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### Publication Date

1983-11-01

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Presented at the First Annual Conference of the National Computer Graphics Association, Arlington, VA, June 16-19, 1980

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November 1983

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Computer-Assisted Information Graphics  
From The Graphic Design Perspective

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November 1983

Presented at the First Annual Conference of the National Computer Graphics Association, Arlington, VA, June 16-19, 1980.

This research was supported by the Applied Mathematical Sciences Research Program of Office of Energy Research, U.S. Dept. of Energy under contract number DE-AC03-76SF00098.



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COMPUTER-ASSISTED INFORMATION GRAPHICS  
FROM THE GRAPHIC DESIGN PERSPECTIVE<sup>1</sup>

ABSTRACT. Computer-assisted information graphics can benefit by adopting some of the working processes, principles, and areas of concern typical of information-oriented graphic designers. A review of some basic design considerations is followed by a discussion of the creation and design of a prototype non-verbal narrative which combines symbols, charts, maps, and diagrams.

I. INTRODUCTION TO IMAGES AND INFORMATION

Technology now permits voluminous information to flow between and among groups. Both senders and receivers face the problem of determining which messages are valid, which are useful, which are significant. Information is not necessarily valid, useful, or significant. Of special importance are diagrams, charts, maps, and tables that can quickly and effectively portray essential and significant information in place of lengthy texts. The means for portraying facts and concepts in the research, marketing, and management sectors of business and governmental institutions are within reach from even the simplest alpha-numeric terminals. The last two decades have been called the "Information Age." The signs of a new decade, an "Image of Information Age," are clearly apparent when a single page of graphics produced even through conventional means can reduce a 150-page executive report into a single sheet of 20 charts,<sup>2</sup> which can be easily created, reproduced, distributed, comprehended, and updated.

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<sup>1</sup>This work was supported by the Applied Mathematical Sciences Research Program of the Office of Energy Research, Department of Energy Under Contract W-7405-ENG-48.

<sup>2</sup>Blake, George B., "Ideas for Action", Harvard Business Review, March-April 1978, pp 6-8 ff.

## THE TWO FACES OF INFORMATION

The state of informational computer-assisted graphics systems can be divided into two camps. In one kind, rich color, high quality typography, and elaborate non-alphanumeric symbols are available. This represents the kind of computer-assisted informational graphics that might be called the "pretty but dumb" variety. If we wish to change the values along the edge of a chart display simply by dividing them by two, it might be impossible in such a system. There is no data space behind this kind of image for semantics (what symbols mean) only a display information space for syntax (how symbols appear). The image is only a "pretty face." Nevertheless, such images are still one important kind of commercially available computer-assisted informational graphics often used for slide and video presentations.

The other kind of graphics is represented by output images from large data banks or from very complex modeling systems. These charts and maps are often unsophisticated in color and crude in typography. The visual image has the advantage however, that the data can be retrieved, changed, and displayed in a variety of ways. The image is "ugly but smart". Its effectiveness as an image of information needs to be improved.

Eventually the capabilities of these two approaches will merge. The average user of information display systems will be able to manage the appropriate form of display, moving from coarse to refined qualities as necessary. Most importantly, the user will be able to manage large masses of information and to shape their facts, concepts, and significance into both an intelligible and appealing visual form. This may end "The Era of Dull Data" and signify the beginning of "The Age of Beautiful Information". Both delights and dilemmas lie ahead.

## STUMBLING TOWARD UTOPIA

It might seem that Utopia is just around the corner; however, there remain formidable challenges in developing effective means of presenting information graphically. As we enter an era of mass information distribution, humanistic values may be overlooked, forgotten or ignored when systems are created that are too much dependent upon the imagination and technical expertise of computer scientists alone.

For many situations, the information may be too technical for parallel-professional or general

audiences. What format should one use? How should typography and color be employed? In many of the informational graphics that we presently see created through advanced computer-graphics systems, the use of typography is often at a very primitive and ineffective level; color is often over-used and out of control. There are often unresolved errors of visual indexing, of cross-referencing, of comparing one kind of information with another, of showing the reliability, precision and age of information. Images must also convey concepts as well as facts. How do we get across concepts?

### THE DESIGNER OF INFORMATION GRAPHICS

As we attempt to make our way through an increasingly complex information environment, we shall need a new kind of person to help make more effective images of information. One term for such a professional is a graphic designer of information. Within the computer graphics world this expertise can be incorporated into emerging information display systems either by adding professional graphic designers (who may have limited computer graphics experience) to the staff or by developing the graphic design expertise of the current computer-oriented staff.

In order to understand how the informational graphic designer would work, I describe a prototypical project of informational graphics in which I participated. Although the project was not created through computer graphics, the qualities of the images can be achieved by current equipment, and the conceptual tasks are typical of those encountered in creating computer-assisted information display. This particular project concerned visually communicating information about global interdependencies to international policy makers.

### AN EXAMPLE: VISUALIZING GLOBAL INTERDEPENDENCE

How would you explain global interdependence to someone? Policy makers spend considerable time examining tables of numbers, dense texts, and complicated charts trying to understand this subject. The East-West Center, a federally funded research center in Honolulu set up by Congress, explores the themes of global interdependence in its institutes of population, communication, natural resources, culture learning and environmental planning.

The East-West Center decided to explore the possibility of new visual means to discuss global interdependence. It invited five visual communicators from

around the world to become Research Fellows and to study the problem of visualizing global interdependencies. Their backgrounds were Japanese, Indian, Persian, Chinese and American. The actual graphic design synthesis of the project resulted from the efforts of information-oriented graphic designers.<sup>3</sup>

### STAGES OF RESEARCH

Our group had a five month period of time to consider and devise a means of visualizing global interdependencies. In the first stage of our research we studied the general topic of global interdependence. In the second stage we considered energy as a specific area for further study. The material we studied was confusing because similar data sometimes were not treated sometimes in the same way. Data were presented with varying and unclear degrees of uncertainty. Crucial data sometimes were missing. Conflicting implications sometimes were drawn from the same data with respect to the shift from non-renewable forms of energy to renewable forms such as solar and nuclear. We organized and clarified what information we could gather in the time available to us.

Finally, we arrived at the third stage of our research, studying the means of visualizing facts and concepts. Our group studied diagrams, maps, charts, tables, photographs, and models. We examined books, films, slide shows, and computer graphics.

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<sup>3</sup> Mr. Yukio Ota, Research Fellow and graphic designer, currently at the Advanced Social Planning Institute, Tokyo.

Mr. Aaron Marcus, Research Fellow (plus Project Coordinator) and graphic designer, formerly Assistant Professor at Princeton University and currently Staff Scientist at the Lawrence Berkeley Laboratory, University of California, Berkeley.

Ms. Susan Marcus, Graphic Designer, formerly freelance designer for the Publications Office, Princeton University and currently principle graphic designer of Meta-Graphics, Berkeley.

Mr. Jerry Kuyper, Graphic Designer, formerly Assistant Professor, University of Hawaii, and currently Fulbright grantee at the National Institute of Design, Ahmedabad, India.

The other Research Fellows were Dr. Shyam S. Agrawal, CEERI, Pilani, India; Dr. Mei Ling, HSU, University of Minnesota; and Dr. Ebrahim Rashidpour, University of Tehran, Iran.

## OBJECTIVES AND PROCEDURES

We sought to make the images primarily responsible for conveying clearly determined concepts. We attempted to create a signage system for the mind that would lead a viewer through a conceptual landscape. What we ultimately achieved was an experiment in visualization, not a new theory of global interdependence. The main goal was to achieve exemplary coherency, clarity, and visual impact. The guiding lights for our project included a book and a film that have achieved much deserved fame in the informational graphics community. The book is called Cosmic Views by Kees Boeke, and the film from the Eames studio based on the book is entitled Orders of Magnitude,<sup>4</sup> Both illustrate what it means to jump orders of magnitude from the size of the electron to the size of the entire universe in approximately 40 steps of a "conceptual zoom." Our objective was to achieve the same clarity and impact as the book/film.

Because of facilities and time constraints, we considered several conventional graphic media for the project, such as a brochure, film, video program, and poster series. We eventually decided to create a slide show, because slide projection facilities are widespread and relatively simpler in comparison to film and video. Through this medium we intended the presentation to be available in developing countries as well as in developed countries. With a slide-show we could achieve large images with strong visual impact that could be changed relatively easily, updated, and duplicated. One final advantage of a slide show in comparison to books and posters would be the fact that viewing a slide show is a socio-petal experience; that is, the medium naturally encourages people to gather together for further discussion about the contents and form of the show.

From our earlier research, we developed a concept list of about 200 entries. We reordered and reduced this list to about 100 entries, a workable sum for a single screen 15-minute slide show. Then came the verbal/visual leap: How could we move from this list of verbal items to images? What charts, maps, diagrams, and symbols could we use?

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<sup>4</sup>Boeke, Kees, Cosmic Views The John Day Company, New York 1957. The film Orders of Magnitude is distributed by Pyramid Films, Inc., Santa Monica, California

## SOME EXEMPLARY ISSUES

It is appropriate to review some of the graphic design issues that we examined. A crucial question for us was not simply how good or bad any image was by itself but how continuity and clarity could arise in a sequence of many images. For any kind of data, thousands of forms are possible. Pie charts, for example, are often used to examine gross differences, but it is sometimes difficult to make cross comparisons from pie chart to pie chart.

In any list, bar chart, or other diagram form, there is a general limit to giving more than five major things to consider at any one time. Many numbers presented at once can not be easily remembered, and in an audio-visual presentation, there is very little time to understand a frame of information. Many diagrams that we examined had too many data or reference points for our use. They were better suited for use in publications rather than audio-visual presentation. The typography and a charting grid can disturb the viewer's ability to read the significant information. It is much more desirable to invite examination, to pose fewer distractions. The reliability of the data is another matter to consider; charts often give the impression that the data are much more certain than is the case.

Flow charts and diagrammatic process charts are another typical means of showing information. Computer programs have been written to display this kind of chart but these computer-assisted diagrams are often hard to read because of typesize, color area patterns, and line weights. Complex images such as these are not easy to display effectively for a professional audience. They are certainly difficult to create for a mass audience, yet the educational or consciousness-raising potential of diagram might be considerable if it were well designed, and clear. One typical charting and diagramming oversight is that in many images, everything is rather interesting and exotic in terms of color and pattern; The fundamental problem is the lack of a clear hierarchy of information.

Maps are yet another important means of showing data, facts, and concepts. Computer-assisted cartograms, for example, have helped to create new images of the world, just as the first photographs of the earth from space changed our global perspective. The cartogram is a specialized, distinctive image. In a narrative sequence of information it presents a typical difficulty: how to combine this kind of image with other kinds of images in a sequence. In attempting to

construct special purpose maps, the graphic designer's perspective is somewhat different from that of many cartographies. Short-time map reading requires a very different visual hierarchy, a different sense of reading, namely, reading over time (multiple images) rather than space (dense single image).

One general comment on computer graphics displays is in order. Such displays are extremely valuable for the analysis of very complex and elaborate systems, but it takes time to learn how to read this kind of imagery. In fact, at last one spokesman for a computer graphics group has commented that he could not be certain how successful such images are even for technical audiences looking at them. The form of these diagrams must be considered carefully to communicate significance to technical audiences, but they must also be planned and designed carefully for professionals from another discipline or for the general public. Unfortunately, typography, color, and composition are often not as effective as they should be in these diagrams. One other factor to note is that it takes considerably more time than usual to program these displays properly if one is demanding about the quality of visual images.

#### THE FINAL RESULTS

For the final form of our project, we decided to experiment with an approach radically different from most of the material we examined. We created a non-verbal symbol/chart/diagram/map system. We developed a new pictographic/ideographic "language" to simplify and to clarify reality. Our approach was not new; it was based on emerging systems of international signage and proposals for universal visual languages. In the latter group are Isotype symbols, Bliss symbols, and LoCos<sup>5</sup> Universal visual language may have no standard spoken form, but it is possible to write and read them easily and to communicate anything that might otherwise be spoken.

We studied thousands of symbols from glossaries and books on the subject. Eventually, we sketched about 500 pictograms or ideograms and created

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<sup>5</sup> Edwards, J.A. and Twyman, Michael, "Graphic Communication through Isotype," exhibition catalogue published by Dept. of Typography and Graphic Communication, Univ. of Reading, England, 1975.

Bliss C.K., Semantography (Blissymbolics), Semantography Publications, Sydney, Australia, 1965.

Ota, Yukio, "LoCos: An Experimental Pictorial Language," 1 cographic, No 6, 1973, 15-19.

approximately 200 composite images. We reduced this collection by careful selection and testing among our own group to about 70 signs and combined these into approximately 80 images.

Because we were developing the presentation for a multi-cultural audience, we were hesitant concerning the use of color. If we wished to say that something is holy or sacred, what color should we use? Should it be white, black, saffron yellow, red, or green? Specific color connotations are a very complex matter. Designers of informational signage systems for international airports know this quite well. We decided to create our show in black and white, and we felt that black itself was a color. In addition, a white on black show would stand out in a milieu of audio-visual presentations that is often characterized by an overabundance of ill-designed color.

We wanted to restrict the use of any verbal material because we did not want to stress left-to-right English language-oriented images. For the same reason we tried to compose centered figure-field relationships wherever possible. These would not emphasize a particular left/right reading direction. We also studied symbol size variations. We determined that we needed symbols with three primary sizes, in effect title, text, and footnote sizes because we were defining a "typography" of pictographic/ideographic symbols.

We revised our symbols and compositions continually, always seeking an ideal resolution to the needs of form and content. Graphic design considerations included a clear, consistent approach to line weights, angles, shapes, simplicity of outline, visual weight (size and amount of ink or light), and location.

At the very last moment we added a sound track. We added a musical score that seeks to create a balance between East and West. As a failsafe feature we wrote a brief verbal (English) narration. This development sequence reverses the traditional flow in which the verbal narrative comes first. What we finally achieved is a visual symbol/chart/map narrative similar to primitive symbol stories or the pictographic/ideographic writing of some civilizations.

The presentation has been shown approximately two dozen times to audiences in the United States, India, and Japan. Written evaluations and informal comments have been used as a basis for adjustments in its final form before the slide show was prepared for limited distribution for educational use. Even in its prototype form, it provides a useful exercise in visual communication. Besides policy makers, a potential

audience in secondary and college-level students exists. The slide show can be used with or without narration as a stimulus to discussions both of its content as well as its form.

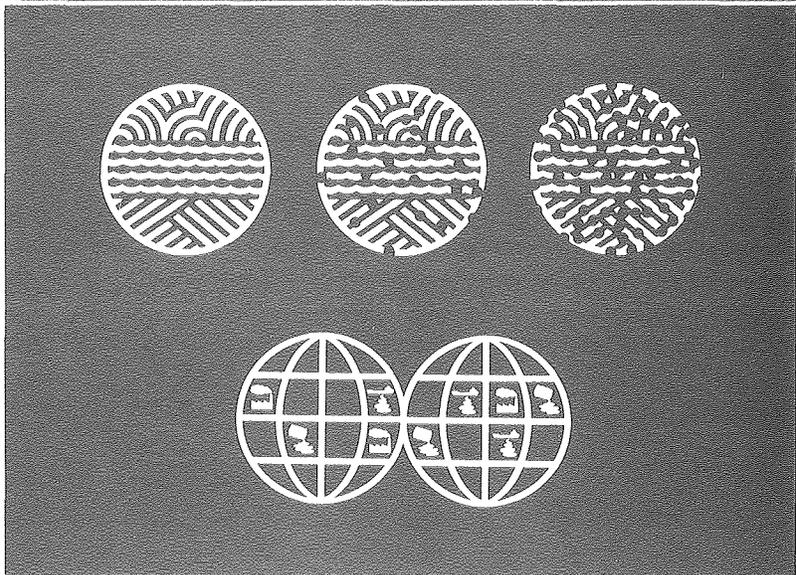
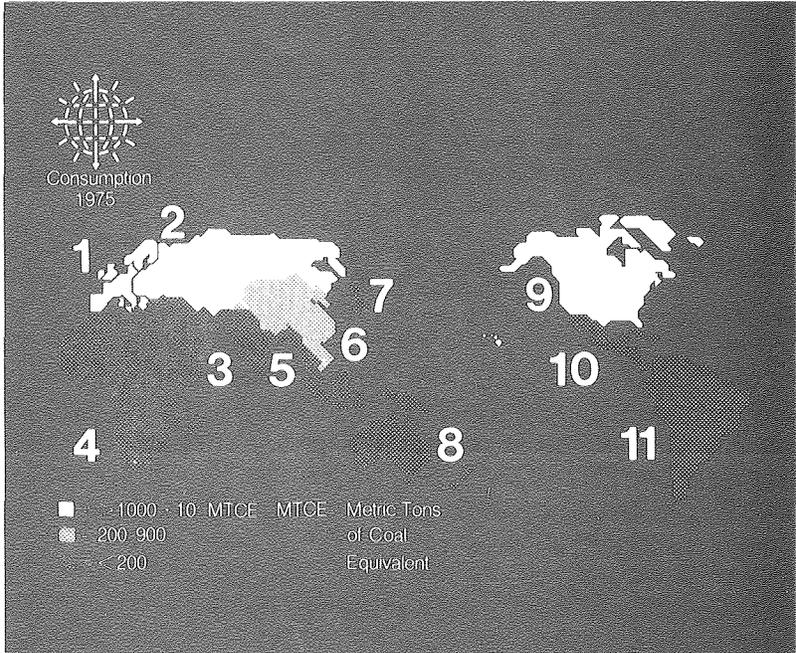
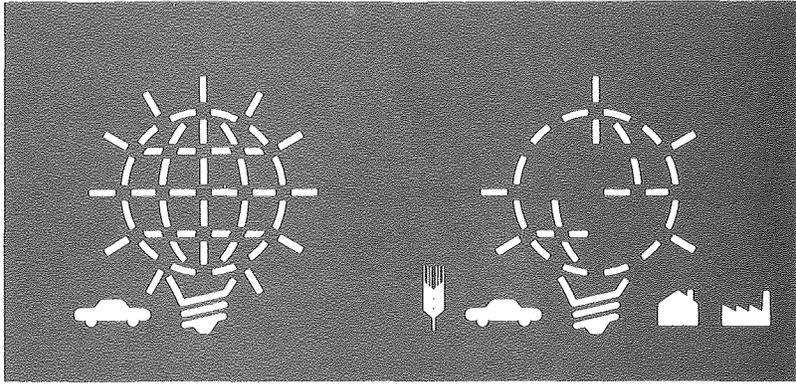
#### SUMMARY

"Visualizing Global Interdependencies" is an attempt to communicate both facts and concepts, to go beyond numbers to link ideas, to create a balance between specific data and abstract information. The sequencing of symbols must introduce the symbol language and at the same time, assist the viewer in learning to think with that system. These white symbols against a deep, black field show the stark reality of global interdependence without distracting decoration. In a dark room, facts, concepts, and the significance of global interdependencies leap forward to confront a viewer's consciousness and conscience.

The discussion of this project and the accompanying exemplary images attempt to clarify and make concrete the working process and some of the issues which the information-oriented graphic designer confronts in achieving a coherent, valid, attractive, and useful image of information. In this context questions about color, typography, composition, symbols, and over-all visual hierarchies are relevant. While the discussion has not been housed in a computer graphics display environment, some of the critical problems facing information display currently are not essentially technical but rather human-oriented ones. Because of this situation there is a new value to joining the experience of the graphic design world with the computer graphics world in exploring the Image of Information Age.

#### ACKNOWLEDGMENTS

This text is adapted from the first lecture of the Design Lecture Series sponsored by the National Endowment for the Arts' Design Arts Program given at the National Gallery of Art, Washington, D.C., 20 November 1979. Exemplary images from "Visualizing Global Interdependencies" appear courtesy of the East-West Center, Honolulu.



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