

WALKER ART CENTER

Computers and Design

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Muriel Cooper

Computers and Design

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The New Graphic Languages

Today's personal computer is a functional tool that mimics old tools. But the next generation of graphic computers will permit the merging of previously separate professional tools; at the same time, powerful networking, increased bandwidth* and processing capabilities will make the transition from print to electronic communication the basis of a vast industry. The primary interaction of electronic communication environments will be visual. Traditional graphic design skills will continue to be important for display and presentation, but a new interdisciplinary profession, whose practitioners will be adept in the integration of static and dynamic words and images, will be required to organize and filter information growing at an exponential rate.

In each period of our history, design and communication have evolved synchronously with the technology of the time. Each new medium has extended our sense of reality and each has looked to its predecessor for language and conventions, referencing and adapting its characteristics until its unique capabilities can be explored and codified. Print, in its infancy, emulated the conventions of calligraphic writing on vellum; typography was modeled on the penmanship of the scriptorium; images and color embellishment

** bandwidth= a range of frequencies within a band of wavelengths in which a computer can function.*

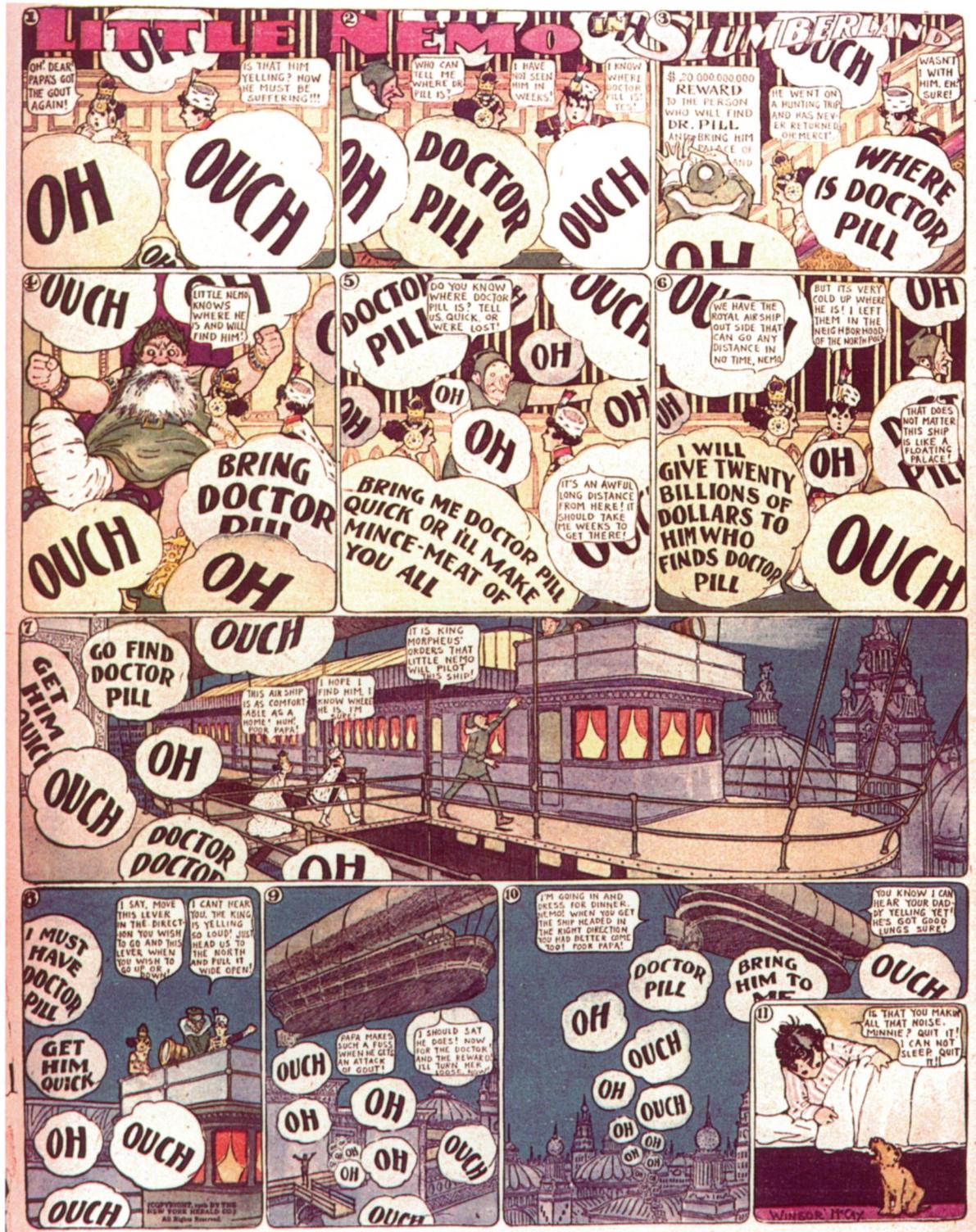
continued to be added to the printed page by hand, emulating the methods of the monastery.

Since the industrial revolution, the expanding tools of the print and broadcast technologies have made the broad dissemination of information possible. A rich and overlapping array of related design and communication fields evolved and matured rapidly in response to mass communication needs. These included graphic and typographic design, illustration, photography, multi-image design, exhibition and interior design, industrial, and environmental design. While the conventions and performance of each often overlapped, they also depended in unique ways upon the physical constraints and characteristics of their trades: reproduction tools of typography, photography, and print; slide, film and video projection, and synchronization tools; sound making, reproduction and mixing tools, for example. As the tools of these media were honed and adapted for broader penetration and use through continuing loops of research and market testing, so were the conventions and languages, the methods of production, and the patterns of communication within each of the design fields.

Natural visual and aural languages were gradually translated into message making conventions that coupled intuitive understanding of human perception with the organization of images and words into two dimensions. Reality was filtered and organized



All technologies are surrogates for physical experience; for example, typography is a substitute for audible speech.



The *Little Nemo* cartoon is an amusing and remarkable exploration of simultaneity. Its multiple voices and serial images bridge time and space and use typographic size, style, and placement to simulate sound and expression. Created by Winsor McCay for the *New York Herald*, 2 January 1910.

through the limitations of the media, modifying the way we think. The restrictions of the page, the frame, the aspect ratio^o of the television set, the physical space of an exhibition hall, and the manufacturing tools also defined the degree to which audience or user could interact with the medium. Communication with large audiences could only be accomplished through expensive, complex media channels, traditionally controlled by the few, motivated and driven primarily by sales and advertising in the United States and often by political expediency in other parts of the world. At this scale, the filtering and editing of information became a consequence of economic control. As H.J. Liebling once quipped, "freedom of the press is guaranteed — to anyone who owns one."

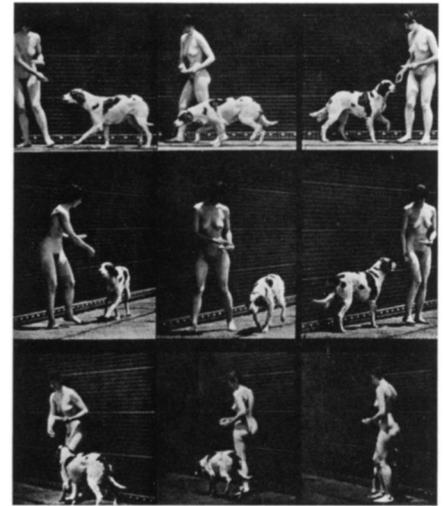
In that context design is interactive and recurrent. It is also focused and goal dependent. The beginning and end of the process are clearly defined and demand conceptual clarity and closure. This limits evolutionary interaction with the medium and the audience or user and requires generalized solutions for large audiences. It is counter to a more intuitive or evolutionary approach to the thinking and problem solving associated with the arts and research, which depends on constant testing and refinement, and encourages lyric leaps.

At the frontiers of expression, unencumbered by the restraints of

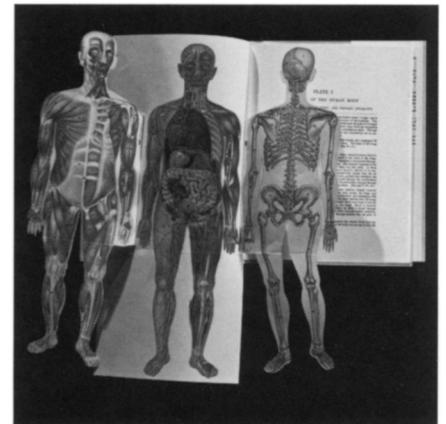
^o *aspect ratio* = the ratio of the width of a television or film image to its height.

the marketplace, artists and designers have pushed the time and space limitations of print and mass production with experimental works in limited editions. The traditions of binding, of the page, of sequence, of materials, of the package, of audience participation, have all been violated in an effort to break away from the tyranny of a fixed set of relationships. The ever evolving art of Robert Rauschenberg hovers between kinetic sculpture and redefining visual "literacy," in his 1967 print series *Revolver*. In these silkscreens, images are printed on translucent rotating Plexiglas discs, in which the time overlaps characteristic of his previous work are achieved in real time.

Special purpose educational productions have extended old boundaries. A medical encyclopedia opens to reveal the underlying anatomy of the human body — a third dimension or spatial understanding is achieved through die-cutting, pop-ups, pullouts, and transparencies. Tables are made dynamic by the use of wheels and pullouts. Children's books have included scratch and smell, built-in sound, and holographic illustrations. Artists and designers have often become their own authors and producers, gathering to themselves the autonomy that allows control over all aspects of



Eadweard Muybridge's turn-of-the-century experiments with photographic motion studies provide both visual and scientific information.



Bonanza Books *Foldout Atlas of the Human Body*, by Alfred Mason Amadon, MD, achieves simultaneous three-dimensional views of elements of the human anatomy by using pop-ups, pullouts, and transparencies that reveal underlying structure. This book is a 1984 reprint of the original 1906 edition.



Ron MacNeil developed a number of experimental computer programs in the Visible Language Workshop such as the pocket watch (1983), in which size, placement, and dimension were manipulated in paint and animation programs. Two-dimensional images typifying the range created by faculty and students at the Visible Language Workshop are mapped onto this three-dimensional cube (1985). Software by Masa Inakage; images by Alka Badshah, Liz Rozenzweig and Masa Inakage.



the objectification of an idea, breaking away from the limitations of mass production. Self-publishing centers created by artists or art schools are equipped with traditional reproduction tools normally found in commercial printing establishments and generate creative publishing alternatives for limited editions. Xerography and computer typesetting and walk-in copy centers with increasingly sophisticated typesetting, printing, and binding facilities allow a form of on-demand printing and inexpensive self-publishing in limited editions. Desktop publishing coupled with high-resolution typesetting challenges the mass production paradigm even further.

The Graphics Computer as Tool and as Medium

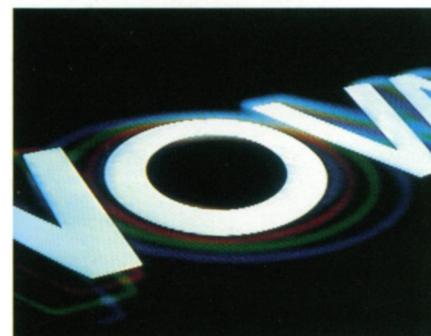
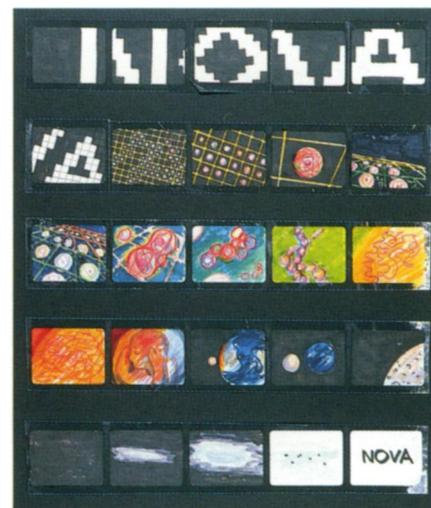
The history of the computer as a new medium follows the pattern of new media emulating old. Very early, its capacity to transform information from analogue to digital and back, shape it at processing speeds that resemble the way we think and maintain massive amounts of data in memory provided us with fast and effective tools that emulate many of the old ones in every professional medium. Early digital paint systems were modeled on physical, analogue brushes; the language

and behavior of physical oil and watercolor painting were laid on top of a digital world like a varnish.

Computer graphics, image processing, computer vision, and robotics required huge computing power and were used only in high-cost research environments. Mathematics provided the tools to model physical processes, to visualize complex scientific data, to animate space travel, and to simulate real-time flight. Large and very expensive mainframe computers dominated the industry well into the 1970s, and continue to play a key role in many corporate and institutional systems.

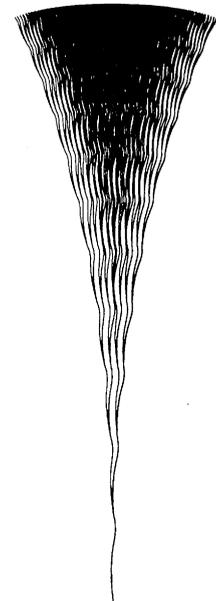
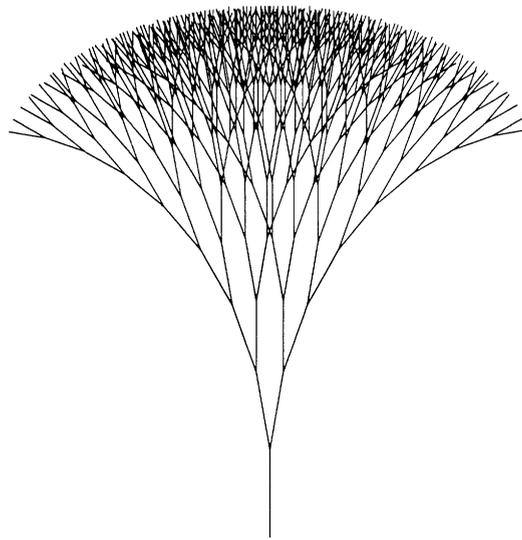
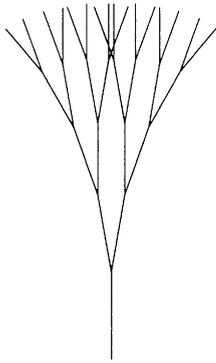
The advantages of the computer for expensive, high-resolution graphic arts soon became clear. Computer typography and layout developed in parallel with the visual computer. Word and image were merged later, when high-end designer stations were developed as a logical extension of the pre-press production process. The creative potential of these machines soon attracted designers and artists. Predictably, the work was traditional but took advantage of the machine's capability for fast and seemingly infinite transformations that would have been impossible with traditional physical tools. New digital techniques, such as "cloning" and changing color matrices were quickly exploited.

Use of the machines was not easy. It required the help of operators or, in the case of research environments, the help of programmers. And use was expensive on an hourly basis. A few



Boston's public television channel, WGBH, has created a number of title sequences for the NOVA science series since its inception in 1974. Traditional filmic techniques had given way to more sophisticated computer paint and animation systems in 1981 when designer Paul Souza created this new title sequence.

© 1981 WGBH Educational Foundation



These images of trees were created by Apple designer Hugh Dubberly using a fractals* program in PostScript software. By changing a small number of parameters, a wide range of visual possibilities can be produced on the computer.

hardy, committed visionaries began to learn programming. A significant number of programmers began to experiment with personal graphic ideas. It was only a matter of time until these tools migrated into the creative domain. The cost effectiveness of connecting such pre-press tools to the creative part of the graphic arts and communication industry was soon apparent.

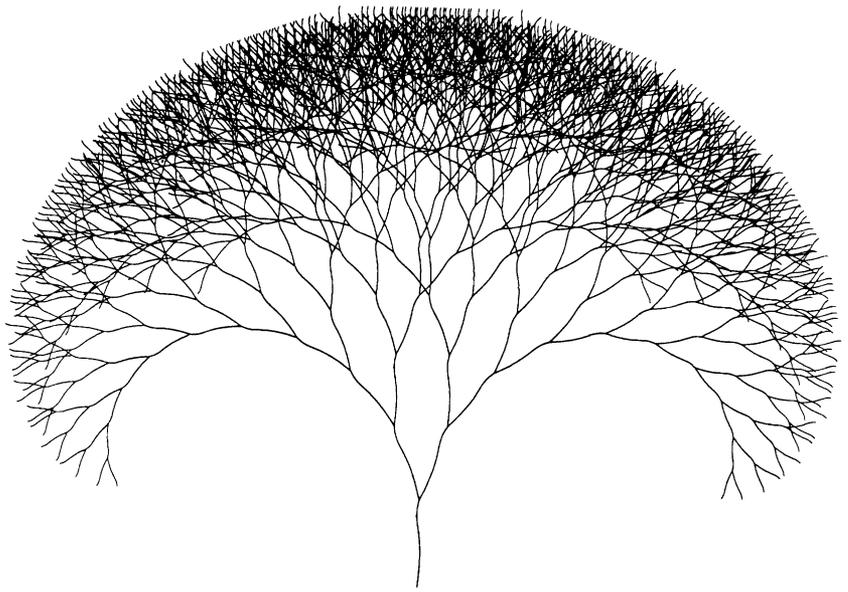
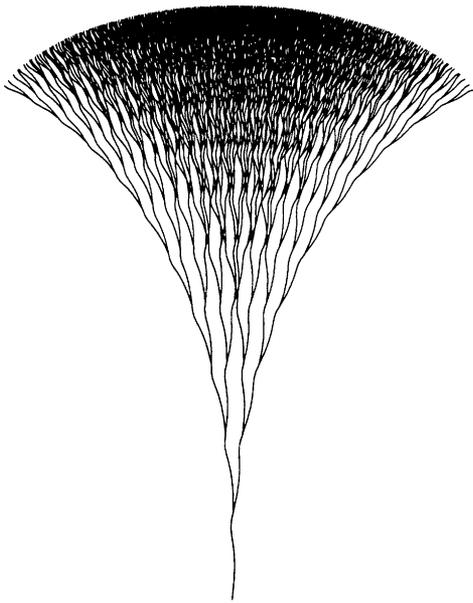
At this stage the term user-friendly was unheard of. A few dedicated designers understood the potential of the future of the graphic computer and began to design interface graphics. Most of the work was static and used traditional print design principles. Much of this work was done in office "automation" where productivity and efficiency were critical. The work was difficult since most of the machines did not yet have

sufficient resolution or speed to provide anything but a crude approximation of print quality. Typography continued to be separate from image in graphic arts systems, following the production model of offset technology; and images were only merged with text at the end of the production cycle in newspaper layout and editing systems.

Input and output were available, but costly. Some experimental prototypes were capable of capturing real-time images from the outside world and of producing print of the completed images. These, coupled with the programmatic capabilities of the computer, an integrated set of image processing tools, and anti-aliased typography,* promised a complete graphics environment for the creative artist and designer.

** anti-aliased typography= computer generated letters whose stair-stepped contours, which reveal the pixels (picture elements) that constitute the letter form, have been electronically refined using gray levels not unlike halftoning.*

**fractals = a way of describing non-geometric forms mathematically*



Personal computers were introduced into the business and education markets in the late 1970s. The goals of computer-aided education and the automated, paperless office helped to lay the groundwork. Word processing and spread sheets became paradigms for direct manipulation, ease of use, and a productive way of accomplishing traditional tasks. Video games dramatized the potential for interactive graphics. Technological growth and the industry's drive to saturate the professional and consumer markets drove down the price of memory to the point that color, graphics, and typography, with greatly improved resolution and input and output devices,* became affordable and usable.

** input-output devices= tools such as printers and scanners allow images, text, or sound to be digitized into the computer from the outside world (input); and the computer provides "hard copy" in the form of print, slides, or videotape (output).*

Desktop publishing emerged, almost unintentionally, from the union of the laser writer and good typography. The Macintosh, the first viable graphic design tool, rapidly became the computer of choice for graphic design, primarily because it supports professional work with enhanced speed and reduced cost of typography in a reasonable work environment. While it mimics the patterns and purpose of existing design tools it changes the patterns of production dependency. Desktop publishing is a transitional phenomenon that has transformed the graphic arts industry by putting production tools into the hands of professionals as well as non-professionals. An industry of desktop publishing has blossomed overnight and given birth to magazines, books, and workshops for new cottage-industry publishing entrepreneurs and new computer users. Computer and business magazines have articles on design, and design magazines inform their readers about computers. These are early symptoms of massive changes in

professional and production patterns that will result in new interdisciplinary approaches to communication.

Desktop tools for all other professions are developing at a similar rate and are following a similar pattern. Such examples as video and animation, music, architecture, engineering, computer-aided design and manufacturing exist at an astonishing level of sophistication and power for a relatively low price. Useful and usable computer-aided tools for all professions will soon be as common as the telephone, radio, or TV.

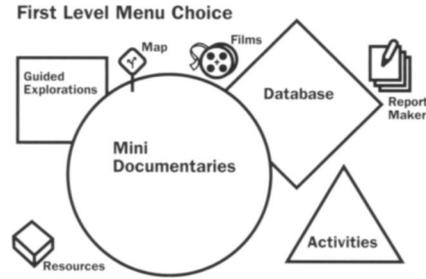
A spate of work is now emerging from studios and schools in which the graphic computer is used as a production tool. A number of application programs such as PageMaker, Adobe Illustrator,

Interactive NOVA

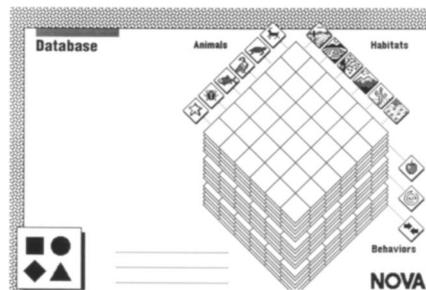
Animal Pathfinders is an interactive videodisc system to be used by science teachers and students in secondary schools.

Apple Macintosh HyperCard is the information management tool that is used to develop the database for this program; HyperCard also drives a videodisc player. The program is being developed at WGBH Educational Foundation and Peace River Films in Massachusetts. These sample screens are work in progress designed by Paul Souza of WGBH.

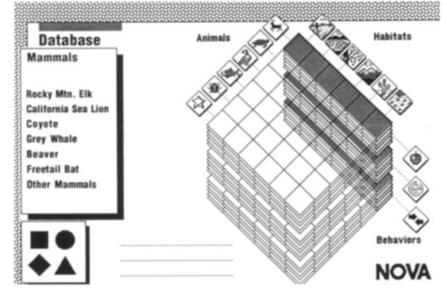
© 1988 WGBH Educational Foundation



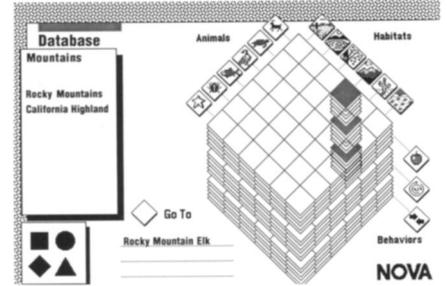
1. Home Card: the first level menu choice includes: guided explorations, mini documentaries, database, report maker, and resource activities.



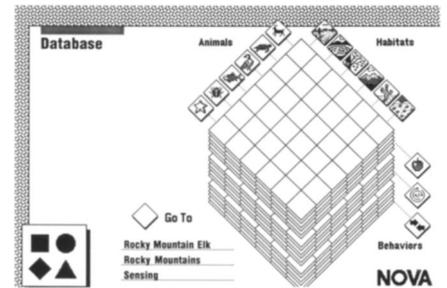
2. Database chooser: a three-axis search menu for exploring the database.



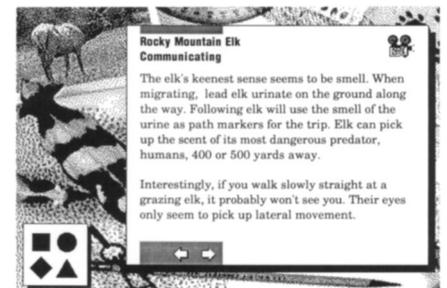
3. Mammal chosen.



4. Mammal and habitat chosen.



5. Mammal, habitat, and behavior chosen. "Go To" (diamond shape) permits card selection and sorting, and takes the user to specific cards.



6. First card in selected sort.

and AutoCad enable designers to sketch ideas that can become camera-ready copy for printing. (Color separation programs are just becoming available.) Digital data is mobile and transformable and therefore allows leapfrogging of many time-consuming and expensive production steps. Many design departments are using computers as design tools and there are an increasing number of workshops that explore design principles using the computer. The primary goal, however, is still a traditional print product.

It is not yet clear that the computer is changing the way people think about design, except to the extent that it saves time and money and provides some experimental tools whose cost would otherwise be prohibitive. At the very least, in this phase the computer may allow more time for creativity, experimentation and some preliminary crossover into three-dimensional imaging and animation by the more adventurous.

A number of designers have become consultants for businesses and schools to help in the building of appropriate systems and to set up training programs. A few designers have been working with

the computer itself as a design problem. A small but growing group has coupled design and programming knowledge to influence big players in the development of new design roles, futures, and methods.

Integration and Interaction

Mixing media on any scale is complex, and may result in changing or modifying media characteristics. Some mass media incorporate characteristics of others. Animation, film, and television are examples of communication media that are both static and dynamic. A television commercial often combines written and spoken words in a disjointed or simultaneous presentation of the same information. Such redundancy helps to emphasize points in different time frames as well as support handicapped viewers. A spoken name lasts only as long as it takes to speak it, and is only as expressive as the voice of the speaker. Jingles and tunes have been developed to extend sound into memorable aural trademarks. A name that is graphic and visual endures and can be embedded with complex symbolic and metaphorical associations and expressions not possible with aural messages. Aural and visual messages when mixed together can result in far more powerful messages as recently witnessed in rock-videos or campaign commercials.

But visual communications in the publishing and entertainment worlds, large or small, traditional or experimental, are closed and passive. The writing and designing

of printed works depend on beginnings and endings and clear-cut linear and non-variable structures. There is no publishing without closure. The reader's participation is limited to choosing when and where one may read or view, delve in or out, scan or flip.

Designing and producing film and animation since the advent of sound is by nature multimedia. While it is dynamic, its interactive capabilities are limited. Videotape provides the viewer with some of the "flipping" control that a book or magazine provides, insofar as one may fast forward and review. Audiotape and videotape recorders allow the relatively easy excerpting and editing that a Xerox machine provides and in limited ways lets the audience reshape the works to individual needs. A world of authorship is open to the owner of a video camera and tape recorder.

Home video games provide a controlled interaction that tempts the viewer to want more control in all television watching. The cordless remote control gives rise to quick channel hopping and a sense of simultaneity. The viewer is able to watch up to a dozen programs simultaneously without losing a single story line or commercial. Umpteen cable channels suggest that audience and community control might provide better programming. The phenomenon

of the video rental and purchase business allows the viewer programming control without advertising. For the fabled yuppie the Saturday night grocery bag is incomplete without weekend videotapes. The computer that was bought for the kids schooling, or for word processing, is equipped with a modem and one can tap into primitive, but interactive and lively bulletin boards, videotext shopping, and the stock exchange.

Design Integration Precedents and Pioneers

Multi-image or audio-visual design is very close to theater and performance, and in fact often incorporates it, integrating media such as film and slides, sound and music. Like performance this requires complex management of different technologies based on synchronized scoring or scripting within a predetermined, common time frame. Like performance, it depends heavily on three-dimensional space and does not translate well into film or videotape.

Examples of cross-media thinking abound in the history of design and have precedent in other art forms. Live opera is an example of a real-time multi-media event for large audiences. In the apocryphal and popular film *Amadeus*, Mozart tries to describe a revolutionary passage in *Don Giovanni* where twenty voices simultaneously express individual

yet coherent melodies and messages, that together convey the meaning of the scene and the relationships of the parts. The Bauhaus, the Futurists, the Russian avant-garde, the Dadaists, the Surrealists, and the performance artists of 1950s Happenings all explored the synthesis of communication media for a more interactive experience.

László Moholy-Nagy wrote that the illiterate of the future would be the person who couldn't take a photograph. His vision was holistic. His photography and movies explored the abstract and formal issues of the static and dynamic aspects of photography and the cinema, and their relationship to text. His diagrammatic notational score for the *Dynamic of the Metropolis* explores visual and verbal means of interrelating the different time frames of sound and moving image in the print medium. In fact, the score itself becomes a piece of meta-art. It is not hard to imagine Moholy using a computer. Gyorgy Kepes, in *Language of Vision* and other writings, is eloquent on the interconnectedness of art, technology, and design, and the need to refresh language to reflect the changing realities of life.

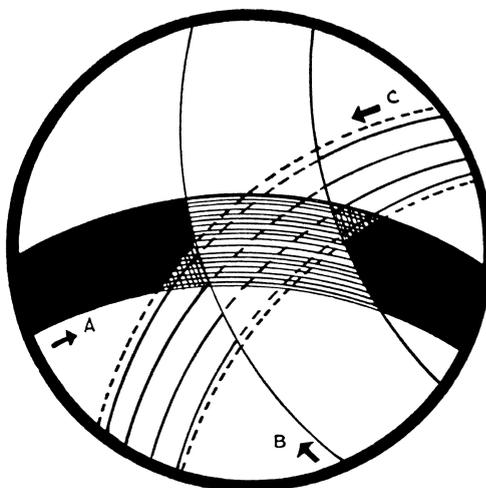
The works of Charles and Ray Eames continue to influence interdisciplinary design thinking. Their landmark exhibitions reflected a deep commitment to multi-media and dimensional forms of communication and a profound concern with content. Their multi-media "Sample Lesson" in art history of 1953, developed with George Nelson at

the University of Georgia and UCLA, was a landmark in the use of projected still and moving graphic images with sound, topped off by the aroma of baking bread wafting through the classroom. This experiment was followed by a series of ground breaking films and exhibitions by the Eames office in which technologies unexplored by other designers were often employed.

Karl Gerstner, who successfully straddles the world of art and design and was an original member of Das Freundes+, wrote the classic, unfortunately out of print, *Designing Programmes* (1963), which explores the structure of design as programmed systems and resultant processes rather than as unique product. This book has a Xeroxed underground life of its own and is just beginning to be seen not only as an homage to the grid but as a way of thinking that permeates all forms of human and natural design, one that is particularly appropriate to future computer design and art.

The literature of art and technology is full of experimental works that explore the relationship of human experience to technology, in which the machine is the

László Moholy-Nagy's schematic drawing of his proposed "poly-cinema" in which a rotating prism located in front of a film projector allows films to be seen simultaneously, overlapping at various points, creating intersects and the merging of aural and visual information.



Low aerial photograph over a square with 8 streets opening into it.

ARC LAMP sparks playing Street smooth as a mirror. Pools of light From above and oblique with cars whisking past. Reflector of a car enlarged.

TEMPO-0-

SCREEN BLACK FOR 5 SECONDS

The vehicles: electric trams, cars, lorries, bicycles, cabs, bus, syklolette, motor-cycles travel in quick time from the central point outwards, then all at once they change direction, they meet at the centre. The centre opens, they ALL sink deep, deep, deep...

wireless mast

Electric signs with luminous writing which vanishes and reappears.

YMOHOLYMO

Fireworks from the Lunapark. Speeding along WITH the scenic railway.

Under the tramways the sewers being extended. Light reflected in the water.

TEMPO

Underground railway. Cables. Canals.

TEMPO-0-0

In 1921-1922 Moholy-Nagy created the film *Dynamic of the Metropolis*. Its purpose was to bring the viewer into the kinetics of the city through the visual association of events in space and time.

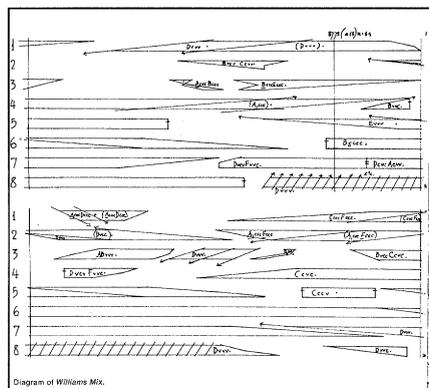
	Tempo J-50											
1 BAR UNIT	BAR 1			BAR 2			BAR 3			BAR 4		
2 COLOURS	white											
3 SOUND	[Musical notation]											
4 LAMPS	[Lamp control grid]											
5 TEMPLETS	[Templet control grid]											
6 MAIN SWITCH 1 & 2	[Switch control grid]											
7 LAMP SWITCH 1 to 8	[Switch control grid]											
8 RESISTANCES 1 & 2	[Resistance control grid]											
9 OVER-ALL PICTURE IN LINES	[Picture control grid]											

LEGEND: $\frac{1}{4}$ time pause \circ switch resistance slowly off \bullet switch resistance quickly on
 \downarrow templet (plate) opens intermittently to the rhythm of the music \downarrow templet (plate) opens gradually \bullet lamp 2 is switched separately.

Ludwig Hirschfeld-Mack created the *Reflected Colour Display* at the Bauhaus in 1922. In it he combines music and directed beams of colored light, evolving a new artistic genre.

Diagram of *Williams Mix* (1952) by John Cage, in which the composer used eight tracks of magnetic tape to create a pattern for cutting and splicing tape-recorded sounds. Cage employed chance operations derived from the *I Ching* (Chinese *Book of Changes*) to create the composition.

© 1960 by Henmar Press, Inc., New York.

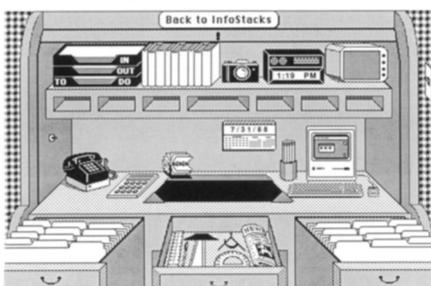
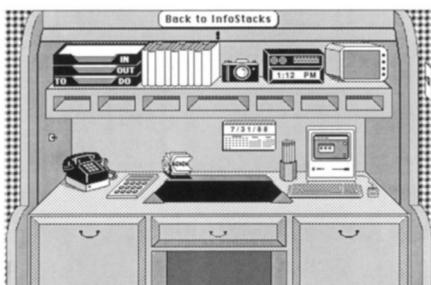
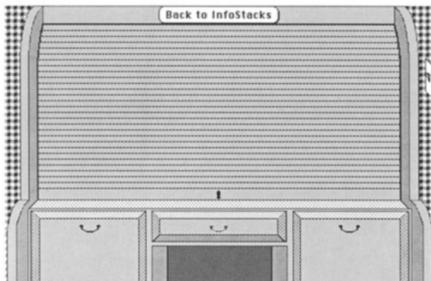


subject, the collaborator, or anti-hero. Such seminal works as Oskar Schlemmer's *Ballet Mécanique* (1923), and Ludwig Hirschfeld-Mack's pioneering works in the interdependent generation of light and sound in his *Reflected Light Compositions* produced at the Weimar Bauhaus (1922), have been followed by a number of innovations in art and technology by such artists as John Cage, Otto Piene, Philip Glass, and Robert Wilson. New creative generations continue to expand the tools with which to engage idea, audience, and machine. The personal computer and related electronic devices have become powerful new tools with which to explore these complex relationships expressively.

While the next phase of computer workstations will be dedicated to individual design professions, be they graphic, architectural, or engineering, the integration of the tools of those and all other professions is an inevitable consequence, which promises great challenges and changes for the design professions. The merging of media in an electronic communication environment and the emergence of



The traditional Advent card (depicting the period that includes four Sundays before Christmas) transcends the static conventions of print by using two layers of paper and die-cutting, achieving interaction with the user while simultaneously describing events over time. The user opens a door each day revealing one-by-one the scenes of the season's holy days.



In a multi-media studio (or desktop) the desk and drawers open to icons that when “clicked” open new applications. The telephone lets the user dial telephone numbers and take messages; the Rolodex gives telephone numbers; the camera connects the user to a scanning program, and so on, in the manner of the Advent card.

multi-media workstations in the work-place and the home will result from improved, integrated technologies. Increased technological capabilities will enable the smooth flow of multi-media information throughout the electronic community.

The combination and use of two technologies such as sound and image requires understanding of simultaneous and multiple frames or time segments: for example, the amount of time it takes to read a paragraph as compared to hearing it, and the ability randomly to scan the printed page as compared to the linear access of sound. While music may be linear, it also may be simultaneous in another dimension with variations of simultaneous voices and rhythms. Natural sound may provoke metaphorical or imagistic response when perceived in the context of words or images. A multi-media work environment will not only provide the user free browsing through media but the opportunity to interact with three-dimensional information in real time. Animated and simultaneous multi-media events in linear time, which are mapped dynamically in space, present a challenging design problem.

The idea of visualizing and modeling the physical environment as a metaphor in the computer is transitional. It appears to work effectively as a comforting introduction to a seemingly flat and mysterious world. The use of icons such as file folders and trash

barrels that stand for programs and move you into other parts of a program help to establish a model of the real world. But in fact, it is not the real world, and at some point on the learning curve moving iconic metaphors around is as tedious as rummaging through filing cabinets. At that point the user understands that the computer is a medium different from the physical world, one that offers the power of abstraction. As computers become more powerful and teleconferencing allows sending real-time video of people, complex issues of workplace communication will arise. The old notion of workplace and home being one and the same is returning. Before the industrial revolution people worked in or near home and there was less schism between work and family living. Computers and networking make it possible to work almost as well at home as at work. Yet the dimension of interaction with others, critical to most work, must be resolved to make that form viable today.