own artistic ideas and aesthetic sensitivities which match those of a particular artist with probability zero' ....Conflicts inevitably arose between the artists and the scientists, and just as some of the scientists declared that they were artists, some of the artists claimed substantial scientific knowledge. (Personal Reflections)



These comments demonstrate Schwartz's defensiveness about those who claim artistic ability prematurely. As a practicing artist before ever hearing of Bell Labs, she naturally has a stake in qualifying the definition of what an artist really is; she also has a vested interest in defending her own position as a computer artist, a title put into question by the very programmer she quotes throughout her book:

Noll drolly stated, 'if the artists at the armory show [an E.A.T. show in the late sixties] were going to use the products and concepts of technology in their work, they themselves should have first learned the skills of the technologists.'" (Handbook 77)

The skills that Noll refers to are those involved in programming and the technical aspects of computer art creation. Unfortunately for the movement of science-art in this period, little attention was paid beyond honorable mentions in the newspaper and from a handful of critics familiar with the avant-garde art scene in New York. Schwartz says she, "... sometimes wonder[s] what the critical response would have been had the electronic art functioned" (Handbook 74). She refers here to the difficulties encountered by E.A.T. at their shows; certain pieces involving complex electronics did not work correctly and, while Schwartz viewed the attempt at colliding these two worlds as an honorable endeavor, she recognized it ultimately did not pan out.

Apart from Schwartz's opinions on the historical record and the definitions at issue here, she had many things to say about the computer as an artistic medium. Similar to Stan Vanderbeek, who was an optimist on all accounts about technology, Schwartz felt that the possibilities the computer pointed to were endless. In her

handbook on the practice of computer art, Schwartz speaks of the computer as a truly challenging medium, one that pushes its user to discover new ideas. This, she said, was something unique to computers: “all of [the] capabilities [of the computer] enrich what the artist can achieve, with an inspiration that no longer has to wait for the paint to dry” (Handbook 146).

The idea of interactivity in computer technology was something all the Bell Labs crew could agree on as an advantage for a creative person. Unlike other forms, such as painting in Schwartz’s metaphor, the computer does not necessarily rely on the programmer (or artist-programmer) to dictate every detail of the output. In fact, often it was the “bugs” in the system that would lead to something new in the creation of the art. Interestingly, this is a major point of agreement for Schwartz and Noll. Noll also spoke very positively of the computer’s unique ability to utilize randomness as a creative tool; one could put a certain program to work that would create a series of dots in a different pattern every time it was employed. Schwartz saw this ability, randomness being one example of interactivity, as something with limitless potential:

I strove to extend the computer into new methods by which I could express my creative impulses, particularly where my imagination soared beyond the capabilities of traditional tools. (Handbook 17)

Here, again, Schwartz refers to the limits of previous artistic media, and how the computer could be a tool, or a series of tools, to unlocking otherwise unachievable aims. Indeed, the very idea of “unlocking” was something Schwartz likes to speak of. To her the computer is a “machine [that] can be finessed to its next level of obedient

cooperation.” (17) It was something to be tamed and wrestled with, the outcome of which would, in many cases, be a surprise. In this sense, the computer was a partner in the creation of the art and films; Schwartz and others said as much in their writings on the medium. Noll even referred to work with computers as “collaboration”, which, although a figurative description, is somewhat ironic considering his intolerance for collaboration among artists and scientists

Lillian Schwartz would continue her stay at Bell Labs beyond her work with Ken Knowlton in the early days of her time there. She would go on to make many films and countless images from computers, eventually gaining notoriety as a person who took a fledgling medium and brought it out of the lab. To this end, even those who criticize her for certain things from the early days cannot argue with the fact that she did what no one else did, or perhaps could. She sacrificed years of her life and thousands of dollars to see that this powerful new form get the recognition within the art world that it deserved. Although computer art from the sixties and early seventies did not gain the same notoriety that other artistic movements did in their heyday, it certainly would not have had the same impact were it not for Schwartz.

# Ken Knowlton

“We are not yet beyond the gee-wiz stage of cuteness, of stunts, and of novelty for its own sake.”



Ken Knowlton and Leon Harmon with their work, *Studies in Perception 1*

Ken Knowlton was, by his own account, not an artist when he first encountered the prospect of creating imagery with a computer. Knowlton was born in 1931 in Springville NY, and attended Cornell to study physical technology, earning a B.S. and M.S (Franke 394). He was hired in 1962 right out of MIT, where he had just gotten his Ph.D. in Communications Sciences, to work in the Computing

Techniques Research Department at Bell Labs. Having garnered degrees in Engineering from Cornell and the Ph.D. from MIT, Knowlton was a good candidate for research in the burgeoning field of computer science (Russett and Starr 193). He was a subordinate of Max Matthews, who was in charge of the Computer Techniques Research Department and was a programmer for Leon Harmon, who was a researcher at the Labs.

In his time at Bell Labs, Knowlton would become one of the leading innovators of Computer Art, a position he little recognized until a later point in the development of the medium. He was the central technical leg of two of the artists featured in this history, and was himself an artist after his time working to help others, providing a programming expertise needed for the development of early computer films. Knowlton had a hand in many projects and wrote extensively on the subject of both computer art as a burgeoning medium and on the development of computer programming languages related to graphics. Although he would have a change of heart about the process of collaboration at a certain point in his life, Knowlton worked as the technical wing of the operation with, at his count, five different artists in his time at Bell Labs.

Knowlton's early accomplishments and endeavors at the Labs were mainly in the area of programming computer languages and creating programs that could read the language, for the purposes of creating graphic imagery. As he recalls:

My own shtick became a sort of greyscale picture made by filling the screen with thousands of different letters chosen for their brightness. I soon wrote a memo to department head Tom Crowley, suggesting the possibility of a "computer language" for making animated movies; his two-part response

launched my career in raster graphics: "It sounds rather ambitious, but why don't you see what you can do?" (*Portrait*)

With this memo as his impetus, Knowlton began the process of creating a system by which he could more easily employ his technique of mosaicking letters and symbols to create images. His first language, BEFLIX, came in 1964 after a year spent creating what are known as subroutines, which are basically preprogrammed orders for the computer to employ in creating imagery. This particular language, and the "corresponding computer program that 'understands it' ... speaks of a picture as a large 252-by-184 array of spots, each of which is represented in computer storage by a number from 0 to 7, which indicates the intensity of light at that point."

(Knowlton, *Movies*, 1) In all, the picture that the program is creating contains some 46,368 individual spots that are lit to the particularities of the image, creating, for example, the effect seen in *Studies In Perception 1 (aka The Nude)*.

It is this language that allowed Knowlton to collaborate with his colleague Leon Harmon to create the infamous *Studies in Perception 1*, which was featured at a gallery opening as part of E.A.T. (Experiments in Art and Technology) in 1967. This story would become a favorite among Bell Labs employees and those interested in the period. The original plan was to prank a superior of theirs, Ed David, who was out of town at the time the plan was initially hatched. Harmon wanted to recreate a picture of a nude woman, the Model Deborah Hays, using Knowlton's programming language. The scheme was to create an image that would be hard to discern but would retain a cohesive image when looked at from a distance. It would be this image that initially brought Lillian Schwartz into the labs. Knowlton created the

image using “small electronic symbols for transistors, resistors and such,” creating the now well-known effect in rendering the nude visible. The 12-foot long print-out that Harmon and Knowlton ultimately hung on their colleagues wall, covering the entire surface, became an instant hit at the Labs, and garnered attention from both admiring and concerned members of the Bell Labs staff and administration.

To add to the controversy within the Labs about the image being made in the first place, it soon became part of an exhibition in Robert Rauschenberg’s six story loft on 381 Lafayette Street, at a “news-conference happening”. This happening naturally attracted attention as it was one of a handful in the mid sixties to proclaim a new alliance between science and art, and to advertise the endeavors of Rauschenberg, Billy Kluver, and other participating members of E.A.T. The creators of *Studies in Perception No. 1*, as it was officially called, had never imagined that the New York Times would subsequently feature their creation as the banner image of a story entitled *Art and Science Proclaim Alliance in Avant-Garde Loft* on the second page of that day’s newspaper. The article featured Knowlton and Harmon prominently as examples of how art and science can come together to create new forms, and mentioned their having created the image at Bell Labs. This naturally created yet another uproar from the higher-ups at the Labs, who were likely as alarmed at AT&T being associated the avant-garde art scene in Manhattan as they were by the nudity.

This story is emblematic of the overall approach employees like Knowlton were allowed to take in their investigations into new uses for the computer. Like Knowlton mentions in the above quote on the memo he got from a superior when

suggesting the idea of images with a computer via a language, his superior's instructions were hardly instructions at all but instead a general go-ahead to do whatever he and his immediate superiors thought was interesting and could lead to something innovative. This was by all accounts a free-license to do just about anything within the realm of computer animation and graphics. Knowlton speaks of Bell Labs, as do all others who worked there that I have spoken to, as a place of little inhibition and total creative freedom for the scientists to follow their passions.

Knowlton's first work with an artist could be considered the *Nude*. In a piece Knowlton wrote some years later, *On the Frustrations of Working With Artists*, he considers Leon Harmon to be one of the artists with whom he collaborated, owing this to a flip of a coin so as to be able to enter Art-Technology shows with their work (Knowlton, *Frustrations*). Another prominent artist he mentions is Stan Vanderbeek, who came to the Labs in 1966, having heard about the films and graphics being produced there. He and Knowlton would collaborate on two projects, one designed as a piece to be shown at the 1967 Expo in Montreal, entitled *Man and His World*, and the other consisting of ten short films, entitled *Poemfields 1-10*.

It was with Vanderbeek that Knowlton first started to aid and actively contribute to the artistic process of making computer films; this is not to say that he would immediately consider himself an artist, but rather that the films he was now making were purely aesthetic in their value. Knowlton had made several technical films before his work with Vanderbeek, one of which, aptly titled *A Computer Technique for the Production of Animated Movies*, was simply an animated demonstration of how one would make a film using BEFLIX and the micro-plotter.



He considers his first collaboration with an artist in creating a film to be the film he made for the Expo mentioned above in 1967.

Knowlton recalls Vanderbeek as an energetic and wildly creative person. In a veiled comment on Vanderbeek, Knowlton seems to refer to him as the artist who, “was so highly-charged mentally that it took me a day each time to recover from half a day of working together — I was constantly bombarded by proposals about what we could do if we only had ten times more time, money, equipment and patience”

(*Frustrations*). Lillian Schwartz described Vanderbeek in a similar light, noting that he often would just show up, go off on a tangent to Knowlton about what he wanted, and then leave as quickly as he had come. Unlike Schwartz, who remained in the Labs on a day-to-day basis, Vanderbeek was seldom seen; however, when he did arrive at the Labs everyone knew about it and it meant a great deal of work for Knowlton, who often had to stretch himself to come up with the vision that Vanderbeek was having.

As Knowlton would later recall: “The first few months of interaction with Vanderbeek were mutually frustrating. I had hoped he would pick up my original BEFLIX language... with all its implicit generality, and begin to do great artistic things with it; he came with great designs in his head and hoped I would program them.” (*Collaborations*) Knowlton and Vanderbeek were both communicating that something new had to be done, as opposed to simply using Knowlton’s already-existent BEFLIX language, which Vanderbeek was not able to master to a level proficient enough for producing his own work. The resulting language that grew from their work together would be known as TARPS (Two-Dimensional

Alphanumeric Raster Picture System). This new system of programming was based on an idea by Vanderbeek that involved, “arrays of closely spaced characters [which] are used to produce all the textures, forms, and motions.” (*Collaborations 400*). This allowed for Vanderbeek to program his own movies, as he was able to learn how to operate what was essentially a random-number generator that included non-numeric symbols as well. The resulting films would be *Poemfields 1-10*. Knowlton felt good about this collaboration, stating:

After a few months, Vanderbeek became quite proficient with TARPS; in due time he was programming almost completely on his own, while I served essentially as a debugging consultant... It was gratifying to me that Vanderbeek was able to do his own programming; but I was disappointed in the language—it seemed to me to be too restrictive. (*Collaborations 400*).

After Vanderbeek was satisfied with his work and had moved on to other projects outside the Labs, Knowlton began a collaboration with the artist Lillian Schwartz, who arrived at Bell Labs after meeting Leon Harmon at an art show at MoMA, called “The machine as seen at the end of the mechanical age”. Schwartz became a regular at Bell and began collaborating with Ken Knowlton as of 1968, when they created several images with his recently created EXPLOR language. This language, much like the previous one with Vanderbeek, grew out of a combination of creative input from both Schwartz and Knowlton and necessity on the part of Schwartz to seek a new means of creating computer imagery. One of the driving

concepts behind the language was a suggestion from Schwartz to seek “something like crystal growth” in the imagery.

This led Knowlton to create a language featuring, “a variety of local operations for things that happen at points on a grid as functions of the local neighborhoods, with the added feature of randomness” (*Collaborations 401*). Basically, the program allowed for a pattern to emerge semi-randomly that resembled crystallization, making for a new means of creating graphics. Although Knowlton enjoyed the collaboration, he reflected at the same time on a slightly hesitant note:

The collaboration with Mrs. Schwartz has produced dozens of still pictures and several movies, the most notable of which are *Pixillation* and *UFO's (1970-71)*. As a collaboration, however, it has been somewhat disappointing because thus far it has consisted largely of my producing the original film, only to a degree specified by the artist—her role has been largely that of editing, superimposing, altering, framing, coloring, and synchronizing with sound, all in the most imaginative way, so as to produce a true work of movie art (*Collaborations 401*).

Knowlton goes on to say that he wished the process of making the EXPLOR language and utilizing it to the end of creating films with Lillian Schwartz had involved more input on both their parts into the language itself, although Schwartz states in her recollection that such advancements did indeed take place. This could be easily chalked up to the date of the referenced paper, after which progress toward a more easily used EXPLOR language could have taken place.



Shot from UFO's  
by Lillian  
Schwartz and  
Ken Knowlton

In his time at Bell Labs, Dr. Knowlton wrote extensively on the subject of Computer Art and the possibilities of the medium. To Knowlton, the collaborative process was largely a positive thing, as he notes numerous times in his recollections; obviously he has since taken a different stance that developed out of his frustrations with artistic personalities and some disagreements along the way. Knowlton realized early on that the computer had numerous uses, one of which was perception. His *Studies in Perception* series that he made with Leon Harmon was revolutionary in its time, and remains fascinating to this day.

Ken Knowlton, since his time at Bell Labs—and partially during his later years there—has become a practicing artist, working in the field of mosaics, much like his initial work in perception with Leon Harmon, small items placed in such a way as to create the appearance of an image. In addition to his becoming a practicing artist, Knowlton has taken somewhat of a different view in his recollections on Bell Labs. Although not in any way resentful or vindictive—insofar as I could tell—Dr. Knowlton feels that the little history that does exist on this subject has

been largely put in favor of Lillian Schwartz as the star of the Bell Labs story. No doubt Schwartz did put in the time and years, as Knowlton willingly acknowledges, but he points to several instances of historians or curators taking liberties with the exact dates and names associated with the “creation” of Computer Art.

In my conversations with him it was clear that Knowlton continues to be troubled by this kind of claim. a position he has stated most clearly in a letter to Mary Lou Bock of the Williams Gallery written in reference to some work by Schwartz that was going up for sale: “I... think that for you or anyone to claim that any one person ‘started’ the ‘computer art revolution’ in 1968 is preposterous.” (Personal Letter 1996). He goes on to assert that selling Schwartz’s work under such a pretense, as is seen in an advertisement for the gallery, could be considered “muddying the waters”, and, at the very worst, fraud.

This issue of who exactly “invented” computer art is infinitely difficult to break down, and Ken Knowlton has about as much reason to claim a major role as anyone else spoken about in this paper. After all, he invented several of the first programming languages for creating graphics in the first place. He had invented BEFLIX already in 1963, only a year after entering Bell Labs, and some five years before Lillian Schwartz ever arrived, as well as several years before Vanderbeek showed up. That being said, Knowlton makes no such claims as “the first” or “the creator” as he knows, and has stated as much, that such claims are absurd. After all, concurrently with Bell Labs, the Germans at Stuttgart University, Nake and Neese, were making more or less the same discoveries as Knowlton, Noll and the rest of them; there is also the work that was done at Boeing, as mentioned in the forward.

In any case, in my time with Dr. Knowlton he seemed to be largely unconcerned with the issue at this point, only seeking the honorable mention he rightly deserves in the annals of this medium.

Much of what makes Dr. Knowlton's contributions to the field so interesting is found not just in the work itself, but in his unique position as a middle-man between the separate "poles", as one might call them, of Dr. Noll and Lillian Schwartz, whose views on computer art differ in such extreme ways. Knowlton would of course become vocal in his years after Bell Labs, often defending his own artistic merit and dismissing the idea that a scientist or engineer cannot also have abilities in the arts. He has spent a great deal of time and writing since his time at Bell Labs to explain his own feelings and reflections; in these writings Knowlton has expressed both nostalgia and reverence for the time and all that happened there, as well as profound skepticism for the results and subsequent history. In a fairly dramatic indictment of technology-based art, particularly computer art, Knowlton had the following to say, an addendum to his piece on frustrations he felt about working with artists:

I have recently visited the Whitney's current show "Bitstreams" — a collaboration only in the sense that the artists unwittingly conspired in art-iconoclasm. The textual commentary supports some of my earlier comments: it squirmed with words like unreal, irreal, surreal. Actually, the artwork was meaningful to me, but as high sarcasm. Deplorably, the medium WAS the message — of alienation, of a future out of control, with machines and people trying to exchange their uncertain souls. We seem compelled to do new things, and old things in new ways, not because we should but simply because we can.

Technology, born to ease the mechanics of life and free us for higher things, is insinuating itself into and polluting those very realms, while not simplifying the mechanics of living in the slightest....if that's the future of art, of technology and/or the combination, then the best and brightest of us are showing no attempt to carry forward anything of value from the past, no cherishing, no preserving of either nature or culture, no gift to future generations other than confusion and impoverishment

This sharp critical view continued in the later writings Knowlton did for conferences, journals, and for his own website that chronicled some of his experiences at Bell Labs. Even in regard to his own position as a programmer, Knowlton was uncertain of the future:

I expect... that art will continue to come from artists or perhaps artists working closely with programmers—I do not expect much art to come directly from programmers, who have devised clever gimmicks for doing cute things. (Knowlton, Printmaking 194)

This seems an indictment of sorts on programmers who stake their claim as artists, although Knowlton is easily classified as an artist due to his extensive work with mosaics during his time at Bell Labs and thereafter. He continues to make his mosaics at his home studio in New Jersey, and has no plans to stop.



## A. Michael Noll:



(Noll's Personal Logo)

*"In the computer, man has created not just an inanimate tool but an intellectual and active creative partner that, when fully exploited, could be used to produce wholly new art forms and possibly new aesthetic experiences."*

***Digital Computer as a Creative Medium***

Dr. A. Michael Noll was born in 1939 in Newark, New Jersey. He received his Ph.D. in Electrical Engineering from the Polytechnic Institute of Brooklyn in 1971, having garnered a M.E.E. from New York University in 1963, and B.S.E.E. from Newark College of Engineering in 1961. Having a background in Electrical Engineering, Dr. Noll was a natural fit for work at Bell Labs, where he was hired in the summer of 1961 as a research assistant on a project exploring ways to determine the frequency of speech patterns. In his capacity as a member of the research team, Noll was using a machine that would become central to the discoveries made at Bell Labs throughout this period of time, a Stromberg Carlson SC-4020 Microfilm Plotter. This device functioned a means of printing graphs and



information from the research being done on the computers. It was at this time that Noll made what would become some of the first graphics designed on a computer, setting him up for several years of research into the potential impact of using computers for such a purpose.

Noll recalls from his earlier years that he was always struck by the field of art and design, “drawing and creat[ing] elaborate pictures of the interiors of ships and space vehicles,” and frequenting the MoMA as much as possible (Noll, *Beginnings*). Although he had no formal training in the field, his work at Bell Labs would inevitably bring him into the world of art, and even put him in several gallery openings featuring the work he made. Noll’s contributions to the field were initially an accident of sorts:

I still can remember the day when a fellow summer intern with I shared an office, Elwyn Berlekamp, came down the hallway with a computer-generated plot of data that had gone astray because of some programming error. Lines went every which way all over his plots. We joked about the abstract computer art that he had inadvertently generated. It then occurred to me to use the computer, an IBM 7090, and the Stromberg Carlson plotter to create computer art deliberately. Thus my experiments in computer art began in the summer of 1962 at Bell Labs. (*Beginnings* 39)

This history is the story that Noll initially told me in a phone conversation we had upon my discovery of this topic. He maintains that almost immediately he recognized the potential of what he and his colleague had accidently created, and that he was quite aware of the aesthetic value and potential of these creations.

These claims have been somewhat disputed by Schwartz, who, while absolutely acknowledging Noll's contributions to the history, has her doubts about his artistic abilities and just how aware he was of these images as art, as opposed to scientific graphics serving a research purpose. This conflict, seemingly personal, would come to define much of what was at stake for the pioneers of computer art and films; what was the dividing line between science and art when it came to images that were aesthetically interesting regardless of their intended purpose?

Although some may maintain that intention is not necessarily a definitive quality for the value of such images, in this case it seems in retrospect to be all too important. After all, if Noll, or anyone else for that matter, was a scientist at heart, just how much ground could he stand on maintaining his artistic merit. This is not to doubt his recollections, but rather to bring forth the issue; who were the *real* artists in this field, and who were merely tagging along for the ride? Were the scientists artists and did the artist's lack of scientific awareness affect their ability to achieve in the medium, or was this question moot from its inception?

In many ways, Dr. Noll's contributions to not only the medium, but his somewhat controversial additions to the history now being written tug at these essential questions in a unique and fascinating way. Having time on his side, in the sense of making his discoveries in the very early days of 1962, Noll has the unique position of being able to stake his ground with a certain authority. As Noll puts it, "all the ingredients for my pioneering discoveries in computer art were present: a childhood interest in art and stereoscopy, the freedom to explore new avenues, and the very best technology of the day" (*Beginning* 39). His subsequent advances in the

field would be some of the first images and films created with the use of digital computers. Whether or not these had ostensible aesthetic value remains up for debate in the writing of the history.

The first images Noll created used straight lines to “combine elements of order with the disorder of randomness.” (Noll, *Beginnings* 39) The results of these experiments with lines and order would become known as *Patterns by 7090*, referring to the computer used to make them, and the arguably most famous of these patterns was called *Gaussian-Quadratic* (1962). This featured many lines moving every which way forming an abstraction that one might call minimal in the sense of placing the structure of the piece somewhat above any essential aesthetic reaction. To this end, Noll’s early works can be thought of both as computer art and as photographic evidence of computer sciences; they demonstrated an advancement in both fields, despite his or anyone else’s particular view of the pieces.

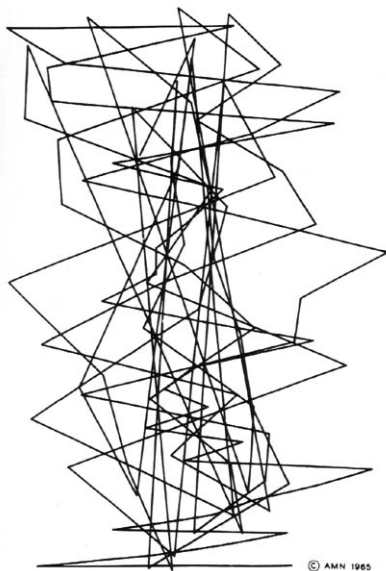


Fig. 1 Gaussian Quadratic

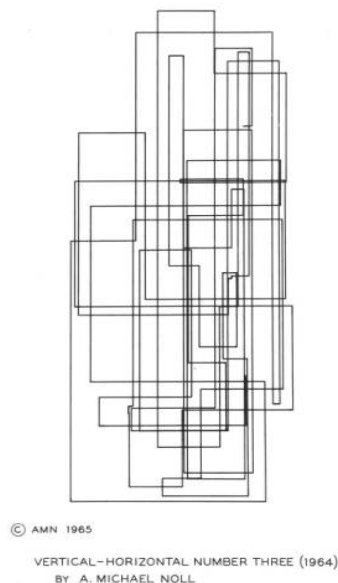


Fig. 2 Vertical Horizontal No. 3

It was during this time that Noll began was noticed by his superiors and transferred to department for further study in the field, working under Bela Julesz and several other members of the Bell Staff. One of Noll's early contributions to computer graphics came in his experiments in human perception, a topic that many in the department were investigating, particularly Bela Julesz who was creating what are called random dot stereograms, images featuring many small dots intended to test the limits of the eyes ability to perceive a whole out of the many small details, something akin to what Ken Knowlton would end up working on throughout his life.

One of the key experiments for Noll was one that he calls "the Mondrian Experiment." In this study, Noll took an existing painting by Piet Mondrian, *Composition With Lines* (1917), and programmed a computer to create images based on the specifications entered by Noll to essentially recreate Mondrian's piece. All of the resulting images held many shared qualities to Mondrian's work, and would ultimately prove indecipherable from the original, at least according to the experiment. Noll took his printouts, of which he made several and picked those he felt were most exemplary of the aesthetic qualities found in Mondrian's, imitating the "horizontal-vertical theme" that defined a series of paintings by the artist. As Noll states of the painting in an article submitted to *The Psychological Record* in 1966:

...some interesting observations about [*Composition with Lines*] overall composition can be made... (a) The outline of the painting is a circle that has been cropped at the sides, top, and bottom; (b) The vertical and horizontal bars falling within a region at the top of the painting have been shortened in

length; and (c) The length and width of the bars otherwise seem to be randomly distributed. (*Human or Machine* )

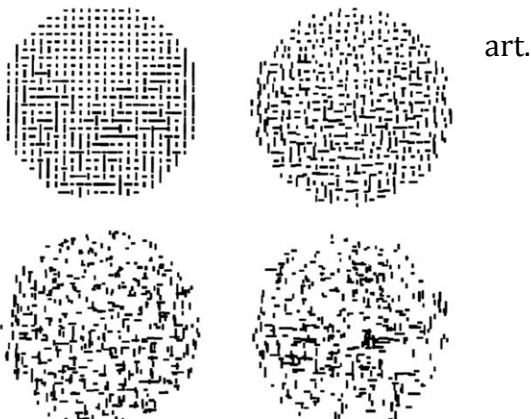
This thorough analysis, albeit on somewhat scientific grounds, would inform the program that Noll would create to imitate the painting in a number of computer-generated compositions based on these observations.

Utilizing the element of randomness that computers can contribute to image generation, the Mondrian imitations would be brought before a panel of people both ignorant and educated in the field of art; these subjects were then given a questionnaire and asked to identify which of the pieces was the original piece, and which was most pleasing on a number of different grounds. Dr. Noll would tout the results for some time after the experiment, as very few of the subjects identified the correct painting or preferred the original over the computer-generated ones. This experiment, if nothing else, pointed to the unique ability of the computer to imitate existing forms down to such detail as to render them indecipherable from their originals. The implications of the new medium's ability to do so were many, and demanded new questions in the seemingly disparate fields of computer science and art. Add to this one of Noll's conclusions from his study, and you have a number of debatable issues:

Artists have been popularly assumed to possess a gifted, special sense of aesthetic judgment that uniquely separates them from nonartists. The results of the experiment reported in this paper tend to refute this popular assumption by showing that for complex pseudorandom patterns the aesthetic preferences of artistically trained [subjects] are indistinguishable. (*Artistic Training* 449)

Noll goes on to state that many factors contribute to such judgments and that his conclusions only pertain to the experiment, but one cannot help reading into this statement. One thing is that this conclusion could be considered a slight dismissal of the very concept of the division between artists and the “nonartist”, a useful idea for someone claiming artistic merit without a background in the subject. To a practicing artist, this claim would be quite unpopular as it seems to devalue the very concept of the artist as a discursive subject. However, Noll maintains that he meant no offense to artists by his general conclusions, and has stated several times his great respect for the artistic integrity of practitioners in the field, but rather wanted to bring to light the new problem of recreation and imitation using a computer.

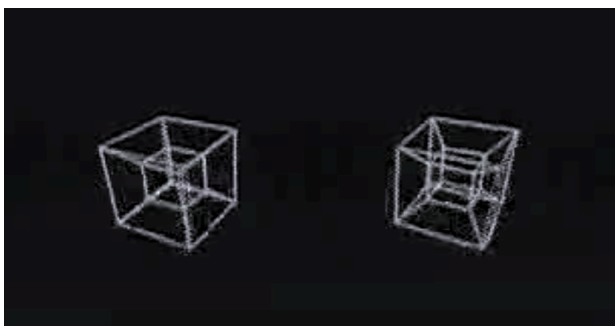
Without taking any great leaps from basic questions in art, the initial discoveries made by Noll, regardless of their artistic value, raised many questions. With the introduction of a medium (taken for granted in today’s analysis of new media as a field of study) that can literally produce infinite indecipherable copies of an existing work, what value does the idea of originality even carry? The computer itself has no stake in such questions, as it is a machine operating through discrete functions, algorithms and code and so forth; this makes it a medium that perhaps is not actually a medium unto itself. Obviously this is taking an extreme position on the subject, but one cannot say this is too far off from the basic questions of computer



Four Mondrian  
Imitations from Noll

In 1965 Dr. Noll would contribute several pieces he had created in his studies of perception and randomness to a gallery opening at the Howard Wise gallery on West 57<sup>th</sup> street in Manhattan. This opening, called “Computer-Generated Pictures” would mark one of the very first displays of computer art, and feature the work of Noll and his superior, Bela Julesz, who contributed several of his stereogram images to the show. Noll recalls: “Bela was always very careful not to call his images ‘art,’ since the images were stimuli for psychological investigations of visual perception. I, however, had generated many of my images solely for their aesthetic or artistic effects and was much more willing to call them art.” (*Beginnings 40*)

Subsequent to his work in the creation of images for both scientific research and aesthetic investigation, Dr. Noll joined a group of people attempting to make headway in the creation of computer animation. Noll made several films to this end. They were 3D stereographic films, meant to create the illusion of operating in a third dimension. For their time, the films were a step toward the more elaborate films that would be created in the years to come at Bell Labs. To a viewer today, they appear much as the very first films of Edison and Mellies do, except within the field of animation, featuring simple designs as opposed to simple depictions of reality. One might have the same reaction to the two different pioneering features in these two mediums, and thus they can be discussed on many of the same levels. One of the



4D Hypercube Screenshot

films, *Hypercube Computer Animation* (1965), features, as the title suggests, a hypercube (4D cube) rotating into and out of a theoretical fourth-

dimensional plane. Although the film is only some one minute and forty-two seconds long, it is a very impressive feat considering the technology of the time.

These films involved many hours of programming to create even one frame, with each point on the screen needing to be specified in the programming. That being said, they still remain simpler, in a very fundamental sense, from the animations that would come out of Ken Knowlton's work with Stan Vanderbeek and Lillian Schwartz. In addition to this, the films and images Noll created utilized what someone might call scientific language, especially in the titles of the pieces, although such titles were also a prominent feature in modern art, such as Readymade pieces like those of Duchamp; this again raises the complicated question of how much these works were art and how much they were scientific research, and whether those things were necessarily mutually exclusive.

The titles point to this question in a big way, as Noll's works had titles describing exactly what was to be seen, with no metaphoric or symbolic gestures. A cube was a cube. This is a feature one finds in many scientific papers, as this world of research demands straight-forward language (within the field of study, obviously not to laymen) and the avoidance of unneeded complications. In this sense, I would call Noll's work scientific in a way that Vanderbeek's and Schwartz's works may not be. This is not to dismiss or give credence to one over the other, but just to raise the point as another instance of easy dispute. Is the fact that Schwartz's movies featured names like UFO's and GOOGOLPLEX make them more artistic than Noll's Gaussian-Quadratic or even Knowlton's Method for Creating Computer-Generated Films?



Knowlton would of course admit that this film was indeed just a work of scientific filmmaking, intended to demonstrate the making computer films in the very making of the film, a sort of meta-analysis of computer-generated films. Despite this fact, the film is still that: a film, and thus carries with it the gamut of aesthetic properties that a film naturally has. One can certainly draw many differences in the films of Noll and Schwartz, and indeed one should, but nonetheless both sets of films are necessarily analyzed on the same level.

Noll is referred to in the handful of sources available on the early days of computer art as somewhat of a “purist” about his views on the medium. He felt, and remains ardent about it to this day, that a “computer artist” should be someone who can operate in the two relevant fields, computer science and art. He did not particularly like Schwartz’s presence at Bell Labs in the period that she was there. Although several years after the bulk of his research, something Noll holds near and dear, her arrival at Bell Labs was seen by Noll as a power grab of sorts. As he sees it, she moved into the Labs at the perfect time to capitalize off the work already done and being done. This view is of course just his opinion, and one that is hotly disputed by both Schwartz and her son, Laurens. As Laurens put it in an email to me: “Noll's history is of course distorted. Besides transmuting himself into an artist, he was also a choreographer... I can say that three people from the Labs in their late stage of life have developed a belief that Schwartz did nothing and they were the artists.” Laurens was responding to an early draft of this same history based more prominently on Noll’s recollections in an interview I conducted. He has come to Schwartz’s defense on more than one occasion; staking the claim that Noll’s history

has been warped by time, Laurens has indicated that time left Noll bitter and desiring more credit than he feels history has given him. Perhaps the most notorious of these exchanges came in an email from Noll to Schwartz several years back, in which Noll made several blunt comments in regard to what he felt was her disregard for his and Knowlton's participation in the movement, stating, "In science and research, we are taught the importance of giving credit and referencing the work of others, of getting facts correct, and of not making extravagant claims... You came to Bell Labs, as I remember, in the very late 1960's... This would place you in the third wave of computer art."

Noll goes on to make it clear that her (apparent) claims to be the inventor of computer art are simply not true and that she was "privileged to have access to people and facilities of the highest order." (Noll, *Email*) All of that being said, Noll was also very clear that she did indeed play a large and influential role in the realm of computer art and that he was by no means dismissing her place in history. At the same time, one does not have to read into the email very closely to see how and why Laurens found it so condescending and was quick to fire back. This dispute is of course difficult to nail down, and to take sides in any way would be unproductive. Why it is important, however, is very clear and speaks to larger issues that just who did what and when.

In the creation of his works, Noll was, for the most part, the sole creator and thus, in his view, a true computer artist. His films were rudimentary and aesthetically simple compared to subsequent works to come out of Bell, but also vitally important. They featured, like his still graphics, basic lines and shapes that

would do simple movements, such as the 4D hypercube moving into and out of a graphical approximation of the fourth dimension. I use words like “simple” and “basic” not out of a value judgment, but for the sake of description. These films were not psychedelic and did not feature rampant colorization and movement. One might think of his films and graphics on the same level as the Op Art movement of the time. In fact, one of Noll’s pieces at the time of his research was a recreation of Bridget Riley’s *Currents* (1966, fig. 4), which featured a number of lines in parallel forming a wave-like pattern. This movement could be defined by its simplicity and focus on structure over a concern for beauty etc. As computer art was in its early days, this type of art was naturally analogous. As Noll puts it:

Many “Op Art” paintings are very regular and mathematical in design. The computer is extremely adept at constructing purely mathematical pictures and hence should be of considerable value to “op” artists. (*Computers and Visual Arts 4*)

It is the focus on mathematical exactness found in Op Art that indeed made it such a useful means of experimenting with 2D images on the computer.

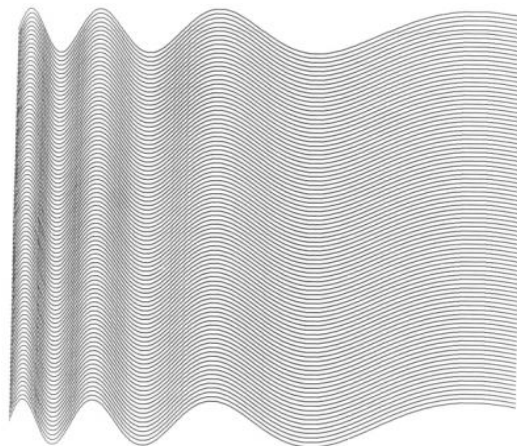


Fig. 4 “Ninety computer-generated sinusoids with linearly increasing period”

In addition to having strong opinions on the history of computer art, Noll has also written extensively on the subject. In an essay called *Computers and the Visual Arts* (1965), Noll outlines the method and means for producing 2D images as well as 3D computer films, stating:

... If the computer can produce a single three-dimensional picture, then it also can produce a series of three-dimensional pictures to make a three-dimensional movie. Now the static character of the computer sculpture is gone and in its place are the almost limitless possibilities of three-dimensional movement and shape transitions. (*Computers and Visual Arts 11*)

## Stan Vanderbeek:



*"The mind is a computer, not railroad tracks"*

While they had many things in common, Stan Vanderbeek provides an interesting and useful contrast to Lillian Schwartz, both as an artist and as a collaborator with the technologists at Bell. Most obviously, both artists were doing new work in similar media: a combination of film/video, still photography and found images. More important, both artists clearly recognized that technology had already changed art and even the idea of the artist, and both wanted to be part of the changes still to come. That said, the two artists differed in several important ways. For one thing, while excited about the prospects for these new forms and new artists, Schwartz was also skeptical about the possible effects on art and the artist.

In a way, she seemed to feel the artist needed to be protective as well as collaborative, cautious as well as excited, as can be seen in her writings, where she suggests that the artist remain the central force in the partnership, with technology being kept in check with “obedient cooperation.” By contrast, Vanderbeek, after some early months of frustration working with Knowlton, becomes an exuberant partner with technology, one whose scope and vision went far beyond the world of art.

Having studied at Cooper Union, receiving a B.A., and subsequently attending Black Mountain College, in North Carolina, Vanderbeek was well versed in experimental arts of all kinds. In 1969, Vanderbeek offered an overview of his work in the late 1950s, work that included a variety of media and forms. As Vanderbeek describes it, he worked with “painting and graphics, polarized light, constructions, heat painting, collages, etc.” By 1957 he began to develop an interest in motion pictures and animation. “ Throughout the period leading up to his brief tenure at Bell Labs, Vanderbeek was an outspoken member of the avant-garde community, often preaching his message of transcendence through film. In fact, Vanderbeek had great hopes for new technology of all kinds. He felt that the cross section of art and technology was a perfect place, so to speak, to seek social revolution and mind-expansion. In his usual sweeping way, he later concluded “we’re entering a mythic age of electronic realities that exist only on a metaphysical plane” (Expanded Cinema 206).

Vanderbeek arrived at the Labs in 1966, having heard about the advent of the computer art scene that had its roots there. Schwartz recalls Vanderbeek being a

somewhat elusive figure at Bell Labs, saying that he would often show up, rattle off a number of ideas to Knowlton, and then take off to attend to other projects. Despite his less present status as a member of the computer graphics crowd at Bell, he still had a dramatic impact on everyone involved, and is largely referenced with only the highest regard. Perhaps the one criticism could be tied to Knowlton, who often felt somewhat lost when Vanderbeek would be off on one of his tangents. Knowlton refers to Vanderbeek implicitly in his piece on collaborating with artists; although one cannot know for sure, it would seem he fits this description:

One [artist] was so highly-charged mentally that it took me a day each time to recover from half a day of working together — I was constantly bombarded by proposals about what we could do if we only had ten times more time, money, equipment and patience. (On Frustrations, Knowlton)

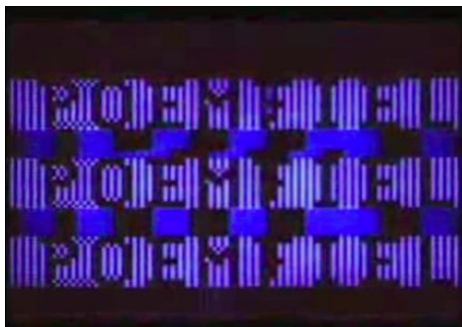
As he sought to utilize the new technology of computers to create films, Ken Knowlton would program all of the material. In their time working together, Knowlton came to feel both admiration and frustration, adding:

The first few months of interaction with Vanderbeek were mutually frustrating. I had hoped he would pick up my original BEFLIX language, with all its implicit generality, and begin to do great artistic thing with it; he came with great designs in his head and hope I would program them. We needed a new way of working together—which turned out to be a new language that grew from one of Stan's ideas about words and letter made out of words and letters.(Youngblood 400)

Vanderbeek compared this to what Knowlton and Harmon had done in their work with pictures-within-pictures, like the design of the *Studies in Perception* series:

“Were trying to do that cinematically.” (250)

An early product of this somewhat uneasy partnership was a film entitled *Man and His World* (1965) and a series of short films called *Poemfields 1-10* (1964-67). These films would feature mandala-like animation, and were produced using Knowlton’s first programming language, BEFLIX and also with a more simple program designed by Knowlton that would allow Vanderbeek to program for himself, called TARPS. Vanderbeek, his energy, and his artistic vision impressed Knowlton: “Stan’s mental and physical energy raced ahead of both of us.” (Recollections of Collaborations with Artists, 2010) This description is consistent with all members of the staff that I spoke to about Vanderbeek; each of them recall him coming into the Labs with a spark and wide vision for what he wanted to create. He could be seen pacing around Knowlton’s workspace, firing off ideas faster than Knowlton could comprehend them: “The Vanderbeek approach was try just about anything to see what happened; it would surely suggest something else to do.” (Relections)



Title shot of from the *Poemfields* series done by Vanderbeek and Knowlton



Similar to Schwartz, he approached computers as a challenge—“a large black box: the memory of the world, a metaphysical printing press”—and with Knowlton’s help he was able to learn enough programming to begin computer-generated animation. Of that early learning experience, Vanderbeek later wrote:

I considered the computer-logic systems and process of image making, a fast high speed car, that is difficult to learn how to drive...and like fast turns is somewhat dangerous and unpredictable...however, in time-speed-memory-ideas and forms, it is breathtaking...

In time, both his confidence and exuberance increased to the point where, as he puts it, “I expect driving a computer down the road of art and sensibilities will lead to flying...and that will be lovely and full of surprises that defy gravity and expected images.”

In addition to his admiration for Vanderbeek for his creativity and artistic intelligence, Knowlton felt very positive about Vanderbeek’s ability to learn a new programming language that they developed together that was used to make their films. Although it is unclear how much programming Vanderbeek actually did (at least in terms of work hours), he did learn how to program his own images, albeit with the help of Knowlton, as a “debugging consultant,” as Knowlton puts it. I suspect that Knowlton was present to help Vanderbeek in many ways, but it is important that the artist was the programmer, to whatever extent that was the case. After all, one of the major objections to collaboration that Noll had, and that Knowlton agreed with although to a lesser extent, is that artists were too reliant on their programmers, and that this would ultimately detract from their ability to

advance as artists in the computer medium. In "Art Ex Machina," he offers this contrast:

Two outstanding animators, John Whitney and Stan Vanderbeek, have used computers in their work although their individual approaches are quite different. Whitney does his computer animation at a graphics console by manipulating parameters in a program written for him by someone else. This gives him almost immediate visual feedback, but since Whitney does not program, he cannot obtain a completely different repertoire of visual images without his programmer's help. Vanderbeek, on the other hand, does his computer animation at the programming level, but the resulting programs are so time consuming and the amount of data to be displayed so large that immediate feedback is virtually impossible. Thus, both Vanderbeek and Whitney are handicapped by the deficiencies of their computer environment. (Art Machina 12)

Would it have helped if Vanderbeek had immediate access to visual feedback in addition to his programming knowledge? Somewhat, Noll concludes, "but not in terms of complete new image producing capabilities" (12). The real problem as Noll sees it, "is of a fundamental nature: artists think visually in a very intuitive manner," while computer programming, "requires logical rigor"(12).

Logical rigor may have been most on the mind of Noll, and to some degree Knowlton, but Vanderbeek's mind was focused on the world outside the labs at Bell. As Michael Rush says, "The social-sexual revolutions of the 1960's found expression in art that was directed away from the canvas into actions that incorporated the viewer into the work of art (37). That is certainly how Vanderbeek saw the promise of this new art. The happenings of certain artists and thinkers as well as the work of

the Fluxus movement would be examples of how artists were trying to do something new and immersive with art.

It is imperative that we (the world's artists) invent a new world language... that we invent a non-verbal international picture-language... [and the development of] new image-making devices.  
(culture intercom 16 )

Vanderbeek was by no means new to the art world or the realm of art theorization when he arrived at Bell Labs, and he would continue for some years afterward. His views on art and the potential for film as a medium that could change the world are widely available just about anywhere one looks for mentions of Vanderbeek: “We’re just fooling around on the outer edges of our own sensibilities. The new technologies will open higher levels of psychic communication and neurological referencing” (Youngblood 247). It is statements like these that defined what Vanderbeek hoped for in the burgeoning world of technology, and the implications this technology could have on art. His idealism in regards to technology went beyond simply being positive about its future uses and possible applications; Vanderbeek felt strongly that technology could be used in as a means of “expanding consciousness.”



Vanderbeek  
with his  
Movie Dome

In tune with the leftist rhetoric of the day, although far more focused and specific, his of future technology could be easily tied to ideas concerning mind expansion in other areas, such as the LSD fad and the antiwar movement of the 60's. That being said, Vanderbeek's opinions are unique insofar as they relate directly to technology and the development of new forms; other people operating on the fringe of art and politics would likely dispute the first thought. Bell Labs would be a perfect example of his position's unusual placement. Here was a large corporate laboratory directly involved in Vietnam and seemingly contrary to the very idea of expanding and refocusing consciousness, as large institutions like this were, at least symbolically, tied to the status quo:

Vanderbeek's metaphysical approach [to film] may be at odds with what computer technology conjures up in most people's minds, yet it demonstrates an attitude which has been responsible for the realization of some of the most enchanting images in motion.  
(Reichardt 80)

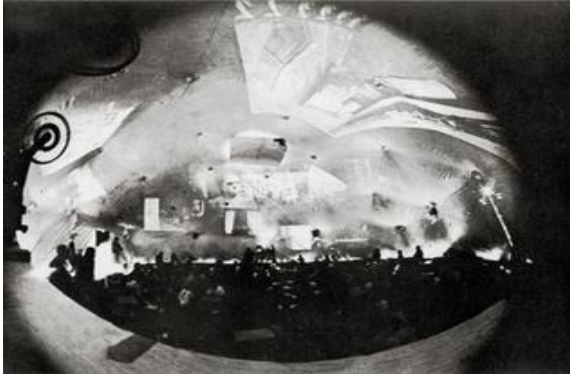
This puts into words well the somewhat paradoxical view of Vanderbeek's about a field (cutting edge technology) that is at odds with his quasi-mystical theories on film. But it was his faith in the intersection of art and technology that made Vanderbeek such an important figure, and it was his bold, fearless vision that dazzled Knowlton:

Stan was the wild man who built a planetarium style dome in the wilderness for simultaneous projections by a dozen slide and movie projectors; who fed the output from a radio station into the armature of an electric motor in a drill press and output from the stator to an oscilloscope in view of a camera;

who projected films into fog arising from makeshift steamers that almost but never actually exploded...he used all these things as gleanings for zany, suggestive, provocative animations... (Collaborations with Vanderbeek)

Youngblood called Vanderbeek a renaissance man, one who had been “a vital force in the convergence of art and technology, displaying a visionary’s insight into the cultural and psychological implications of the paleocybernetic age” (246). In his overview of American ‘underground’ film, Sheldon Renan calls Vanderbeek “a collisionist” because “he likes to bring disparate elements together at high speed, cut-outs, cars, pictures of politicians, pin-ups from *Playboy*, and so on” (184). He also calls him an “illusionist” because “everything in his films is always changing into something else, cars into carnivorous creatures, hands into birds, and so on (184).

Concurrently with his work at Bell Labs, Vanderbeek was also working on his own ideas for a new means of viewing films. In what he referred to as his MovieDome, Vanderbeek famously wanted to create an immersive environment to view films that would cause their viewers to have transcendent experiences, something akin to meditation or mind-expanding substances. In his usual way, Youngblood offers his view of this project: “Vanderbeek’s movie-murals are part of a plan to develop a new visual language that could be used to communicate broad concepts of existence among the cultures of the world” (Youngblood, 189).



This project was one of many that Vanderbeek involved himself in. His films at Bell Labs were a marked shift from the previous ones made by Noll and others in the “first generation” of computer art (a classification Noll refers to in a personal correspondence). As I discussed, Noll’s films were experiments in computer science as much as they were forays into aesthetics. Vanderbeek and Knowlton brought the computer film to a new level of creative endeavor, seeking to utilize its ability to render abstract images. As Youngblood writes:

Whereas most other digital computer films are characterized by linear trajectory figures moving dynamically in simulated three-dimensional space, the Vanderbeek-Knowlton *Poemfields* are complex, synchronistic two-dimensional tapestries of geometrical configurations in mosaic patterns.” (247)

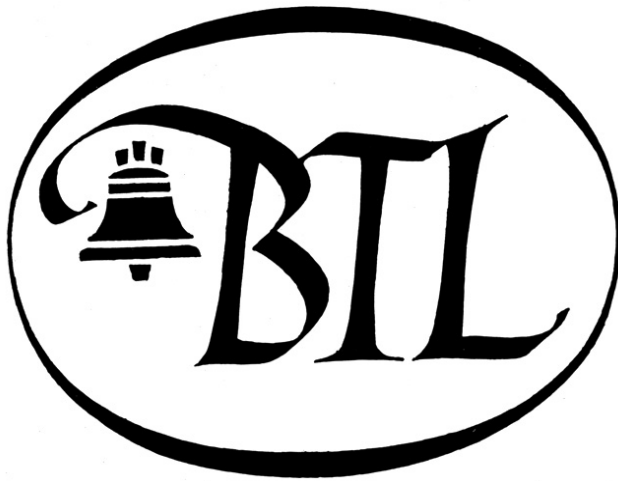
The Vanderbeek-Knowlton collaborations did indeed do something much different than Noll’s films. This is not to downplay Noll’s efforts, as his films were some of the very first ever made, regardless of how they are viewed by some today. Rather, the importance of the Vanderbeek films is in their complete dissimilarity to the first wave of films, which have the colder, dryer look of a research animation. The intense use of color and abstract patterns pointed to something computers had that hand-

drawn animation did not: absolute geometric perfection. The patterns used in the *Poemfields* series and *Man and His World* are far more akin to the films Schwartz would make with Knowlton in years to come. They moved very quickly and were comprised of many smaller, discreet shapes (or in the case of *Poemfields*, letters and words) that formed larger ones, creating a fractal-like effect for the viewer.

In terms of the timeline and history of influences that played out at Bell Labs, from the first graphics created there to the acceptance of the medium as a semi-legitimate form of research, Vanderbeek's films would be best described as the stepping stones from Noll's work, along with Edward Zajak and other early sixties researchers, to Schwartz's work starting in the late sixties. It also marked the beginning of Knowlton's own interest in creating art, not to mention the first time he even considered that he could take that route:

After our sporadic interactions for a few years, Stan went on to other labs, travels, shows, events and teaching appointments. I don't know whether he took away from our collaborations any better ordering of his activities; for my part, I began to appreciate wider possibilities of making things that were meaningful in ways I have stopped trying to explain. And so, a decade or two later, thanks in part to Stan, I began to call myself an artist. (Collaborations with Vanderbeek)

## Epilogue: A History Unwritten



**Bell Telephone Labs Logo**

As important as this story is, in both a historical and analytical sense, it has been largely overlooked by art criticism and history. There are a small handful of people who have written on the subject, providing very insightful and often succinct thoughts on the subject, but the larger history of the period has left computer art in the margins. This could be for a number of reasons, but it would seem that the very issues I raise in this essay account for the majority. Seeing as between three interview subjects and a spattering of commentators could not come to an agreement first on the specifics of who is or was the true pioneer but also cannot agree on what computer art or a computer artist is, it is no surprise that a historical record would rather let sleeping dogs lie. Given that the history is so complex and difficult to nail down, you would think, however, that theorists and art historians would revel in the uncertainty, using the disagreements to approach the same problems I have. But ruminating on this can serve no purpose than to reassure



myself of the importance of my own work, something I have learned may not be in one's best interest as far as the historical record is concerned.

The story of early computer graphics at Bell Labs, whether it be film or images, speaks to very specific issues that have plagued the art world as long as it been (around?). The characters I chose for inclusion in this paper all played a major role in not only producing early examples in the medium, but also were at the forefront of the theoretical basis for defining it. Naturally, their memories and particular viewpoints clash in a number of ways; add to this the lack of proper chronicling that the overall history has received, and the problem is exacerbated. But although both of these facts make the historical record quite contentious, they also provide the fine lines that make this so interesting. Each person's perspective raises some of the same questions, as well as unique questions that tug at each person's claims and thoughts.

Lillian Schwartz was an avid defender of the artist in this story. Her point generally focused on the fact that an artist can have an overarching artistic vision that outweighs the technical input provided by others involved. In addition this, she felt that the computer was a medium unto itself, a new form that must be treated as such, and rejected the label of "computer art"; she felt that since the computer is a new medium, that no such specification is necessary. Just as one would not call painting "brush and canvas art", or something akin to this, there is similarly no need to seclude the new art form by predicating it as something different, the products are simply art.

Ken Knowlton, a programmer and artist by his own accord, felt similarly about the medium and the name. He often was skeptical of the title “computer art”, almost always putting it in quotations and questioning the very categorization. That being said, he was obviously a proponent of the possibilities of the medium. On the issue of what exactly this new form was, and who exactly should be considered a practitioner of it, he was not as much in agreement with Schwartz. In his early days of working with computer graphics, Knowlton never identified himself as an artist. Once he had worked with several artists, he began to recognize his own abilities and interest in going beyond just programming and collaborating with artists.

This pushed toward feeling that his contributions to the projects he had worked on with artists were compromised in some way. He did not regret his work, and in numerous cases reflected positively on it, despite having some reservations about the process of collaboration. To this day, Knowlton sees himself as an artist, one working in the field of computers, and is inclined to believe that “computer artists”, in the early days of their existence anyway, were those who could perform the tasks of programming and aesthetic vision. He does not question the artistic integrity of those he worked with, as they have all proven themselves able artists, but feels that Schwartz is an example of one who may not have done all that was necessary to really be considered an artist in the computer medium.

Michael Noll, for all his vitriol, may be the easiest of the bunch to explain the opinions of. There is very little room for compromise in Noll’s mind, since he felt himself to be a computer artist in the truest sense of the term, insofar as the term applies. He was an engineer whose fascination with art and the creative process led

him to utilize the computers available to him for research. This places him in the hypothetical category I have suggested of the “complete computer artist”, one who can operate in the two disparate fields of programming and art. Noll’s suggestion is that an artist needs to be in complete control, stating:

I strongly believed that the artist must understand the medium. The artist must be gifted in the use of the medium. You can’t be an artist, and then say well, here’s my crafts person and I’m going to say what to do. You have to understand the medium and how to use it.”

*(Machina 13)*

To Noll, “understanding the medium” is a very specific thing. Rather than thinking about the medium of computers in terms of purely their output and a comprehension of the aesthetic possibilities of the form, he strongly endorses the necessity of technical knowledge in addition to singular vision. One can think of several examples from art history that directly contradict this view, but it nonetheless carries weight and cannot be dismissed.

Stan Vanderbeek would be the odd man out in this arrangement of ideas and views on the medium. He was not very concerned with the same questions that the other three involved had. Vanderbeek had a vision that went above and beyond the details of what made one a computer artist or what exactly defines art made with computers. He was far more concerned with the possible influence the medium could have on society, given its ability to be reproduced and shown in conjunction with modern communications technology, such as satellites. There was not the same need on Vanderbeek’s part, perhaps because he was known outside this insular world for many other films and projects, to be recognized in the medium’s history;

nor did he have the same interest in setting the terms for his own image and definition in the newly emerging medium. In terms of his own practice in the medium, Vanderbeek was very similar to Schwartz, in that he learned basic programming after working with Knowlton on a new language more suited to his abilities and interests. Thus, Vanderbeek was able to work from the technical side of the paradigm, but always with the buffer of Knowlton between him and the real business of computer programming.

On the question of who the real computer artist is, the line drawn is difficult to walk without falling into one camp or the other. After all, society has always entrusted the artist, as a discursive category and regardless of the particular medium, with a great deal of autonomy and power. Films of all kinds are referred to by their director before anyone else involved; this suggests a value given to the aesthetic vision over the practicalities of what work was done on the film, and by whom. The nature of the artistic work can be said to demand a certain degree of ownership, despite the existence of a creative “committee”, so to speak. The films of Stan Vanderbeek and Lillian Schwartz were made by collaboration with Ken Knowlton; does this make them any less their work? The films would not have been made, or even thought of, were it not for the artists coming into Bell Labs and expressing their specific ideas for what they wanted to create. But at the same time, the films would not have been made without the programming knowledge of Ken Knowlton, a large hindrance for any artist unskilled in that science.

This brings the question to something larger. What defines a work of art as such? Is it a sum of the parts or a text to be analyzed without the weight of intention

considered? On one level, disregarding intention can be useful, insofar as analysis can have more breathing room and not be constrained by all the “parts” that compose it. This analytical “tactic”, if you will, is not necessarily useful in this context, at least in trying to sort out the definition of computer art/films; this could be due to the fact that the films and images discussed here were some of the first of their kind, and therefore it could be said that each person who created something in this period had the privilege of defining what it was. The creation of a new medium in the arts allows its progenitors a degree of latitude in this way. Thus, to ignore their opinions in any way is to claim an authority that is unproductive in the examination of this history.

Thus, each of the artists that I have examined has every right to call themselves as such; if one is working in a medium that is in its infancy, then the simple practice of creating anything could be considered an artistic achievement. Consider the early films of Edison and the Lumiere brothers; their chronicling of movement, whether it was somebody dancing or a train arriving at a station, was immediately, by nature of it being among the first of its kind, innovative within the medium. Today, they are viewed as works of art in their own right. In much the same way, Michael Noll’s films, titled in a similar explicatory manner, were certainly research into this new discovery but were ostensibly pieces of computer film as well, and that being said, asserting their position as art is not far off.

That being said, if Noll’s work is Edison’s basic shots of movement, as much research films as Noll’s were, then the work of Vanderbeek and Schwartz is indeed advancement in the medium. They wanted to push this new art form to create

something that no one could imagine, something that defied definition and could even affect one's psyche. In this, they succeeded. The world of computer graphics has since expanded into a world so thriving and enormous that it has come to define our current century. To ask the question of who a computer artist is today is very different from that same question being asked in the heyday of early computer art. Anyone who can recognize simple symbols can operate a computer and can utilize any number of programs where the code and the entire process of programming is made so discreet that one can forget it even exists. The early visions of these pioneers were absolutely right; computers and computer graphics would go on to alter humanity in ways unimaginable to anyone back at Bell Labs.

As to the question of the artist, the art, and where the credit goes all these years later, I leave it as much up to the reader as I do any future historians who wish to delve into the subject. All the people I cover make their point quite eloquently; one can certainly take a stance similar to any of the subjects, but I feel that to do so is largely unproductive. Instead, taking the good with the bad, and acknowledging each of these computer artists for their contributions, and using their dispute to examine a larger issue seems more pertinent. Or perhaps it is best to end with John Whitney recollections on working as a programmer at IBM:

I have not had to worry about hardware. Nor have I with the program. I've really had three years of the most rewarding creative study. In other words, it's the same as if you decided to play the piano, you would never have to fuck around with the keys or the strings or tuning or anything else. You'd have three years playing the piano. (Whitney, quoted in *Computers and Creativity*)

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