

By the summer of 1969, IBM had been contracted with A & T as a Patron Sponsor for more than a year, but we had not succeeded in placing an artist with the company. (We had proposed matches with Vasarely, Vjenceslav Richter, Eduardo Paolozzi and Jackson MacLow, and Robert Irwin had toured IBM's San Jose facility; discussion of these attempts can be found in the sections on these artists.) In July, Jane Livingston contacted artist Jesse Reichek in Berkeley to sound him out on his potential interest in working with IBM. Reichek is a painter and Professor of Design at Cal Berkeley; both the nature of his work and his published ideas on problems of urban design and education, and his esthetic philosophy in general suggested to us an approach that might well imply his desire and ability to work with computer technology. As early as 1951, Reichek wrote a short statement which appeared in *Arts and Architecture*, March, 1951, outlining an attitude which has continued to inform his work and thinking to the present time:

It is not what I see that is important to me. Vision is but one means of absorbing or projecting the construction of forces which is experience. The problem is in the way these forces are constructed; giving rise to the endless variety of experiences and acts of which we are capable.

Such experiences and acts as: space, color, light, motion, time, forms, moods, emotions, personal history, social comment, imaginary worlds, etc., etc., are indeed undeniable facts. But facts, regardless of the amount of detail they include, are limited truths. The process, ever-changing and limitless, by which these facts are constructed is the constant truth. A structured process is composed of especially formed, organized, and placed elements. These elements are placed according to the dictates of the conceived structural form; the conceived functions; potential functions; and possible functions of the structured form as a totality. The elements in addition to their position in the life, history, and assembly of the structural whole have a life, history, and assembly of their own. They are simultaneously a whole and elements of a whole. The structured process is not only conceived—the elements so assembled—as to allow for the continued existence of the whole, but the total structure acts IN the functions of the elements. The elements which make up the structured process besides having their own activities outside the whole, act independently and/or in relationship with each other UPON the whole. The total structure is established in a constant state of being re-established.

Reichek spent some time considering our proposal, and agreed to meet with us and members of IBM's Scientific Center at Century City, Los Angeles. Through our contact man, Dr. David Heggie, the artist was introduced immediately to the man he was to work closely with in

the ensuing months, Dr. Jack Citron, a physicist and mathematician. [1] James Kearns, Manager of the Los Angeles Scientific Center, also met Reichek at the outset of his collaboration and has continued to be involved in the development of the project.



Citron, because of his background and special interest in the arts, particularly music, was receptive in principle to the notion of working with an artist, and he was enthusiastic about Reichek's ideas as they related to his work in the area of computers. On the basis of his and his colleagues' positive response to Reichek, IBM approved the project. A system was arranged by which, starting in September, 1969, Reichek would fly to Los Angeles at least once a month to meet with Citron and Kearns. The first few sessions were basically used in dialogue, to clarify the artist's intentions and determine what was feasible to do and how, given the possibilities and limitations of the computer. According to Reichek's initial description of his theoretical area of interest, the concept of *process* was critical. He was interested in the capability of the computer to transform visual images into series of configurations, based on a limited number of pictorial elements, or parameters. He wanted to determine whether the computer, once programmed with certain information which could somehow be translated into graphic form, could respond to that initially given information by some internal process, to create series of variations. The principle would be one of continuous, somehow self-perpetuating, input, transformation, output; that output would become input, transformation, output, etc. Citron seemed to indicate, during these early discussions, that many of the notions Reichek described were not possible. Reichek left with Citron a series of drawings to familiarize him with the kinds of figures and color systems he might want to work with.

Although most of the long sessions between Reichek and Citron were taped, and transcriptions made, it is difficult to cull from them excerpts which would communicate the technical gist of the problems they were confronting.

However, Reichek set down in a letter written in September, 1970, a sort of recapitulation and progress report of the project as he saw it; and in October, Citron wrote a technical description of the project at our request.



At the time of Reichek's letter, there had arisen some problems regarding IBM's willingness to continue supporting the collaboration after December of 1970; these considerations prompted him to formulate the statement. He wrote,

It seems to me that we now have sufficient working experience with this project to allow us to review where we are and indicate the directions it can take and the products it may produce. Since I view this project as a collaborative effort between the Museum, IBM and myself, I would like this memorandum to serve as a basis for discussion, modification and decision by all of us.

Background

When you called me in July, 1969 concerning my interest in working in a project with IBM as part of your Art and Technology program, I asked for two weeks to think about it. I spent those two weeks reviewing some of the non-technical literature on the use of computers, the development of my own work over the past 25 years and the direction it might take in the future. I also gave a great deal of thought to

the use of computers and related advanced technologies as it impinges on the situation and the problems of our present-day society and the manner in which they may determine our future personal and societal life-styles. I should add, that I have been concerned, as others have, with these issues for many years; both in my work as an artist and in my academic activities as a professor.

Briefly, these are the objectives I set for my participation in and the design of the project.

1. That while being aware and respecting the role of any tool in the process of generating any form, be it a work of art, a paper clip or a political system, this project should not be a display of technological gymnastics.
2. That the products which will be produced are to be determined by the logic made explicit from the study of my present and past work.
3. That the implicit meaning and the conceptual basis of my work must be embodied in the works coming out of the project.
4. That the manner in which the works produced are presented should be consonant with characteristics of the underlying conception inherent in my work and the nature of the tools used—the computer, etc.
5. That this project should not produce a unique work or several unique works: such a result would be a contradiction of the fundamental characteristics of the computer and do violence to the basic philosophical position which has guided the development of my work.

These statements need elaboration which we should do when we discuss this memo. More precise meaning can be derived from the description of the project and my proposals for what the project should produce.

In August, 1969 at our first meeting with Jack Citron, Jim Kearns and others from IBM, I sketched out some tentative notions for a project. There was an expression of interest and a desire to engage in it. Simply stated, the project called for the computer to be programmed using the rules of logic which have generated my paintings. The logic is such as to not only produce a painting, but is capable of utilizing the 'experiencing' of that painting in order to produce the next—ad infinitum. At a subsequent meeting with Jack, we thoroughly discussed and analyzed some 40 sketches of my work. (I've since added many

more as part of the project.) Jack kept these sketches for further study and at a later meeting we again discussed them. Jack developed a proposal which was approved and the work on programing began in January, 1970.

Since then, I have been meeting with Jack at IBM almost monthly. He has explained the non-technical aspects of the program he is designing and has kept me abreast of the problems involving equipment.

Present Status

The programming part of the project is well along. During our last meeting on September 3, Jack explained the coding system which would enable me to interact directly with the equipment to be used in making the three color separations. For the present time, the plan to have me interact with a display panel which would give me immediate visualizations, in outline form, of my instructions is being put aside. As I understand the situation, the necessary piece of equipment is not available now and Jack does not expect to have it for another six months. The idea at present is for me to work at a terminal which would feed directly into the color-separation machine. Although I shall attempt to do this, I feel that I will be greatly inhibited by the inability to see what I'm doing.

The color separation machine produces one color separation (approximately 4" x 5") in a half hour, i.e., an entire picture in an hour and a half. In addition, the use-time on the machine available to this project is restricted. This places important limitations on the speed with which I can see the results of my direct in-put (assuming that I find it possible to work effectively without a visualization device) and the number of works that can be produced.

It may be that these difficulties are insurmountable. However, with the exception of the production time required for the color-separation machine, it may be that increased access-time can be obtained and a visualization panel can be made available. We ought to discuss this and explore how this might be accomplished.

The many trips to Los Angeles, I imagine, were necessary in the early stages of the project. I would hope that it is possible to drastically reduce the number of these trips as the project progresses. I would think that at least one of the factors mentioned above, visualization, has a bearing on the alternative arrangement possible. We ought to discuss this.

Future Development

I see a two-fold development of the project, a main-line and a branch-line. The branch-line terminates at the Museum in May 1971 as part of the Art and Technology exhibition. The main-line terminates at the Museum in May or November 1972 as part of a retrospective exhibition of my work.

The Branch-Line

Taking into account equipment limitations and more crucially, the time required to produce separations and process them into color, I would guess that the most we could produce by May 1971 is 30 to 50 images. Jack may have a better estimate. My very tentative idea is that these images be made into transparencies and be back-projected on a fairly large sized screen. The projection to be continuous in a permuted sequence (1 2 3 4 etc., 4 3 1 2 etc., 4 3 2 1 etc. . . .) for the duration of the exhibit. We can fix the time of exposure for each image. Although I have not done the calculations I feel sure that, allowing for a reasonable time for the viewing of each image, the sequence would not be repeated at any time during the exhibition. At least one other alternative way of displaying the images on the screen could be to show all the images on the screen at the same time in a grid pattern. In which case the permutation would be the spatial order of their appearance. Written material as part of the exhibit and/or in the catalog would describe the project.

The Main-Line

In many ways this part of the project is more consistent with the characteristics of the computer and the conceptual underpinning of my work: it has four parts.

1. Retrospective Exhibition: which will show that this project is a logical continuation of the direction in which my work has developed over the years. It should show the historical evolution of the form and the structure of the image as well as the compatibility between the conceptual framework underlying my work and the basic characteristics and implications inherent in computer technology.
2. Multi-Editions: A display of a large number (100-200) of the images the computer has generated. These images to have been reproduced in runs of 5,000 each. This would be a manifestation of an affinity between a conception in art and an implication of a technology. The appropriate use of the computer as a tool is to produce a large number of varied works in large quantities of first-rate quality at low cost for mass communication. The computer's

capacity for diverse and duplicatable responses does not call for a unique work of art.

3. Book (s): Available at the Museum and elsewhere during the exhibit and later on. A book is another form of mass communication and the rationale is essentially that which was described above.
4. Film: To be shown at the Museum during the exhibit and elsewhere later on. Here too, the rationale described earlier applies since a film is composed of many and varied images and is another form of mass communication.

Finally, I want to say what I see as the most interesting and exciting aspect of this project as it relates to my own work and, perhaps, art in general. I've written about this more fully elsewhere. I see each of my paintings as a fragment and what one calls a 'body of work' as only a larger fragment. I believe this can be shown to be true of existent individuals and societies. What fascinates me about this project is that its development and the products it will produce is related to the evolutionary process in nature. Evolutionary 'design' in nature differs from the way man designs in that it is not 'design' according to external specifications. Biological 'design' is controlled by an internal basic mechanism contained within all species—the 'designed' object. Differences in species are accounted for by configurational changes of the basic mechanism; differences within species by rearrangement of the configuration. What I am trying to suggest is an analogy between the program for this project and a genetic code, the computer's capacity to store and arrange bits of information and DNA's similar capacity, the works we can produce and species variations, our process and the biological process.

Jack Citron's description of his project with Reichel is as follows:

Background

Over the past few years, a number of artists have been able to make use of computers in one way or another. In each case, they were given a predesigned system and told how to use it or what its inherent capabilities and limitations were. The artist was then free to experiment within the defined framework presented by the computer hardware and software.

In the present case, the approach is quite different. We have nominally entered what Joseph Schillinger called 'the fifth morphological zone in the evolution of art.' Reichel's work is in some ways ideal for this because his principal thematic component—what he refers to as 'process'—is methodology. And methodol-

ogy is the essence of science and technology. Our goals can then be described as follows.

The first step is to analyze the Reichel style—not in anticipation of mimicry—but to isolate a complete set of creative components which could serve in all three phases:

1. recording or notation (analogous to a musical score)
2. modification (variations on a theme is equivalent to changes in these basic components)
3. synthesis (conversion from these components to mathematical and logical relations to geometric relations to the final material form)

Next, a user-oriented system is to be designed in which the artist would manipulate the creative components like words in a language to get his ideas into a computer. The computer would then use this information to control an output device to produce the defined piece of art. It will also be possible to describe 'temporal' modifications of the input which in turn would cause the computer to produce an endless succession of pictures based on the 'original'. The precise methods of interaction with the user, the forms of intermediate and final computer output, and the process of converting the latter into a final product are also to be defined in detail and depend completely on the particular hardware that is available for our use.

Analysis

An examination of forty or so paintings revealed a number of logically related features. Since each work was carried out on graph paper, exact size relationships were readily apparent and Reichel's intuitive methods of handling strict mathematical symmetries could be easily seen. Color, while restricted to red, blue, and black, was clearly used to accent the symmetry in each work by employing permutations as accompaniment to the symmetry operations on the spatial material. This spatial material in turn consisted of three distinct classes:

1. framed figures with two possible orientations inside areas with boundary sizes making some simple ratios with the background size
2. vertical and/or horizontal lines usually in paired colors and one unit wide
3. solid areas really marking the absence of the above two classes

Three types of works also appeared in which the featured elements were:

1. Just figure blocks with an interplay of the symmetrics relating block position, figure orientation, and color permutation
2. Just lined areas again with symmetry relations between areas to complete a theme
3. Both figures and lines where the latter play a definite role in 'connecting' the various figure blocks

System design

An initial estimate as to the number of possible Reichek paintings is both enlightening and astounding. If only a 40 by 40 grid is considered and we simply ask how many ways three colors can be arranged, one to a square, the answer is a number containing 764 digits! Notice the number one million contains 7 digits, a trillion is 13 digits long, and even an octillion is 'only' a 28 digit number.

At least two important conclusions can be drawn from this. The first and obvious one is that there is no danger of 'running out' of something to do in this style. The second and more subtle one provides information as to the kind of user control that is necessary. A common tendency among many of today's artists would be to allow random choice from this enormous backlog of possibilities. However, thermodynamic arguments concerning large ensembles show clearly that the results would be most disappointing and, even more important, would show no relation to Reichek's main theme: 'process'! Thus control must be exercised over the basic components isolated in the section on analysis by establishing mathematical/logical operations and operators which can then be used to specify unique works or practically infinite classes of works by allowing the artist's mind to dwell upon the 'method' to be used or developed without the distractions inherent in any extra-logical approach.

Because the computer we are currently using is located on the East Coast (Cambridge, Massachusetts) and our access to it is via voice-grade telephone lines through a typewriter-terminal, input to the system must be in some form of typed code. The implementation currently under development compresses the necessary information into six types of statements.

These serve the following functions:

1. establish background grid size and color
2. specify up to four types of spatial periodicity

3. define blocks uniquely or with reference to previously defined blocks
4. set up figure information for a block
5. set up line information for a block
6. describe symmetry operations when developing new blocks from old ones

Interaction with the developing composition must also be carried out through the terminal. We hope to be able to use a graphic terminal to make this easier, but may have to rely on a typed printout of the developing picture.

The output from this phase will be a computer produced tape which contains a new representation of the picture. This tape could then be used as input to another computer which in turn would control either a milling machine or a photo-composer to produce engraved printing plates or color separated film transparencies. This secondary output will then be used to produce the final results in the form of conventional visual products.

At the time of this writing, the outcome of the Reichek/IBM project is dependent upon the corporation's willingness to extend their commitment into 1971.

Jane Livingston