Rochester Institute of Technology

A Thesis Submitted to the Faculty of
The College of Fine and Applied Arts
in Candidacy for the Degree of
MASTER OF FINE ARTS

**Computer-Aided
Graphic Design**

by
Donald P. Harbison

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APPROVALS

Advisor:_____

        Date:_____

Graduate Academic

Council

Representative:_____

        Date:_____

Dean, College of

Fine & Applied Arts:_____

        Date:_____

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INTRODUCTION

"The objective of this thesis is to explore the graphic visual potential of the computer.

The program will include the generation of computer-aided imagery which will be applied to the design requirements of a book on perception. The computer-aided images anticipated are a series of symbols and a cover visual. These elements will therefore become an integral part of the total book design."

The above proposal was approved on September 28, 1978. My decision to explore the graphic visual potential of the computer in the context of an applied design problem grew out of a desire to demonstrate some practical as well as aesthetic uses for computer generated output. The thesis topic emerged gradually after my initial exposure to the field of computer graphics . A course taught by Mr. James Ver Hague served to provoke the issue of the interrelationship of this relatively new tool and the needs of the designer in today's demanding communications profession. The need to visualize effectively and efficiently many possible solutions to a design problem can be met by interactive computer graphics systems. Just as photography became accepted and exploited as a design tool, so will computer graphics systems. As a tool still developing, it needs the guidance from within the profession itself in order to mature to its full potential. Such guidance would result in more accessible computer languages being devised and systems designs being developed to suit the particular needs of the designer.

RATIONALE

Prior to beginning my actual thesis work I became initiated to the world of computer graphics by working with three different areas or computer graphics systems.[1] When I accepted the opportunity to design Dr. Zakia's book, a collection of quotations on the subject of visual perception, the initial concept was to solve the problem of how to design and present the manuscript as a book taking into account all of its particular needs. The idea to use a computer as a tool and visual element in the design did not come together until after a few weeks of studying and analyzing the manuscript. Its title, PERCEPTUAL QUOTES FOR PHOTOGRAPHERS, and the quotations, both individually and as a whole, strongly suggested an opportunity for graphic illustration within the controlled environmment of careful typography. Such abstract illustration would be possible to achieve effectively with the aid of a computer drawing system. It was my desire to explore the potentials of the computer within the context of a practical design problem, the book, that led to my decision to perform thesis work in this area.

[1] Apple II, Sigma IX, and Zeta Plotter. See Appendix A

THESIS PRODUCTION: A Chronology

Part One
Background Development

In the fall, before the work on the thesis topic actually began, I started to learn the basics of how to write short programs using a Zeta Incremental Digital Plotter. This method allows the user to write a graphics program conforming to specific subroutines provided by the Zeta system itself. For instance, a Zeta subroutine will supply the required variables needed to execute drawings within basic geometric configurations. There are sub-routines for drawing and manipulating circles, rectangles, polygons, elipses, simple lines and grids. If one approaches this initial orientation process with an open mind, patience and the assurance that common sense will serve adequately, then progress and satisfying results are easily at-tained.

Parallel to my orientation with the Zeta Plotter, I began to solve the actual typographical and layout problems inherent within the manuscript. This process followed established convention and was entered into with a desire to observe standards consistent with fine typography yet in a contemporary presentation. The manuscript was analyzed from a number of different standpoints.

First, I carefully went through the entire manuscript to more completely understand the nature of the book and to isolate problem areas. An intuitive grasp of the theme of the book was gained. By meeting with the author, I was

able to determine, more completely, factors necessary to a successful design. Such issues as economics (what should the unit cost be), formats which were acceptable, and more specific information concerning the nature of the audience that would be addressed were discussed and evaluated.

With this information and general sensibility about the book's topic and the author's intent, I began the process of organizing the manuscript into an integrated piece, a book.

A first step was to make a careful character count of the manuscript to enable accurate copy fitting and page estimation. A problem encountered here was the fact that the quotations comprising the main text were themselves from disparate publications. This condition was actually a minor inconvenience and was overcome by averaging the counts for each particular type represented within the different passages.

The next major step in the shaping of the design of the book was the development of an organizational grid system, modelled after a design system refined by Paul Rand for the Westinghouse Design Center.[2] This grid system was based upon the actual size of the type to be used and its leading. In my case, I decided to use nine point Palatino Roman leaded to two points thereby constructing my organizational grid based upon an eleven point unit. At this time, if my computer skills had been more fully developed, it would have been easy to have drawn a large eleven point unit grid as an aid to visualizing module development. By manipulating key values within the program many alternative grid systems could have been tested and tailored to organizational needs. As it was, I developed the final grid using conventional methods, reached the final solution and programmed the Zeta Plotter for its execution. The final Zeta drawing of the grid will serve to provide an acetate overlay for production purposes and is accurate to .0025 inches.[3]

Page size and format were determined from this "Master Grid" according to the most economical division of standard book papers (25 X 38 inches). The final page size was resolved at 5¼ X 7½ inches. The grid configuration itself effectively accommodated the need to credit each individual quotation with its author's full name in a clear, easily referenced fashion. By the end of the fall quarter a type dummy had been completed and a tentative decision had been reached to use abstract drawings executed on the Zeta Plotter as a

[2]Westinghouse Design System for Major Appliance Care and Use Guidebooks, Westinghouse Corporate Design Center.
[3]See illustration, # 1.

visual device flagging the opening of each individual section under which Dr. Zakia had organized the selected quotations. All of the type required to construct this dummy was set by myself on a Merganthaler V.I.P. photographic typesetting system.

Part Two
Working with the Zeta Plotter

My work with the Zeta Plotter began on a full-time basis beginning during Winter Quarter. I immersed myself in the programming and development of visual ideas via the Zeta system. From a personal viewpoint I found much of the required procedures and the abstract numerical nature of the process to be undesirable for a designer. Yet, by approaching the endeavor with discipline, a unique yield becomes the ability to more effectively consider visual forms as abstract ideas. This results from the requirement that all graphic concepts be described for the computer as numerical data. The facility to describe one's ideas in abstract terms within a matrix that provides many possible variations from the initial description proved valuable for the problem at hand.

A disadvantage of the Zeta system is that it lacks "real-time" capability. In other words, a program would have to be written, key-punched flawlessly, logged in at the front desk of the computer center where it would be picked up by hand and fed into the host computer, a Xerox Sigma IX. While the Sigma IX requires less than a minute to process all of the data, it is then filed to the Zeta tape where it waits until an operator actually begins and monitors the plotting sequence. A sufficient number of processed plots are usually required to justify running the plotter. With luck, a finished plot is delivered approximately an hour after the program was submitted. Needless to say, real-time capability is highly desirable. It is also required to truly qualify a computer graphics system as interactive.

An interesting adjunct project that I investigated with the Zeta Plotter was to program the movement of a shape through space to a prescribed goal. These programs were inspired by photographic imagery.[4] A photograph would be made of graphically suggestive subject material. Then it would be analyzed for spatial configurations that would lend themselves to programmable treatment. For instance, a window pane could easily be described as a square and commanded to move through space, rotating a prescribed number of times before arriving at its described destination. A

[4]See illustration, # 2.

program conceived and executed in this fashion could then be re-integrated within a new photographic print. The possibilities for this genre of combining photographic imagery with the machine rendered line drawing are intriguing[5].

Soon, I had gained confidence in the development of simple programs that produced quite interesting drawings. Abstract programs written in FOR-TRAN began to correlate with the visual output. It became easier to associate raw data sequences with the intended graphic realization. An example of this would be when I began to program the drawings that were to become the book illustrations.

A graphic concept that emerged in the early stages of designing the book typographically was that the book, while being very carefully organized, remained a collection of different quotations on the subject of perception. I felt that the presentation of these quotations within a comprehensive design should encourage the reader to open the book at random. This would be in the form of a reference book. However, at the same time, this encouragement should not make straight-through reading unattractive.

The concept of randomness is one particularly suited to computer translation. After becoming oriented to the required methods of accessing random numbers within Sigma IX, I began to explore the graphic implications of randomness in the context of categories of form[.] An initial program used the dimensions of the grid module itself as a shape to draw at random within a certain area. Variables such as the angle at which the grid rectangle was drawn relative to the x-axis or the actual base and height of the rectangle were described in association with a random number. As the name implies, a random number generator is a method whereby it is possible to produce results at random by first planting a "seed" number within the program. This number in turn produces other numbers that serve in conjunction with the programmed values to create randomness within controlled parameters. The grid module could be controlled within certain limits this way so that, for example, its base and height could be no more or no less than desired but that the rendered results would fall at random within those limits.

The execution of plots that incorporated this type of random number application evolved to become the core of my work for the illustrations needed. Many different possibilities were explored. Programs were often like blocks

[5] See illustration, #l 3.
[*] See illustration, #l 5.

of stone that began as crude ideas and through careful manipulation and modification over subsequent generations became more and more refined. Wherever possible I attempted to relate randomness with several factors.

One factor was that the finished drawing have an overall 'color' that would be compatible, after reproduction, with the 'color' of the page of type upon which it would be imposed. It would be counter-productive to attempt to program drawings that were excessively heavy and overly complex. Therefore, a conscious effort was made to maintain a certain overall quality to the randomness and the complexity of the line quality within the drawings.

Another factor that was considered was the contrasting allusive qualities of different categories of form and line. Randomness was primarily confined within one category of line quality: for example, circles with spirals. The computer's unique ability to iterate a stated form according to one's idea became another factor that was developed and utilized. A simple form, a polygon or anything else describable, could be associated with a contrasting form by commanding the computer to draw it "x" number of times while it moves along the desired path.

Throughout this program development, refinement, and execution, the ultimate requirements of 58 illustrations were kept as the goal. This number was derived from the number of individual sections within each chapter. The focus as to how to resolve the diverse requirements of the sections sharpened under the idea that the individual chapters provide an identity to those illustrations within its boundaries. Thus, Chapter 1, "Perception Is...", is identified by curvilinear drawings; Chapter 2, "Man...", is identified by rectilinear drawings; Chapter 3, "Perception Is Influenced By...", is identified by curvilinear drawings differing in nature from those representing Chapter 1; Chapter 4, "Other Quotes", is identified by a unique mixture of the preceding three chapters.

The actual process of selecting and cropping the drawings began after all typographical details and problems had been resolved. One of the problem areas was the organization and lay-out of the Table of Contents. This particular problem was essential to the success of the overall design. As Mr. Ralph Hattersley states in his Introduction, it is clearly intended to be used as a guide. Because it contains all the 'signposts' to the groupings of quotations that make up the subject of the book, the organization and presentation of the Table of Contents in a style consistent with the book as a whole had to be successfully achieved.[6]

[5]See illustration, # 5.

[2]See illustration, #10.

Another area that required concept and development was the cover design. After a period of evaluating abstract cover design programs, it was determined that a visual concept based more directly on the title of the book was more appropriate. A process of brain-storming for ideas originating from the title led to the decision to employ the image of a 4 X 5 film holder on the front and back cover as a visually allusive device as well as an organizational aid to the typographic placement. A white ground in the area normally occupied by film would serve to hold a computer drawing. The drawing that was ultimately selected for this area was directly related to the illustrations within by its randomness and its fragmentary utilization.[7]

This final selection did not occur until other options had first been explored. A program was written specifically for the cover illustration. An elliptical pattern with its coordinates relative to the four corners of the film holder was programmed and drawn. Modifications were made and while the end result was exciting it was determined to be inappropriate for the role of cover illustration. The criteria for its rejection were that it lacked continuity with the other illustrations and was overly complex.[8]

Occurring as a parallel effort to the illustration of the book design was the actual typographic composition of the book dummy. While not directly related to the thesis topic, I feel that the attention given to this work was extensive and thorough. All type was set on a Merganthaler V.I.P. using two types, Palatino and Helvetica Italic. Point size was almost entirely maintained at nine points, leading at eleven points. Some quotations were reset to solve poor line breaks or other undesirable characteristics. Manipulation of character set width was employed infrequently but where necessary. Letter fit was adjusted by kerning where needed. The work in this area allowed complete control over the typographic quality and provided a finished result. It also provided a proving ground for the organizational grid and the design of the book as a whole.

The final thesis production consisted primarily of selecting the 58 plots to be used as illustrations. The decision to perform this selection by subjective judgment, intuition and an eye to serving the requirements of each chapter's identity as stated above served well. The selection process itself was subject to revision and certain choices were changed and strengthened. The final group of selected drawings, executed by computer, successfully fulfilled their purpose. The thought of providing the 58 needed illustrations without the aid of computer graphics would necessarily lead to a different design approach. In the case of PERCEPTUAL QUOTES FOR PHOTOGRAPHERS I believe a unique solution was achieved.

[7]See illustration, # //
[8]See illustration, # 6.

CONCLUSIONS

In conclusion,I would like to mention some thoughts on the topic of computer graphics for the designer. I believe that as in most new approaches to time-worn problems there are new problems and potentials. The field of computer graphics is in such a situation. I had hoped that by coming from a predominately art and design background,   my work with computers would not be impeded. Unfortunately, this was not to be the case. My involvement required that I come to terms with computers to a degree that many designers would probably not have the time or inclination to give. Until interactive graphics systems incorporating light tablets and light pens, or programs written expressly for the designer are offered, it is likely that these tools will remain in the hands of the specialists, perhaps offered by service houses. This condition already exists but it remains to be seen if computer graphics will gain enough acceptance to warrant its development as a designer's tool. If current trends in other areas of the graphic arts industry, namely, typesetting technology, are any indication, this develop-ment is not far off. Also, if the economics of the field continue their pattern of decline this will further encourage development.

In the context of my work with a book design problem there appeared in my path many opportunities to utilize the benefits of computer graphics that were peripheral to my immediate problems but indicative of the maxim that if there is an idea it probably can be done. For instance, it would take some programming development but it would be possible to draw grids in quan-tity to explore organizational systems development for practical communi-cations problems. Such a system would most likely be based on the unit grid method.

Computer graphics for the designer of visual communications needs to gain the active attention that it most assuredly deserves from the design community, the electronics industry and the software specialists.

APPENDIX A

My personal interaction with computers as a graphics generator has followed several paths. One of the first was working with an interactive system centered around a micro-computer, an APPLE II, which uses a color video monitor for graphics display. This system is currently inexpensive, priced around $1500. Prices in this market have enjoyed the enviable circumstance of decreasing rapidly in recent years.

The APPLE II in its standard configuration assigns the area of the display monitor 1600 points of programmable display. An x, y axis arrangement is organized with 40 "x" points and 40 "y" points available. BASIC, as a computer language is used. A typewriter keyboard unit provides the communications link whereby the designer is able to immediately effect graphics changes in real-time. This interactive characteristic is very attractive and desirable for graphics related work. Often, while en route to the solution to a prescribed problem many options and unforeseen possibilties are presented to the designer as programs are refined and developed. The display may be recorded easily, at any time, with a camera or on videocassette.

One of the first practical applications I made of the APPLE II was to provide a background visual for a book jacket design problem. This ability to provide strong color and minimal form as figure and ground for communications needs such as posters, book jackets, outdoor advertising, etc. opens up an entirely new area of image generation and design methodology.

A second system that I became involved with was working with a program, ARTAID, by James Ver Hague, which allows the user to produce graphic output as alpha-numerical overprinting. These prints are first manipulated interactively on a graphics terminal linked on-line to a host computer. Once the design has been completed it is sent to a line printer for execution. There are several aspects of this system that are attractive.

First, ARTAID is a non-technical approach to interactive computer graphics work. Very little knowledge of computers is required of the designer. Aside from describing the dimensions and positions of the figures to be printed no mathematical expertise is required to successfully work with this tool. Another advantage of this system is its "hard-copy" output. Levels of value from white to gray to black may be achieved by manipulating the character selection and overprinting sequence. It can be an enlightening method to examining form and dimension, figure-ground relationships, symmetry options and repetitive patterns. Another facet of this program is its ability to produce color separations of the designs automatically with nothing but the assignment of the color to the desired figure.

In a fine arts oriented problem I incorporated one initial computer generated drawing into three related color Kwik-Prints.[9] The three variations were achieved by the use of symmetry commands, applied color and photo-mechanical manipulation. Once again I found the result satisfying and the design process itself to be stimulating.

A cause for dissatisfaction for me became the actual quality of the high-speed lineprinter copy. My familiarity with the Merganthaler V.I.P. typesetter led to the conjecture that it could be used as a means of producing the final design. All that was necessary was to develop the appropriate interface between the Sigma IX and the V.I.P. With the help of Mr. Ed Buffan, of R.I.T.'s User Computer Services Department, a software program was developed to translate the graphic designs off-screen to six-level teletype paper tape which in turn would be compatible as a means of information input to the Merganthaler system. These tapes could then be edited and modified on a video display terminal. Such typographic qualities as font selection, point size, leading and line measure could be attended to. Besides enhancing the quality of the design, this method has many more possible direct applications because of its greater clarity and visual acceptance. Type may be used in the context of concrete form or syntactically with sequentially generated forms. Again, visual texture patterns and symmetry may be successfully explored with this method.

[9] See illustrations 7, 8, 9.

12

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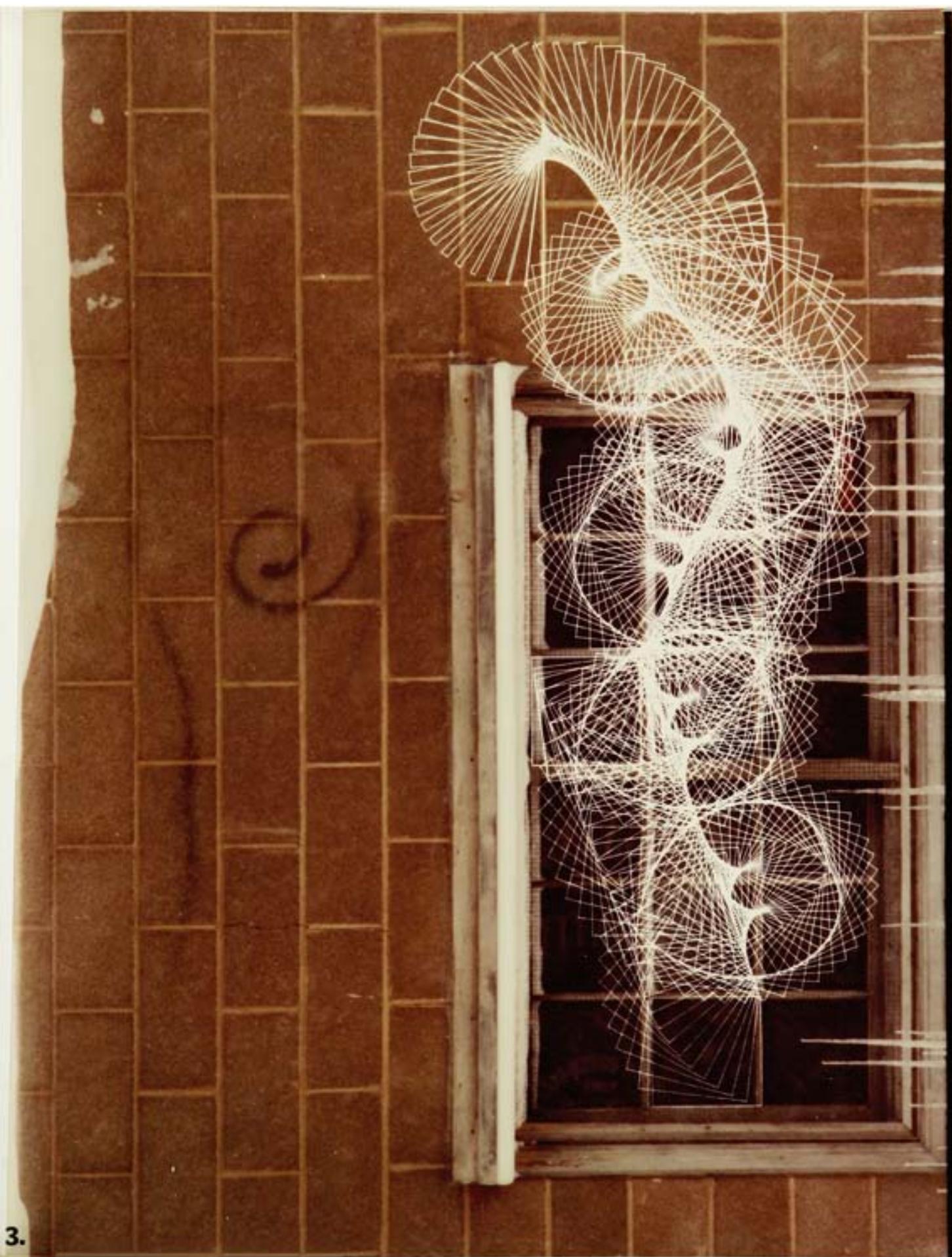 New York: American Management Association, 1966.

Table of Illustrations

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          MASTER GRID APRIL 1979
              DIMENSION X(9),Y(10)
              U=11.*.01394
              WX=89.*U
              WY=49.*U
              CALL WINDOW(2,WX,WY,1,1234,2111)
              CALL RECT(0.,0.,WX,WY,0.,0,0.)
              Y(1)=4.*U
              Y(2)=5.*U
              Y(4)=15.*U
              Y(5)=15.*U
              Y(6)=20.*U
              Y(7)=30.*U
              Y(8)=30.*U
              Y(9)=45.*U
              Y(10)=46.*U
              X(1)=7.*U
              X(2)=10.*U
              X(3)=11.*U
              X(4)=29.*U
              X(5)=34.*U
              X(6)=39.*U
              X(7)=58.*U
              X(8)=59.*U
              X(9)=68.*U
              DO 5 I=1,9
              CALL PLOT(X(I),0.,3)
              CALL PLOT(X(I),WY,2)
        5     CONTINUE
              DO 10 I=1,10
              CALL PLOT(0.,Y(I),3)
              CALL PLOT(WX,Y(I),2)
        10    CONTINUE
              CALL FINPT
              END
```

1.

2.

3.

Contents

5.

6.

8.

Perception is Active

Ulric Neisser

In normal use the eyes are rarely still for long. Apart from small tremors, their most common movement is the flick from one position to another called "saccade." Saccades usually take less than a twentieth of a second, but they happen several times each second in reading, and may be just as frequent when a picture or an actual scene is being inspected. This means that there is a new retinal image every few hundred milliseconds.

Minor White

In putting image together I become active, and excitement is of another order—synthesis overshadows analysis.

2

Perceptual Quotes for Photographers

Perception is Contextual

The photographs are not illustrative. They, and the text, are coequal, mutually independent, and fully collaborative. By their fewness, and by the importance of the reader's eye, this will be misunderstood by most of that minority which does not wholly ignore it. In the interests, however, of the history and future of photography, that risk seems irrelevant, and this flat statement necessary.

Agee-Evans

When the image of an object changes, the observer must know whether the change is due to the object itself or to the context or to both... otherwise he understands neither the object nor its surroundings. Interwined through the two appear, one can attempt to tease them apart, especially by watching the same object in different contexts and the same context acting on different objects.

Rudolph Arnheim

...gestures not only do not stand alone as behavioral isolates but they also do not have explicit and invariable meanings. By the study of gestures in context, it became clear that the kinesic system has forms which are astonishingly like words in language.

Ray Birdwhistell

To engage a sequence we keep in mind the photographs on either side of the one in our eye.

Minor White

3

Perceptual Quotes for Photographers
Photographers

Edited by R.D. Zakia

Perceptual Quotes for Photographers

Edited by R.D. Zakia

Photographers traditionally like to talk about photography, but they often get hung up on technique and can't think of anything else to dwell on. Richard Zakia's book provides a whole raft of new things to talk about in the context of photography. Though the quotes often fail to mention photography as such, a connection can be made by the intelligent reader who is willing to try. Actually, every single one of them can be seen as applying directly to photography as a process involving visual perception.

Ralph Hattersley
Virginia Beach, Virginia

Richard D. Zakia is Professor of Photography and Coordinator of the Master of Fine Arts program in Photography at the Rochester Institute of Technology, School of Photographic Arts and Science. He has a B.S. degree in Photographic Science and an Ed.D. in Educational Psychology. His other books relating perception and photography are, PERCEPTION AND PHOTOGRAPHY (Prentice-Hall, 1975) and VISUAL CONCEPTS FOR PHOTO-GRAPHERS with Professors Les Stroebel and Hollis Todd (Focal Press and Hastings House, 1979).