EXPANDED CINEMA

by Gene Youngblood

Excerpt

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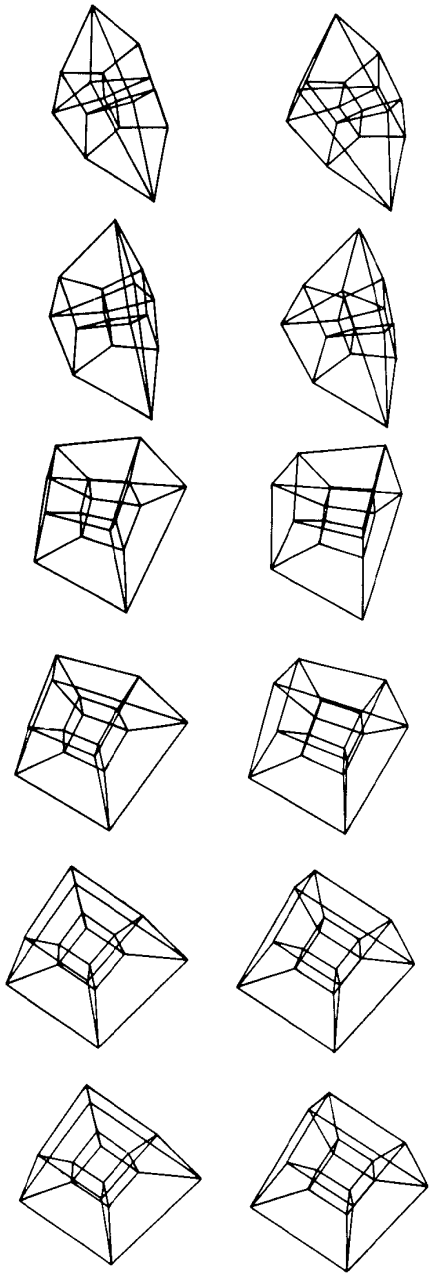
The Aesthetic Machine

As the culmination of the Constructivist tradition, the digital computer opens vast new realms of possible aesthetic investigation. The poet Wallace Stevens has spoken of "the exquisite environment of face." Conventional painting and photography have explored as much of that environment as is humanly possible. But, as with other hidden realities, is there not more to be found there? Do we not intuit something in the image of man that we never have been able to express visually? It is the belief of those who work in cybernetic art that the computer is the tool that someday will erase the division between what we feel and what we see.

Aesthesic application of technology is the only means of achieving new consciousness to match our new environment. We certainly are not going to love computers that guide SAC missiles. We surely do not feel warmth toward machines that analyze marketing trends. But perhaps we can learn to understand the beauty of a machine that produces the kind of visions we see in expanded cinema.

It is quite clear in what direction man's symbiotic relation to the computer is headed: if the first computer was the abacus, the ultimate computer will be the sublime aesthetic device: a parapsychological instrument for the direct projection of thoughts and emotions. A. M. Noll, a pioneer in three-dimensional computer films at Bell Telephone Laboratories, has some interesting thoughts on the subject: "...the artist's emotional state might conceivably be determined by computer processing of physical and electrical signals from the artist (for example, pulse rate and electrical activity of the brain). Then, by changing the artist's environment through such external stimuli as sound, color and visual patterns, the computer would seek to optimize the aesthetic effect of all these stimuli upon the artist according to some specified criterion... the emotional reaction of the artist would continually change, and the computer would react accordingly either to stabilize the artist's emotional state or to steer it through some pre-programmed course. One is strongly tempted to describe these ideas as a consciousness-expanding experience in association with a psychedelic computer... current



Visualizing the invisible: Six successive stereo pairs from a film by A. Michael Noll of Bell Telephone Laboratories, demonstrating the rotation, on four mutually perpendicular axes, of a four-dimensional hypercube projected onto dual two-dimensional picture planes in simulated three-dimensional space. The viewer wears special polarized glasses such as those common in 3-D movies of the early 1950's. It was an attempt to communicate an intuitive understanding of four-dimensional objects, which in physics are called *hyperobjects*. A computer can easily construct, in mathematical terms, a fourth spatial dimension perpendicular to our three spatial dimensions. Only a fourth digit is required for the machine to locate a point in four-dimensional space. Photo: Bell Telephone Laboratories.

technological and psychological investigations would seem to aim in such a direction."[21]

This chapter on computer films might be seen as an introduction to the first tentative, crude experiments with the medium. No matter how impressive, they are dwarfed by the knowledge of what computers someday will be able to do. The curious nature of the technological revolution is that, with each new step forward, so much new territory is exposed that we seem to be moving backwards. No one is more aware of current limitations than the artists themselves.

As he has done in other disciplines without a higher ordering principle, man so far has used the computer as a modified version of older, more traditional media. Thus we find it compared to the brush, chisel, or pencil and used to facilitate the efficiency of conventional methods of animating, sculpting, painting, and drawing. But the chisel, brush, and canvas are *passive* media whereas the computer is an *active* participant in the creative process. Robert Mallary, a computer scientist involved in computer sculpture, has delineated six levels of computer participation in the creative act. In the first stage the machine presents proposals and variants for the artist's consideration without any qualitative judgments, yet the man/machine symbiosis is synergetic. At the second stage, the computer becomes an *indispensable* component in the production of an art that would be impossible without it, such as constructing holographic interference patterns. In the third stage, the machine makes autonomous decisions on alternative possibilities that ultimately govern the outcome of the artwork. These decisions, however, are made within parameters defined in the program. At the fourth stage the computer makes decisions not anticipated by the artist because they have not been defined in the program. This ability does not yet exist for machines. At the fifth stage, in Mallary's words, the artist "is no longer needed" and "like a child, can only get in the way." He would still, however, be able to "pull out the plug," a capability he will not possess when and if the computer ever reaches the sixth stage of "pure disembodied energy."[22]

[21] A. M. Noll, "The Digital Computer as a Creative Medium," *IEEE Spectrum* (October, 1967), p. 94.
[22] Robert Mallary, "Computer Sculpture: Six Levels of Cybernetics," Artforum (May, 1969), pp. 34, 35.

Returning to more immediate realities, A. M. Noll has explained the computer's active role in the creative process as it exists today: "Most certainly the computer is an electronic device capable of performing only those operations that it has been explicitly instructed to perform. This usually leads to the portrayal of the computer as a powerful tool but one incapable of any true creativity. However, if 'creativity' is restricted to mean the production of the unconventional or the unpredicted, then the computer should instead be portrayed as a creative medium—an active and creative collaborator with the artist... because of the computer's great speed, freedom from error, and vast abilities for assessment and subsequent modification of programs, it appears to us to act unpredictably and to produce the unexpected. In this sense the computer actively takes over some of the artist's creative search. It suggests to him syntheses that he may or may not accept. It possesses at least some of the external attributes of creativity."[23]

Traditionally, artists have looked upon science as being more important to mankind than art, whereas scientists have believed the reverse. Thus in the confluence of art and science the art world is understandably delighted to find itself suddenly in the company of science. For the first time, the artist is in a position to deal directly with fundamental scientific concepts of the twentieth century. He can now enter the world of the scientist and examine those laws that describe a physical reality. However, there is a tendency to regard any computer-generated art as highly significant—even the most simplistic line drawing, which would be meaningless if rendered by hand. Conversely, the scientific community could not be more pleased with its new artistic image, interpreting it as an occasion to relax customary scientific disciplines and accept anything random as art. A solution to the dilemma lies somewhere between the polarities and surely will evolve through closer interaction of the two disciplines.

When that occurs we will find that a new kind of art has resulted from the interface. Just as a new language is evolving from the binary elements of computers rather than the subject-predicate relation of the Indo-European system, so will a new aesthetic discipline that bears little resemblance to previous notions of art and the creative process. Already the image of the artist has changed

[23] Noll, "The Digital Computer as a Creative Medium," p. 91.

radically. In the new conceptual art, it is the artist's *idea* and not his technical ability in manipulating media that is important. Though much emphasis currently is placed on collaboration between artists and technologists, the real trend is more toward one man who is both artistically and technologically conversant. The Whitney family, Stan VanDerBeek, Nam June Paik, and others discussed in this book are among the first of this new breed. A. M. Noll is oneof them, and he has said: "A lot has been made of the desirability of collaborative efforts between artists and technologists. I, however, disagree with many of the assumptions upon which this desirability supposedly is founded. First of all, artists in general find it extremely difficult to verbalize the images and ideas they have in their minds. Hence the communication of the artist's ideas to the technologist is very poor indeed. What I do envision is a new breed of artist... a man who is extremely competent in both technology and the arts."

Thus Robert Mallary speaks of an evolving "science of art... because programming requires logic, precision and powers of analysis as well as a thorough knowledge of the subject matter and a clear idea of the goals of the program... technical developments in programming and hardware will proceed hand in glove with a steady increase in the theoretical knowledge of art, as distinct from the intuitive and pragmatic procedures which have characterized the creative process up to now."

John Whitney: Composing an Image of Time

"My computer program is like a piano. I could continue to use it creatively all my life."

The foremost computer-filmmaker in the world today, John Whitney has for more than thirty years sought new language through technological resources beyond human capacity. He has, however, remained resolutely "humanist" in his approach, constantly striving to reach deep emotional awarenesses through a medium essentially austere and clinical. He has realized his goal to a remarkable degree, yet he would be the first to admit that there is a long way to go. "Computer graphic systems," he has said, "present an opportunity to realize an art of graphics in motion with potentials that are only now conceivable and have never been explored."

In his essay "Systems Esthetics," Jack Burnham observed: "Scientists and technicians are not converted into artists, rather the artist becomes a symptom of the schism between art and technics. Progressively, the need to make ultrasensitive judgments as to the uses of technology and scientific information becomes 'art' in the most literal sense."[24] Whitney is making those judgments with a powerful extension of his brain.

Following studies at Pomona College in California, Whitney spent a year in Europe where he studied photography and musical composition. In 1940 he began specializing in concrete designs in motion, working with his brother James on animated films which won first prize at the first Experimental Film Festival in Belgium in 1949.

Early in the 1950's he experimented with the production of 16mm. films for television and in 1952 wrote, produced, and directed engineering films on guided missile projects for Douglas Aircraft. He was a director of animated films at UPA in Hollywood for one year. The title sequence for Alfred Hitchcock's *Vertigo* was among the

[24]Jack Burnham, "Systems Esthetics," *Artforum* (September, 1968), pp. 30-35.

work he produced in association with Saul Bass during this period. Following that he directed several short musical films for CBS television, and in 1957 worked with Charles Eames assembling a seven-screen presentation for the Fuller Dome in Moscow. Each screen was the size of a drive-in movie screen.

In 1960 Whitney founded Motion Graphics Inc., producing motion picture and television title sequences and commercials. Much of this work was done with his own invention, a mechanical analogue computer for specialized animation with typography and concrete design. In 1962 he was named Fellow of the Graham Foundation for Advanced Study in the Fine Arts. Finally, after approximately a decade, he found himself free once again to begin experimenting with less commercial, more aesthetic, problems of motion graphics.

The analogue computer work gained Whitney a worldwide reputation, and in the spring of 1966 International Business Machines became the first major corporation to take an "artist in residence" to explore the aesthetic potentials of computer graphics. IBM awarded Whitney a continuing grant that has resulted in several significant developments in the area of cybernetic art. Whether working with hand-drawn animation cards or highly abstract mathematical concepts, Whitney has always displayed an artist's intuition and a technologist's discipline. He is a man of tomorrow in the world of today.

The history of cybernetics reached a milestone during World WarII with the development of guidance and control mechanisms for antiaircraft artillery. Two men riding a telescope table sighted enemy aircraft and followed their penetration into the battery range. Selsyn motors in the gun-director mechanism automatically aimed an entire battery of guns while analogue computers set fuse times on explosive shells and specified true-intercept trajectories from data fed into the ballistics equation from movements of the operators.

An M-5 Antiaircraft Gun Director provided the basic machinery for Whitney's first mechanical analogue computer in the late 1950's. This complex instrument of death now became a tool for producing benevolent and beautiful graphic designs. Later Whitney augmented the M-5 with the more sophisticated M-7, hybridizing the machines into a mammoth twelve-foot-high device of formidable complexity

John Whitney working with his mechanical analogue computer. Photo: Charles Eames.

upon which most of the business of Motion Graphics was conducted for many years.

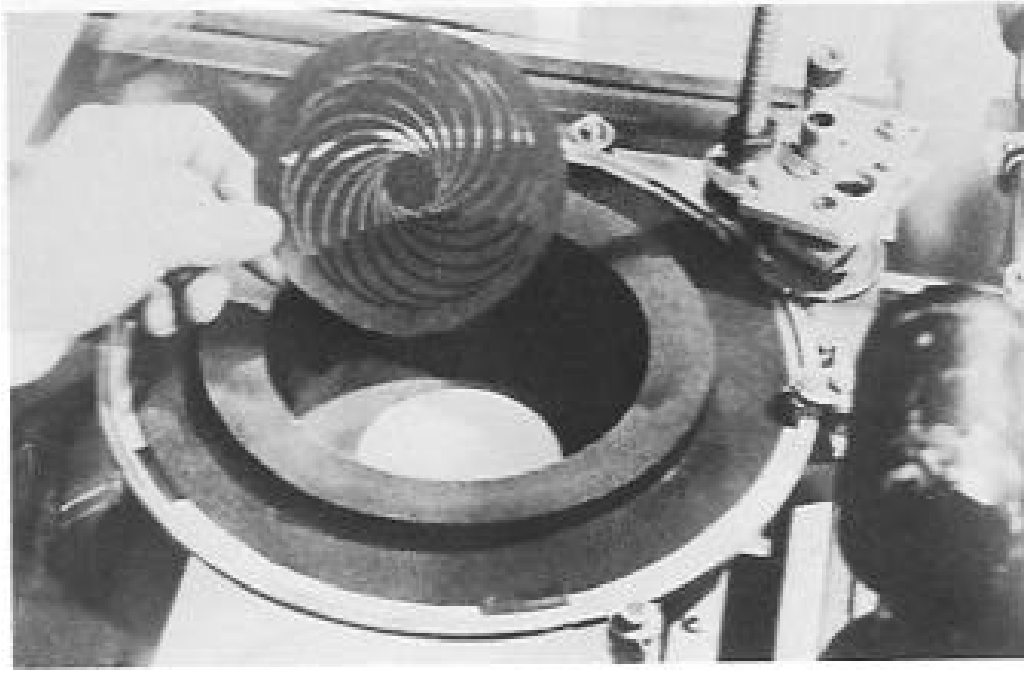
Similar to the analogue device built by Whitney's brother James for the production of *Lapis,* but far more complex, the machine consists of primary, secondary, and tertiary rotating tables, cam systems, and other surfaces for pre-programming of image and motion sequences in a multiple-axis environment. Whitney's son John, Jr., an electronics genius who improved his father's device as a teenager by rewiring and implementing its circuitry, explains the basic functions of the machine:

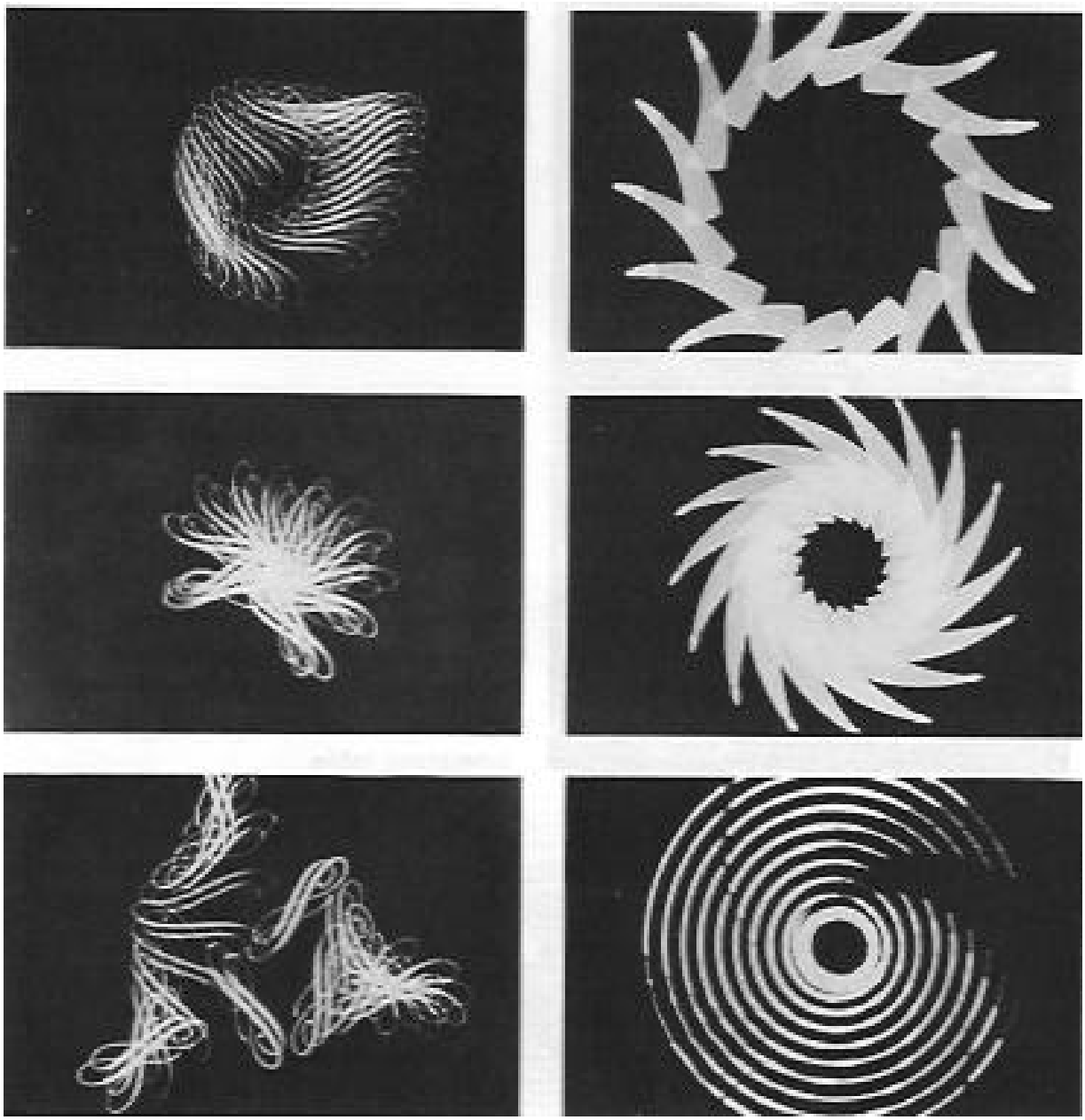
> There's not one function that isn't variable. The whole master table rotates and so does every part in it, as well as moving laterally, horizontally, and in some cases vertically. The camera moves in the same way completely independent of the rest of the machine, or in synchronization with it. I don't know how many simultaneous motions can be happening at once. There must be at least five ways just to operate the shutter. The input shaft on the camera rotates at 180 rpm, which results in a photographing speed of about 8 fps. That cycle time is constant, not variable, but we never shoot that fast. It takes about nine seconds to shoot one frame because the secondary rotating tables require nine seconds to make one revolution. During this nine-second cycle the tables are spinning on their own axes while simultaneously revolving around another axis while moving horizontally across the range of the camera, which itself may be turning or zooming up and down. During this operation we can have the shutter open all the time, or just at the end for a second or two, or at the beginning, or for half of the time if we want to do slit-scanning.

The elder Whitney actually never produced a complete, coherent movie on the analogue computer because he was continually developing and refining the machine while using it for commercial work. It remained for his sons John and Michael to make full creative use of this device that had dominated their childhood from earliest recollection. However, Whitney did assemble a visual catalogue of the effects he had perfected over the years. This film, simply titled *Catalogue,* was completed in 1961 and proved to be of such overwhelming beauty that many persons still prefer Whitney's analogue work over his digital computer films.

The machine, like the digital computer, not only facilitated the quick and effortless rendering of complex geometrical shapes and

Left: Camera zoom lens *(center)* focusing into primary rotating table of Whitney mechanical analogue computer. (Photo: Charles Eames)
Below:
Whitney places design template into computer table.





John Whitney: Catalogue. 1961.16mm. Color. 7 min. "Floral patterns curl as though they were actually organic growths..."

motions, but also actually helped realize certain graphics possibilities that otherwise might not be conceivable to the artist untrained in mathematical concepts. *Catalogue* is a brilliant display of floral patterns that seem to bloom and curl as though they were actually organic growths photographed in time-lapse. Also they have a natural quality quite unlike traditional single-frame animation and are far more convincing. Elsewhere in the film, neon-like coils expand and contract, throwing out bursts of pastel color. Dish-shaped curvilinear disks wobble and strobe, stretch and contract in a variety of unexpected ways. Syncretistic dot-pattern fields collect together as in *Lapis.* Strings of green light perform seemingly impossible transformations into endless intertwined configurations of baffling optical complexity. Words assemble and disintegrate, defying logic. Floral ringlets pop like neon confetti, showering the screen with flak bursts of color.

Unlike the digital computer, which requires only a mathematical code as its input, the mechanical analogue computer as used by the Whitneys requires some form of input that directly corresponds to the desired output. That is, at least a basic element of the final image we see on the screen must first be drawn, photographed, pasted together, or otherwise assembled *before* it is fed into the analogue equipment for processing. This means that a great deal of handicraft still is involved, though its relation to the final output is minimal. The original input may be as simple as a moiré pattern or as complex as a syncretistic field of hand-painted dots—but *some* form of handmade or physically demonstrable information is required as input in the absence of conventional computer software.

GENE: You're among the few people in the world working to bring the public into a closer understanding of technology on a basis we can relate to—a movie, pretty colors, things that move. It's very important.

JOHN: Just after World War II my brother and I were constantly excited by a future world. We sort of expected it to happen before the 1940's were past. We thought nothing of taking on the formal and creative problems of a totally technological medium such as the cinema. It's taken twenty or thirty years to realize that thetechnology we looked upon as being the technology of the future

was far from it. Instead of being the camera, the most important piece of instrumentation is the computer itself. Still ahead is considerable disciplined study to gain understanding or control of this kind of formal dynamic material so that it can be human. That's the whole problem. The light show people are doing a lot of wonderful sensory things, but I feel there must come insight into what is riot seen now—an understanding of a whole new area of conceptual form. The light show people are doing something like an infant pounding on the keys of a piano. Sometimes it can be very creative and terribly exciting. But in the long run, looking at it as an adult, it's just banging away at the piano without training. We know that someone who plays a Beethoven sonata maybe has been sharpening his sensibilities and manual dexterity with that one piece for seven or eight years. That's the way I see the relationship between computer æsthetics and contemporary light shows.

GENE: Where would you place yourself today concerning what you've done and what you'd like to do?

JOHN: In one sense I'm just beginning. In another sense my work with the digital computer is a culmination of all my interests since the 1940's because I found myself forced into the techniques and mechanisms of cinema. I got to work with the digital computer thanks to the fact that I developed my analogue equipment to the point that I had. As I continued to develop the machine I realized it was really a mechanical model of the electronic computer. Anyone experimenting with the medium of cinema as opposed to working in the industry is forced into a direct confrontation with his technology. People tried all different techniques of abstract cinema, and it's strange that no one has really invented anything that another experimental filmmaker can take up and use himself. It's starting afresh every time. Jim and I were trying to make something and there wasn't a machine available for making it. So my work has come to fruition because the past thirty years of search for instrumentation has culminated in the present availability of the computer. On the other hand I'm only beginning to use it. We all are. It's the same with those who are beginning to use the computer to compose music—they're at a very primitive stage today.

Permutations (see color plates), the first cohesive film to come out of Whitney's work with the digital computer, is a dazzling display of serial imagery that seems to express specific ideas or chains of ideas through hypersensitive manipulation of kinetic empathy. The patterns, colors, and motions dancing before us seem to be addressing the inarticulate conscious with a new kind of language. In fact, Whitney thinks of his work precisely as the development of a new communicative mode. Speaking of *Permutations,* he explains:

> The film contains various types of dot patterns which might be compared to the alphabet. The patterns are constructed into "words," each having basically a two-hundred-frame or eight-second time duration. These words in turn can be fitted contextually into "sentence" structures. My use of the parallel to language is only partially descriptive; I am moved to draw parallels with music. The very next term I wish to use is "counterpoint." These patterns are graphically superimposed over themselves forward and backward in many ways, and the parallel now is more with counterpoint, or at least polyphonic musical phenomena. Should it be called "polygraphic phenomena"?

Whatever they're called, Whitney's films are impossible to describe with the archaic language of the phonetic alphabet. Circles, crescents, quadrants, and multiplex forms of infinite variety and endless motion interact serially, and cosmically, until one is transported into a realm of expanded consciousness that intuitively understands this new language. It's as though the very essence of the idea of permutation is expressed in this film, as though the "word" no longer were separate from the fact. And that's exactly what Whitney has done: he's merged language with what it is intended to express. "Beautiful" seems such an inadequate term in this respect.

Before discussing the film itself, it will be helpful to understand in some detail how it was made, beginning with the program and going on through the final stages of photography and optical printing. This will be helpful to readers interested in making computer films, since Whitney's methods and working conditions are those most likely to be available to the average person—with the exception of his own specialized film processing equipment.

Dr. Jack Citron of IBM became interested in Whitney's work and began collaborating with him before there was any formal IBM

support. Dr. Citron later was given formal responsibility for further work with Whitney under the IBM program, exploring the creative possibilities inherent in the IBM Model 360 computer and the IBM 2250 Graphic Display Console. It was Citron who wrote the original program called GRAF (Graphic Additions to Fortran), which Whitney has been using since the spring of 1966.

Citron: One of the things I was interested in doing was to set up a kind of instrument which would buffer the computer user from the technical details. I think this can only be done by someone who understands both areas. The line of attack in my program was to start with what's in the artist's mind, and somehow have him use a kind of mathematics which he learns by rote with a "teaching program," to learn to express what's in his head visually. Once such a program is written, the fact that the programmer who wrote the algorithms knew what the artist needed enables the artist to sit down and say the kind of things John says without all that other training. I'm very happy it worked that way. Certainly in the future one will need more of a mathematical-logical background than artists have today. But you won't need ten years of schooling in nuclear physics. The thing that should be done is to develop a scientific curriculum for the artist. I don't know of anyone seriously considering that, but it should be done.

WHITNEY: Dr. Citron and I talked for some time before I actually began working. When I first began to realize from correspondence with IBM that I would be given the grant, the first thing that came to my mind was the question: would I be able to draw a free-hand line and somehow get that into the computer as digital information so I could manipulate it? I was presenting these ideas in preliminary talks and I was told that anything you can define mathematically you can do with a computer very easily. At first, having flunked mathematics consistently all through school, I was a bit horrified. And yet I began to realize the great breadth of elegance in simple geometrical graphics, and the historic respect geometry has enjoyed as a graphic form. Slowly these misgivings about having to define things in mathematical form died off... Some people in computer work criticize me for not being able to program myself instead of relying on someone else. Yet I've used this one program

for more than three years and I know that it is still only fragmentarily explored. In terms of software the program Dr. Citron developed for me is like a piano. I could continue to use it creatively all my life. But one program is like one area of a total palette. Let's assume that other people are going to develop other programs that will have another area of significance. Some of the ultimate orchestrations to come in fifteen or twenty years will perhaps involve many combined programs.

The GRAF program is based on a single polar-coordinate equation having about sixty parameters. In preparation for a display of images in what is called the "leaming" stage of the program, the light pen is used to select numerical variables, displayed on the CRT, which can be assigned to any of the parameters of the program to determine a particular graphic pattern. After values have been selected for all parameters and the camera is brought into play to record the images, control of the computer program is by punch cards, not the light pen. The shutter of the computer camera specially modified by Whitney and his son John is operated electrically, under control of the computer. The functions of opening and closing the shutter and advancing the film are controlled by a separate program in addition to GRAF.

Three types of punch cards are used during filming for control of images, and are signified as Identification Statements (for specifying particular curves), Parameter Statements (for assigning values to the curve), and Frame Statements (for control of successive displays). During this time the artist interacts with the computer through the Program Function Keyboard (PFKB), part of the 2250's hardware. The PFKB is equipped with thirty-six sets of keyswitches and lights. The program turns on light 1 as a signal to open the camera shutter. Interface connections between camera and computer include feedback circuits that allow the camera, in effect, to respond to computer commands: thus key 1 is depressed, entering 20 volts back into the computer and pulsing the camera with 5.3volts, which operates one single frame exposure. This is followed by an exposure timing loop in the program, and subsequently light 2 is illuminated ordering the shutter to close. Programmed logic decides whether or not more information is to be displayed for this same frame of film.

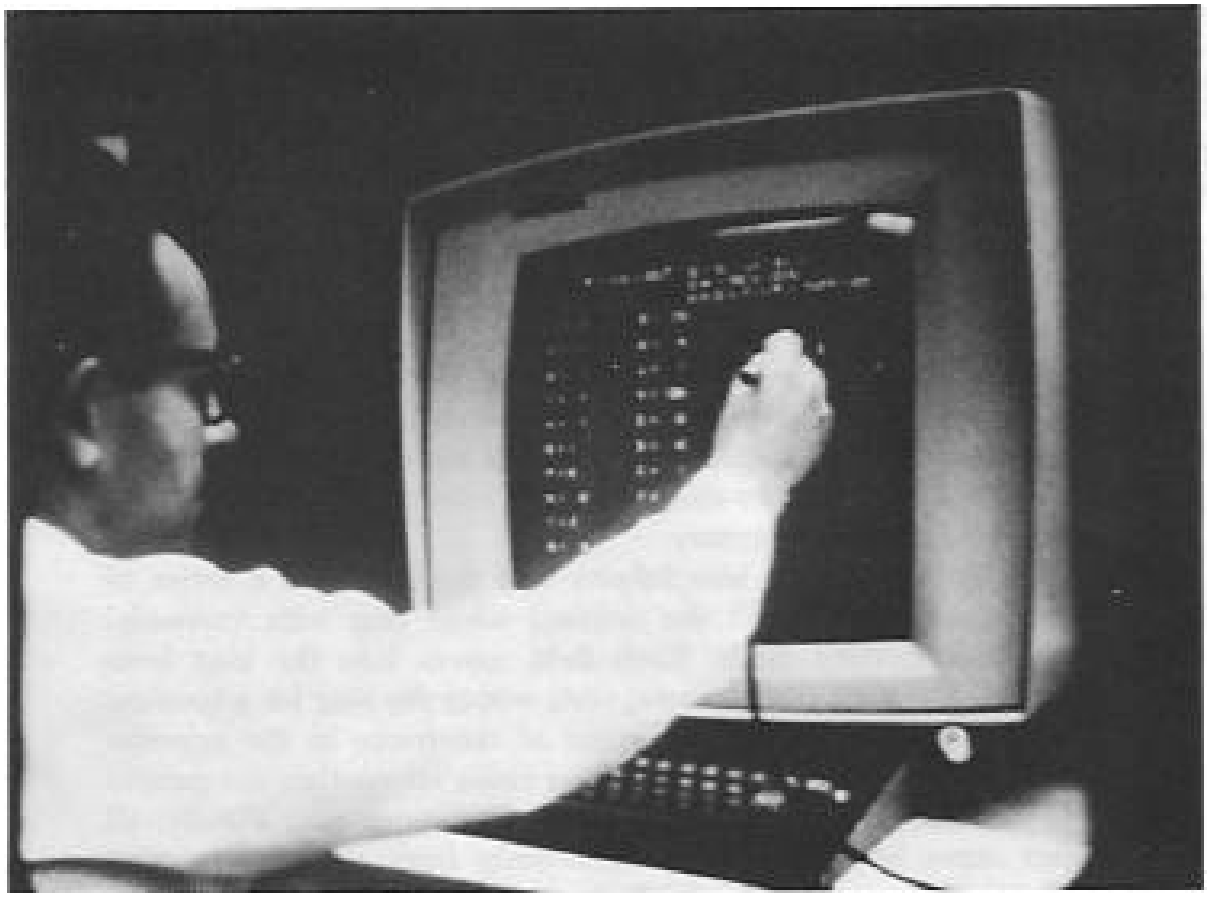
When the film frame is to be advanced, light 3 goes on and the next curve is computed and displayed, the camera is activated, and so on.

The 35mm. black-and-white negative from the camera is processed normally on high-contrast stock yielding an image that consists of clear lines on a dense black field. This film is threaded into the projector side of Whitney's optical printer, which has several special features: the optical axis of the system is vertical with the camera looking down into the projector. The projector itself is mounted on a compound mill table. Thus additional translations and rotations of a mechanical nature may be superimposed, and the camera may be moved along the axis so as to provide for an additional scaling factor of from .1 to 10. A stepping switch circuit and preset frame counter allow a wide range of skip-frame ratios to expand editing capabilities temporally. For *Permutations* Whitney used little skip-framing, but quite a bit of superimposition, slowing and speeding, and forward and backward printing.

Set to a *tabla* solo by Balachander, *Permutations* begins with a ring of white dots in a black void, with individual white dots circumscribing the inner circumference of the ring. This becomes an oval floral pattern of blue, green, and pink dots moving simultaneously clockwise and counterclockwise.

Two factors quickly become apparent: first, the neon-like cold scintillation of the image, a result of electrons deflecting traces in the cathode phosphor at a rate of 30 cycles per second. In our fluorescent world of neon suns and video eyes this scintillating glimmer more closely approximates daily experience than, say, the artificial arc lamp lighting of conventional movies.

Second, is the quite noticeable seriality of the composition, the unified wholeness of the statement, although it is composed of discrete elements. In defining "serial" in this context I should like to quote from art critic John Coplans: "To paint in *series* is not necessarily to be *serial.* Neither the number of works nor the similarity of theme in a given group determines whether a [work] is serial. Rather, seriality is identified by a particular interrelationship, rigorously consistent, of structure and syntax: serial structures are produced by a single indivisible process that links the internal structure of a work to that of other works within a differentiated whole. While a series may have any number of works, it must



Dr. Jack Citron, IBM Los Angeles, selects numerical values for a typical image, using the light pen at the 2250 Display Console.

must as a precondition of seriality have at least two... there are no boundaries implicit to serial imagery; its structures can be likened to continuums or constellations... all contemporary usage of serial imagery is without either first or last members. Obviously at one point there had to be a beginning, but its identity becomes subsumed within the whole, within the macrostructure. The same principle applies to the last member. At any given point in time one work in a series stands last in order of execution, but its sequential identity is irrelevant and in fact is lost immediately on the work's completion."[25]

[25] John Coplans, "Serial Imagery," *Artforum* (October, 1968), pp. 34-43.

It is this seriality, then, that identifies *Permutations* both as "words" and "sentence structures" as well as a complete overall statement, which is the meaning of the title. Whitney speaks of "graphic integrity" in this respect, referring to the mathematically precise interrelationships between forms, colors, and movements.

At one point in the film there is an exploration of centrifugal and centripetal ring movement in alternating colors and dot-pattern fields. This becomes an extremely dramatic statement in which bright emerald-green linear figures sweep the inner circumference of a white ring in a black void. The action is asymmetrical, not center-oriented, a fluid kind of motion not restricted to one point, a multiplex motion with no static elements, moving on a path in space that approximates a trajectory.

This figure vanishes into infinity and there follows a series of superimpositions that fill the original white ring with variously-colored dot-pattern fields. Each field moves into the ring from different directions in the frame, rests within the ring for a moment scintillating gently, then moves out of the frame in the opposite direction from which it came, making room for another dot-pattern field of another color which moves in simultaneously. Finally, all colors move into the ring simultaneously from all sides, forming circles within circles all scintillating smoothly in a floral configuration.

GENE: You seem hesitant or apologetic using the parallel with musical forms.

JOHN: I'm wary of it. I've been making that analogy all along, but I'm aware of the pitfalls of a lot of people in history. Da Vinci talked about an art of color which would be dealt with as musical tones. Wilfred and Remmington in England at the turn of the century were building color organs. They were so hung up with parallels with music that they missed the essence of their medium. People talk about abstraction in graphics as being cold or inhuman. I just don't see that at all. What is a musical note? It's totally abstract. That's the essential point and that's why I use the musical analogy. The essential problem with my kind of graphics must resemble the creative problem of melody writing. It is perhaps the most highly sensitive task of art, involving as it does balance, contrast, tension, and resolution all brought into play with minimum expenditure.

Music really is the art that moves in time. The many statements about architecture being frozen music notwithstanding, here we are truly looking at another art that moves in time. Someone once said about musical compositions: "Time and tone completely fill each other... what the hearer perceives in the tones and rests of a musical work is not simply time but shaped and organized time... so the conventional formula receives its final interpretation: music is a temporal art because, shaping the stuff of time, it creates an image of time." I like that idea very much, so I ask myself, what can be essentially the image of time for the eye to perceive?

One such image in *Permutations* involves bright blue, green, and red ellipses that move in perspectival space from static positions at each side of the frame, growing larger as they move alternately to the center and back again, exchanging positions. The feeling is precisely one of counterpoint and of temporal experiences.

This sentence structure becomes a white ring spinning rapidly on a vertical axis until it appears to be a group of white rings in a cagelike configuration, still spinning on a polar vertical axis. Inside this cage appears a similar ring of elliptical spheres, emerald green, revolving on a horizontal axis. Finally, the whole assemblage becomes an incredibly beautiful constellation of all colors and quickly runs through all configurations and movements seen during the film. These are seen moving around, within, and through a total field of scintillating colors as the film ends.

GENE: Which comes first, sound or image?

JOHN: Image. In *Permutations* the sequences and colors were all done before I selected a piece of music, yet there are all these astonishing relations with the music. That's where accident is working in my favor. In many areas of art and music it has been commonplace for the artist to tell you there's nothing in his work that doesn't have some sort of valid relationship or meaningful reason for being there. They've constantly sought to avoid arbitrariness—not accident: you can often make an accident turn into a very wonderful twist to new meaning. But the worst kind of arbitrariness is when a person thinks his own casual decisions

are great simply because he's done it, because he decided to be arbitrary. I expect to make a lot more progress in the direction of having more and more levels of formal organization—therefore it should be more and more human and multistructured.

GENE: In one sense you're in the forefront of avant-garde art today, concerned as it is with systems aesthetics, scientific discipline, and so on. In another respect, however, you do seem to be running against the grain of a trend toward the stochastic element, especially in music, films, and theatre.

JOHN: It's a universal misunderstanding. At the Aspen Design Conference in 1967, a scientist was describing a problem scientifically, saying it could be done this way and that, and then he said if it couldn't be done in such a rigorous way let's do it anyway and that'll be art. Scientists very frequently get excited about becoming involved in art. And the very first thing that comes to their minds is just to chuck out the whole discipline that their entire career is based on. They think if it's art, it's free. Anything that goes with random numbers is art; and anything that has to be worked out carefully so that this goes here and this has got to go there, that's not art, that's science. But for my moneyit's more important and difficult to get this here and that there in the area of art, because it involves much more than just counting numbers and making it mathematically sound: it's got to be intensely and intuitively sound. That's what I'm searching for That's what I mean by structure.

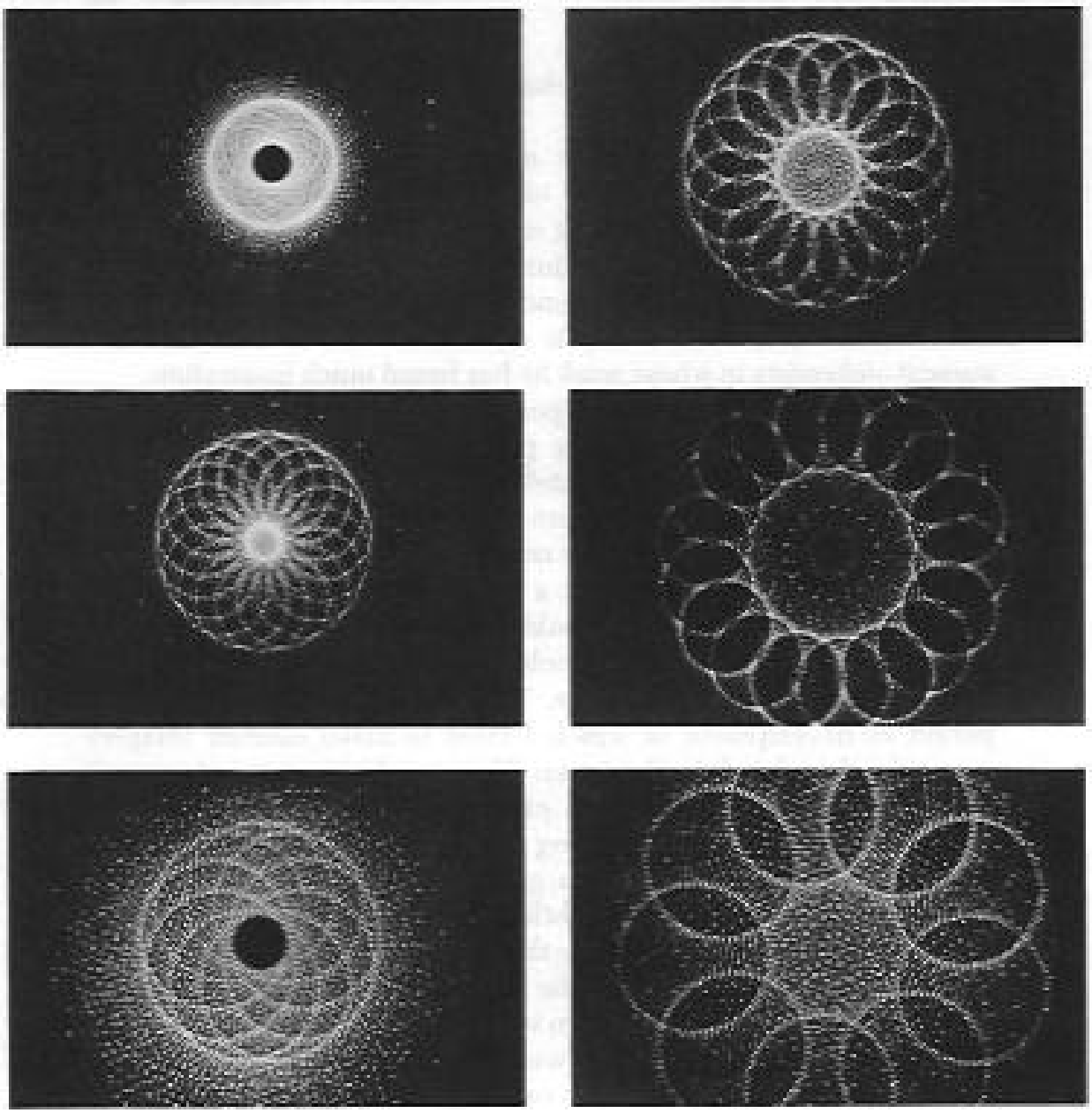
James Whitney's *Lapis:* Cybernetic Philosopher's Stone

James Whitney's cybernetic art seems totally removed from the idyllic scene in the serene Southern California garden where he has developed ceramic handicraft to a fine art in days of quiet meditation. Yet his *Lapis is* perhaps the most beautiful, and one of the most famous, of all computer films. Like the work of his long-time friend, Jordan Belson, it represent expanded cinema in its widest meaning: an attempt to approximate mind forms. That Whitney claims to have failed in his quest does not subtract from the archetypical eloquence of his works. They are glowing testimony of the truth of Herbert Read's assertion that greatness lies "in the power to realize and even to forecast the imaginative needs of mankind."

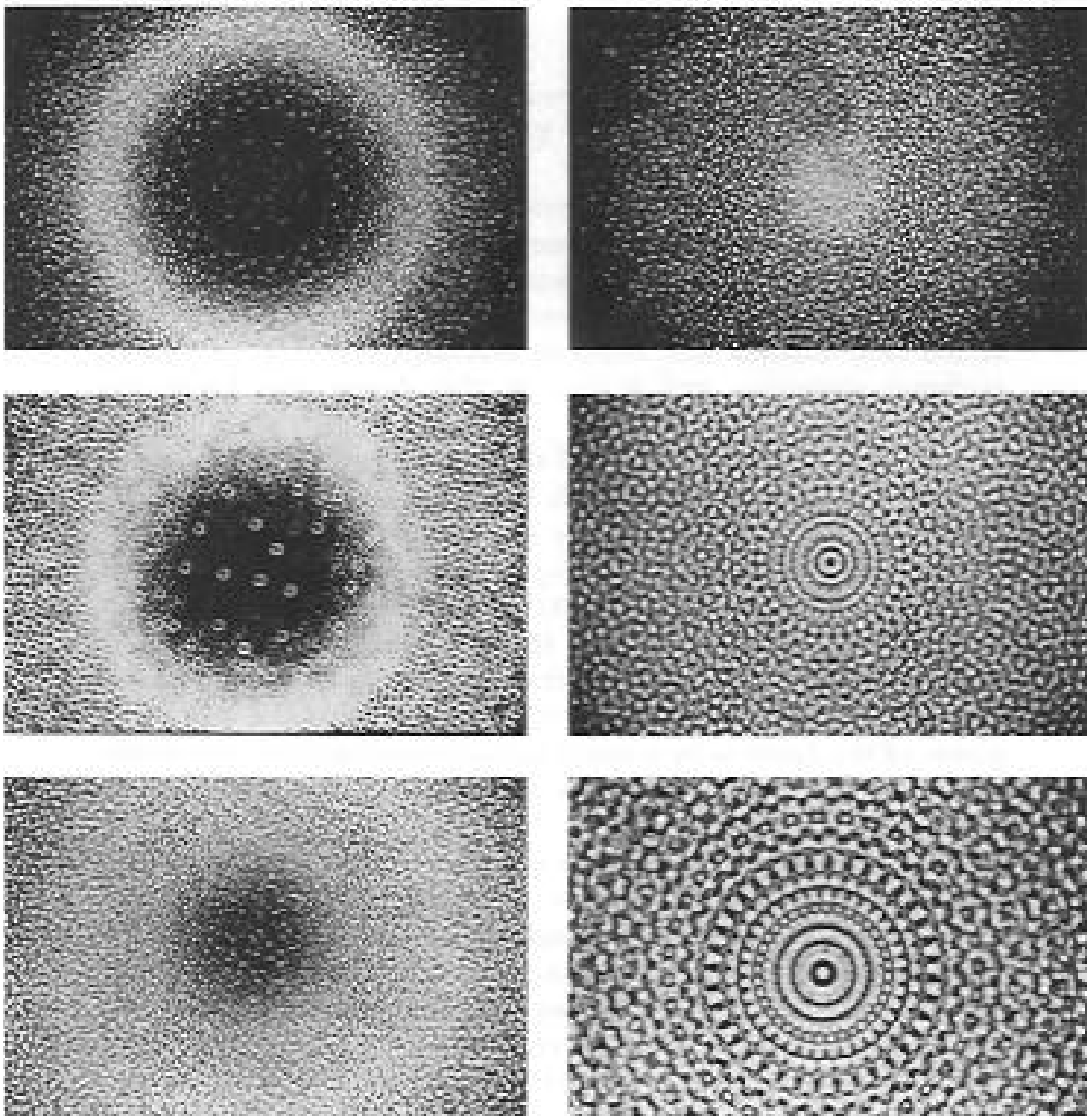
The fundamental imaginative need of mankind today is, as it always has been, the bridging of the chasm between spirit and matter. Atomic science is moving us closer to that realization. But in the words of Louis Pauwels, "just as science without conscience spells ruin for the soul, conscience without science means defeat also." In this respect Whitney is a "scientist of the soul" like the ancient alchemists in whose work he has found much inspiration.

Internationally known as experimental filmmakers because of their five *Film Exercises* of the period 1941-44, James and John Whitney began working separately around 1945. "After the exercises," James recalls, "the structure of my work was external, following pretty close to serial imagery concepts. The intent was a unity of structure which would result in a whole experience. The structure was whole, and naturally it would relate to your own attempts at wholeness: as you were more whole the structures you were dealing with would become more whole. Then after that there was a long period of development in which I tried to make exterior imagery more closely related to the inner. Those early images just weren't relating thoroughly to my own experiences in meditation, for example, where forms are breaking up. So I reduced the structural mode to the dot-pattern, which gives a quality which in India is called the *Akasha,* or ether, a subtle element before creation like the *Breath of Brahma,* the substance that permeates the universe before it begins to break down into the more finite world. That idea as expressed through the dot-pattern was very appealing to me."

Thus in 1950 Whitney began work on his first truly personal film, *Yantra,* an inspired and arduous project, which was to consume ten years before its completion. Drawn entirely by hand on small filing cards, it was an attempt to relate images to Yoga experiences. ". . . A *Yantra is* an instrument designed to curb the psychic forces by concentrating them on a pattern, and in such a way that this pattern becomes reproduced by the worshiper's visualizing power. It is a machine to stimulate inner visualizations, meditations, and experiencees... when utilized in connection with the practice of Yoga the contents of the *Yantra* diagram represent those stages of consciousness that lead inward from the everyday state of naive



James Whitney: *Lapis.* 1963-66. 16mm. Color. 10 min. "A mandala that revolves eternally like the heavens."



Lapis: ". . . they manifest as though out of the air itself, gathering and converging around a central sphere ... revolving with implacable grace against the eerie drone of the tamboura."

ignorance through the degrees of Yoga experience to the realization of the Universal Self."[26]

During most of the ten-year period in which James Whitney was laboriously producing the intricate images of *Yantra* by hand, his brother had developed the analogue computer, which could produce images of far greater complexity in a fraction of the time. After *Yantra* was finished the brothers assembled another mechanical analogue computer, and it was on this device that *Lapis* was created.

In general, the term *Lapis* held the same meaning for the ancient alchemists that the mandala holds for the Lamaist, Tantrist, Taoist, Hindu: a kind of "philosopher's stone" or aid to meditation. In alchemical times, and later during the period of the Rosicrucians, the *Lapis* was felt to contain a vital force or mystic power, a center of knowledge. Hermes asserted that the *Lapis* was composed of body, soul, and spirit, "…that thing midway between perfect and imperfect bodies." Gnostic philosophy suggests that the way to the power of the *Lapis* is by a spiral or circumambulation, specifically, according to Jung, "a mandala that revolves eternally like the heavens."

Whitney began work on *Lapis* in 1963 and completed it in 1966. Much of this time was consumed, however, in the construction of the analogue computer that programmed the extremely intricate mandala-like structure of the film. Thus cybernetics assisted Whitney to return through the centuries to the ancient practice of syncretism in his search for a more total vision.

The opening sequence of *Lapis is* startlingly beautiful: a pure white frame into which, very slowly, moves a ring of thousands of tiny particles. They manifest as though out of the air itself, gathering and converging around a central sphere of light, gradually tightening, growing more complex, until they become a vast syncretistic mandala of intricate geometrical patterns. These configurations defy definition as they revolve with implacable grace against the eerie drone of a tamboura.

[26] Heinrich Zimmer, *Myths and Symbols in Indian Art and Civilization* (Harper Torchbook; New York: Harper & Row, 1946), pp. 141-142.

To achieve this effect, Whitney hand-painted glass plates with fields of dot-patterns that began sparsely and collected into high concentration toward the center. These were placed on rotating tables beneath a vertically-mounted camera. The tables spun on their own axes while simultaneously revolving around another axis, and at the same time moving horizontally across camera range.

At first the huge mandala is a monotone beige against a white field, then it becomes a glowing red-orange and crystallizes into thousands of intricate modules, each containing a green floral pattern inside a diamond configuration. Forms take shape and vanish as the whole revolves majestically, its movement accentuated by the sonorous drone of the tamboura. Suddenly the image disintegrates into a loose cloud of red, yellow, and orange particles that solidify into the word *Lapis.* This bursts apart slowly as the first beats of the tabla are heard and a raga begins.

The mandala draws away from the camera until its individual sections are no longer distinguishable from the whole. It dissolves into a blue multispoked mandala in the center of a black void, revolving and spewing out showers of fine sparklike particles that fade and vanish. One seems to detect snowflake crystals, diamonds, molecular clusters—but they're transformed before the mind's eye can grasp their trajectory. Later we see starbursts throwing off showers of light, spinning around dark centers. A repeat of the opening sequence is done in blue and black—thousands of tiny blue particles slowly collecting around a central vortex. For a split second the particles freeze into diamond-like crystals and then melt back into the syncretistic field. A vibrant orange sun shimmers in blackness, surrounded by a corona of concentric rings, each enclosing a peacock floral pattern.

Finally the original beige mandala reappears and spins rapidly through the various configurations we've seen throughout the film. Two translucent globes within a blinding white center begin to stretch apart diagonally across the frame, creating a sense of enormous tension and stress, shimmering, pulsating, until the final blackout. This was Whitney's way of suggesting what he calls "the last breaking or snapping, unable to reach *Samadhi.* That was because *Lapis* was near the end of what I could do. The machine restricted me; my fantasies couldn't flow. Of course we're in the most primitive

stages of cybernetic art, but my inner imagery gave way at the same time that my outer ability to control the instrument broke down."

Whitney finds more than a casual resemblance between Eastern philosophy and modern science, and suggests that this confluence may have a profound effect on conventional notions of art. "Only to a person who has expanded his consciousness," he says, "is ordinary experience expanded. So it's exciting where art is going in this respect. Art and science are getting much closer to Eastern thought. But you'll always find those who seek to go beyond any language. Those are the people whose eyes and ears are really open. But they will come back, and they will be totally open and very sympathetic to what the artist is doing, but they won't have the energy to remain within that confine of art. Artists must in order to create. The other man will see art as the great play and fun that it is, but he won't be able to put that same sort of intensity into it as the artist does. The artist, in a sense, must keep a lot of ignorance. To stay in the world you have to preserve a certain amount of ignorance.

"I certainly do not feel that art is dead. But when you're really involved with the thing you want to experience, you stop conceiving it. Art finally becomes a barrier to accepting what *is.* Art stays within its closed circle and reality never does. Art is all symbols of reality. Symbols are never going to free you. But it would be foolish to say 'Stop making art.' That's not what I'm saying. One should be aware of its limitations, that's all. This must be what they had in mind when they said: 'Thou shalt not create graven images."

The Younger Whitneys: Children of the New Age

"An inadvertent spin-off from technology will transform man into a transcendental being. Nothing we can conceive now will give us a clue to what that spin-off will be. But I suspect that vision will play an important role. The eye will have a lot to do with it."

JOHN WHITNEY, JR.

If the Starchild Embryo of 2001 were to grow up as a human he'd probably feel quite at home with the Whitney brothers. From earliest childhood the future has been their way of life. John, Jr., Michael, and Mark all were born well after World War II. They were raised in