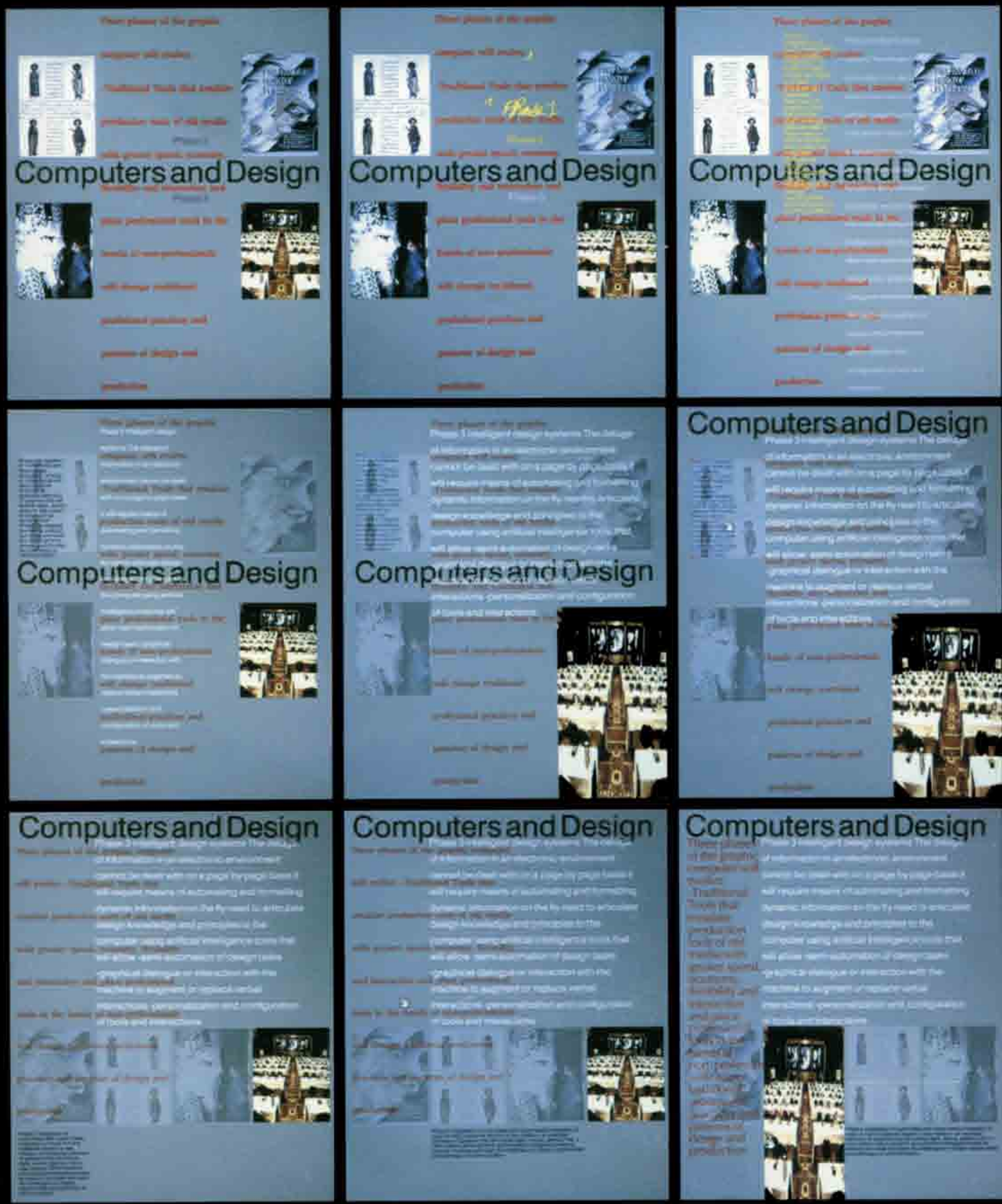

Computers and Design

Early work at the Visible Language Workshop focused on the relation of traditional forms of visual communication to the changes implicit in the electronic revolution. SYS, a high-resolution prototype graphics workstation integrated tools for word and image making for the first time. The work of this period included page layout systems that presaged desktop publishing and remote slow-scan imaging. The Mona Lisa program was designed by Rob Haimes (1983).

Editor's Notes

In 1966 Walker Art Center published "Design and the Computer," edited by Peter Seitz. That issue of *Design Quarterly* was an unprecedented investigation of the ways in which the computer would affect the design professions. In his introduction, Seitz stated that "Very much like children who are caught between the old math and the new, today's designers have to face the computer age."

In the eighteen year interim between that issue — a provocative collection of essays by designers, educators, and scientists — and this one, by the distinguished graphic designer Muriel Cooper, the computer has become a primary design and production tool in diverse fields. Graphic designers, architects, and industrial designers have learned how to make the computer work for them. Virtually all design students are now taught to take advantage of the fact that the right software can bring quick and accurate results in the hands of a skilled user. The T-square and paste pot have literally disappeared from many graphic design studios, and the truly venturesome have created new image vocabularies that reflect the processes through which they are created.

Much of the progress in the areas of design and production by computer is the result of pioneering work by researchers in the computer industry. But a great deal of the long-term work, which has no immediate or even apparent practical application, is undertaken in educational institutions. Among the most advanced in both scientific and design terms, the Media Lab of the Massachusetts Institute of Technology is a multi-disciplinary institution striving to bring the various media into mutually productive relationships.

The Visible Language Workshop, which became a part of the Media Lab in 1984, was co-founded at MIT in 1976 by Muriel Cooper, Director and Professor of Graphics, and Ron MacNeil, Principal Research Associate. The VLW is most immediately concerned with design issues. Its early investigations in the mid-70s focused on the relation of traditional forms of visual communication to electronic communication and the integration of tools for making words and images in a high-resolution, interactive electronic environment. Thus, a great deal of effort went into the digitization, display and manipulation of high quality typography. When the VLW became a part of the Media Lab, expanded resources extended earlier ideas into the realm of multi-media coupled with design intelligence. The collaborations that the Lab encourages are attempting new approaches to old and new communications issues. Out of these investigations among the various disciplines, new, vital insights emerge.

The contributions to design theory and practice of Muriel Cooper — who, in mid-career as a highly regarded designer of books and other graphic materials threw it all over to take on the issue of new graphic languages that bridge art and technology — are both rare and remarkable. Her example is a challenge to the self-satisfied streak in us all.

MSF

Muriel Cooper

Computers and Design

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.

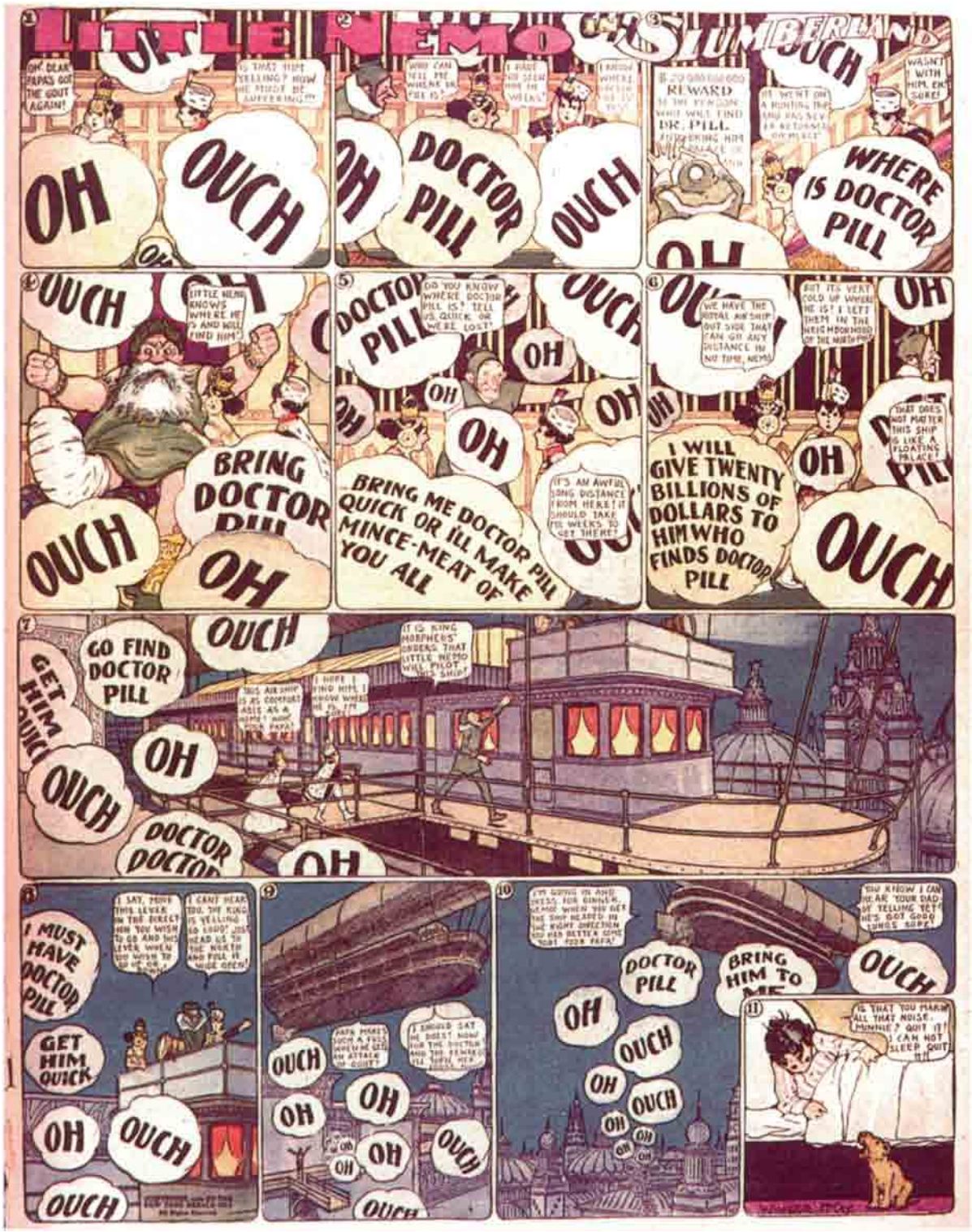
In each period of our history, design and communication have evolved synchronously with the technology of the time. Each new medium has extended our sense of reality and each has looked to its predecessor for language and conventions, referencing and adapting its characteristics until its unique capabilities 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 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

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

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



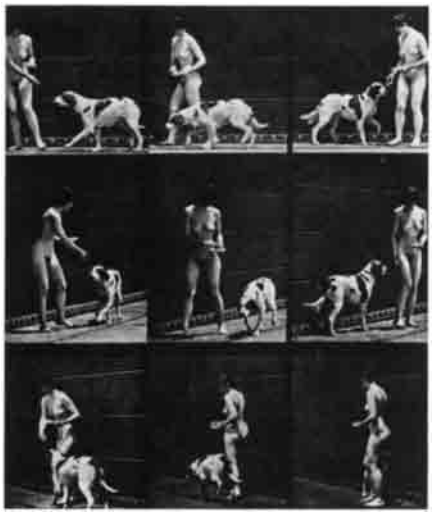
The *Little Nemo* cartoon is an amusing and remarkable exploration of simultaneity. Its multiple voices and serial images bridge time and space and use typographic size, style, and placement to simulate sound and expression. Created by Winsor McCay for the *New York Herald*, 2 January 1910.

through the limitations of the media, modifying the way we think. The restrictions of the page, the frame, the aspect ratio* 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 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.

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

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.

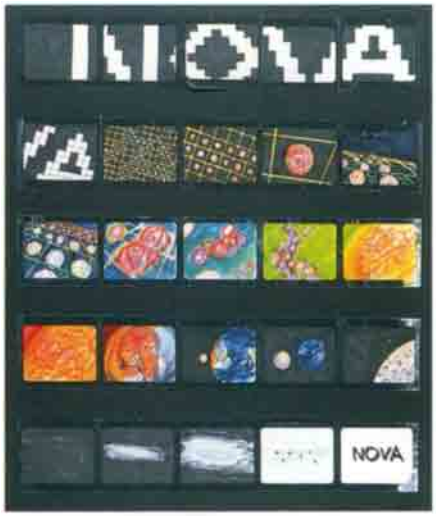
The Graphics Computer as Tool and as Medium

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.

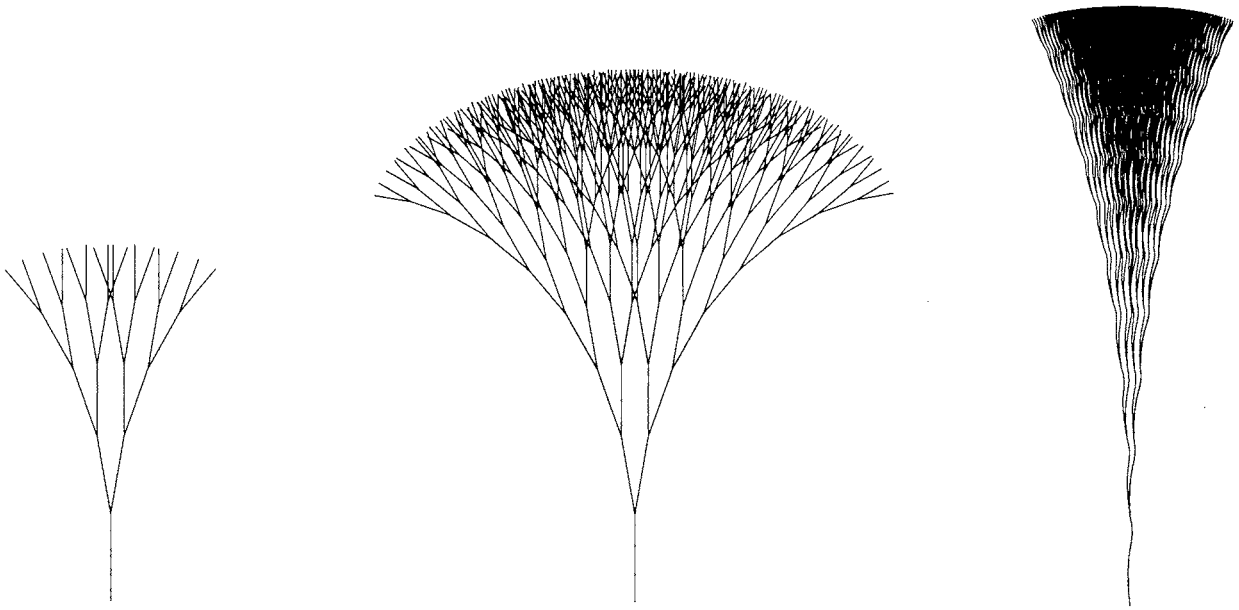
Computer graphics, image processing, computer vision, and robotics required huge computing power and were used only in high-cost research environments. Mathematics provided the tools to model physical processes, to visualize complex scientific data, to animate space travel, and to simulate real-time 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.



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.

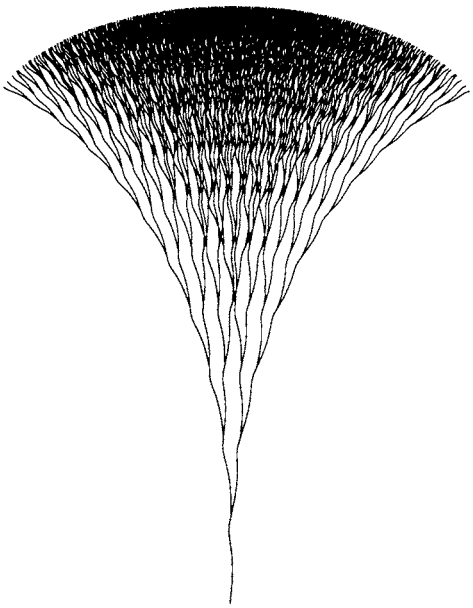
*fractals = a way of describing non-geometric forms mathematically

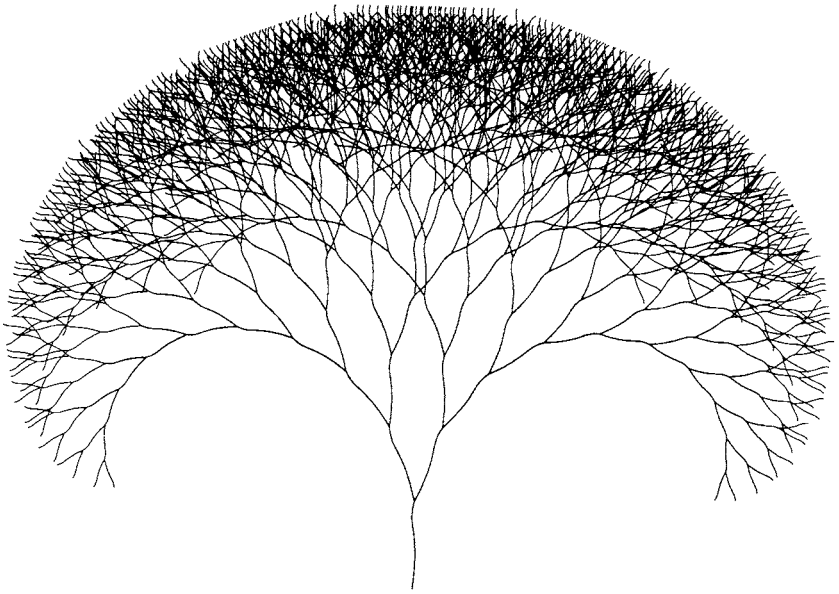
hardy, committed visionaries began to learn programming. A significant number of programmers began to experiment with personal graphic ideas. It was only a matter of time until these tools migrated into the creative domain. The cost effectiveness of connecting such pre-press tools to the creative part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





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.

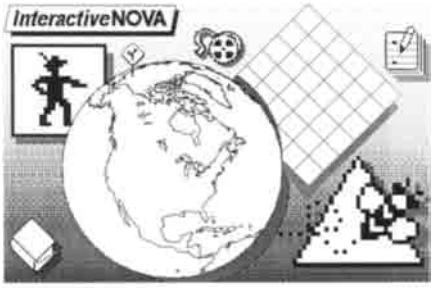
Desktop tools for all other professions are developing at a similar rate and are following a similar pattern. Such examples as video and animation, music, architecture, engineering, computer-aided design and manufacturing exist at an astonishing level of sophistication and power for a relatively low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

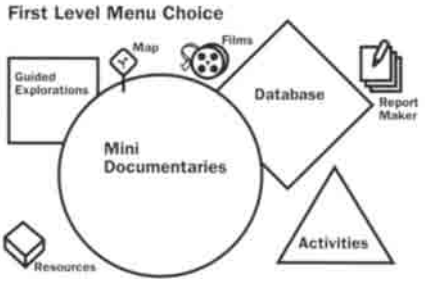
A spate of work is now emerging from studios and schools in which the graphic computer is used as a production tool. A number of application programs such as PageMaker, Adobe Illustrator,

Interactive NOVA

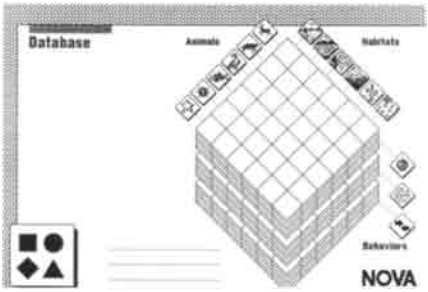
Animal Pathfinders is an interactive videodisc system to be used by science teachers and students in secondary schools.

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.

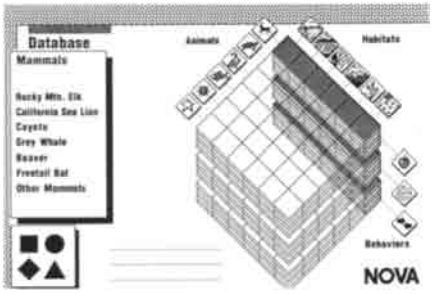




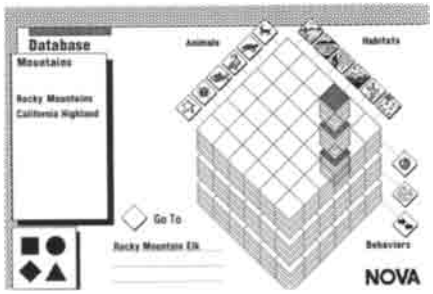
1. Home Card: the first level menu choice includes: guided explorations, mini documentaries, database, report maker, and resource activities.



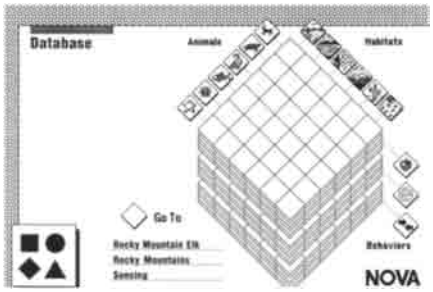
2. Database chooser: a three-axis search menu for exploring the database.



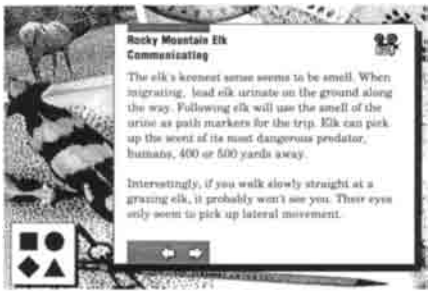
3. Mammal chosen.



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 yuppy 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.

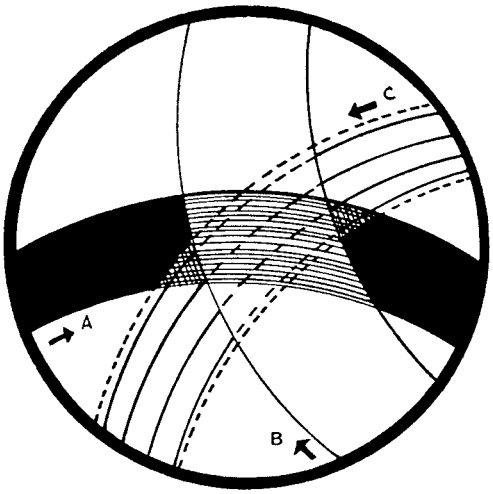
László Moholy-Nagy wrote that the illiterate of the future would be the person who couldn't take a photograph. His vision was holistic. His photography and movies explored the abstract and formal issues of the static and dynamic aspects of photography and the cinema, and their relationship to text. His 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.

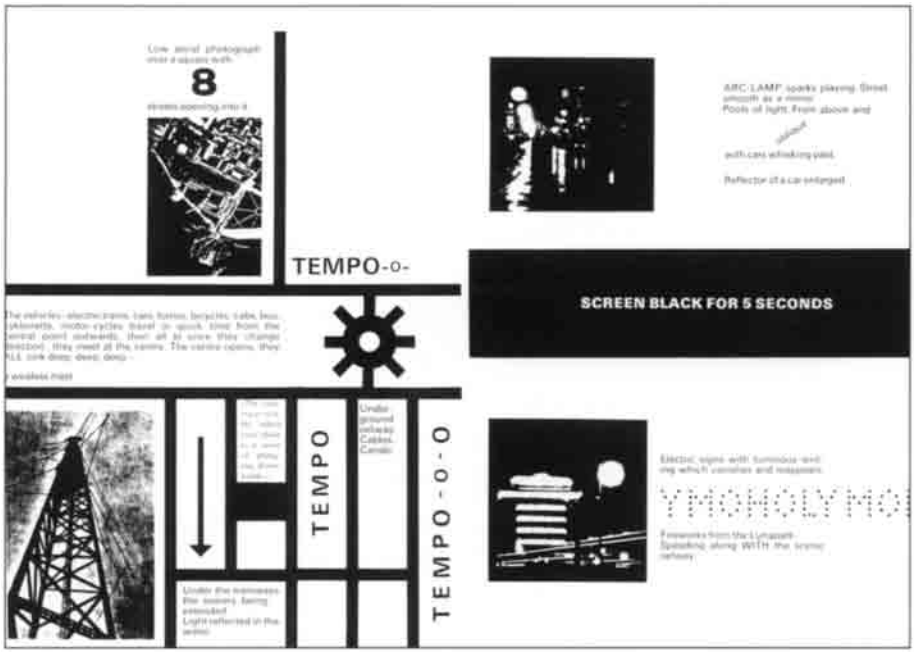
The works of Charles and Ray Eames continue to influence interdisciplinary design thinking. Their landmark exhibitions reflected a deep commitment to multi-media and dimensional forms of communication and a profound concern with content. Their multi-media "Sample Lesson" in art history of 1953, developed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

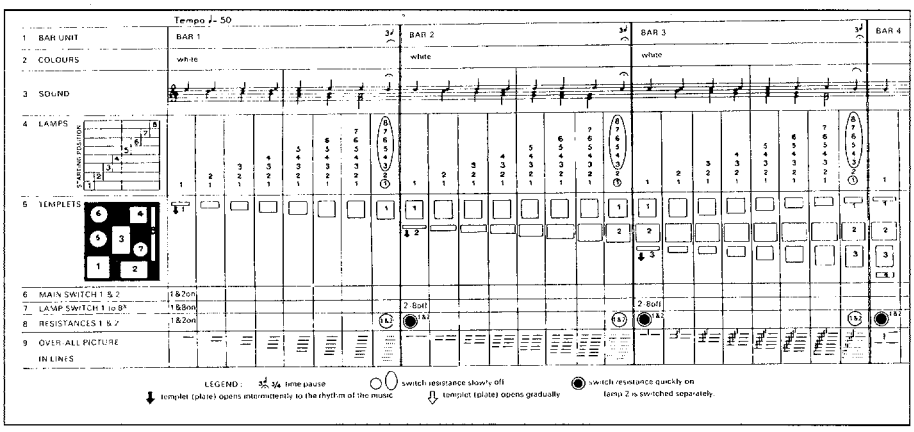
The literature of art and technology is full of experimental works that explore the relationship of human experience to technology, in which the machine is the

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.





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.



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.

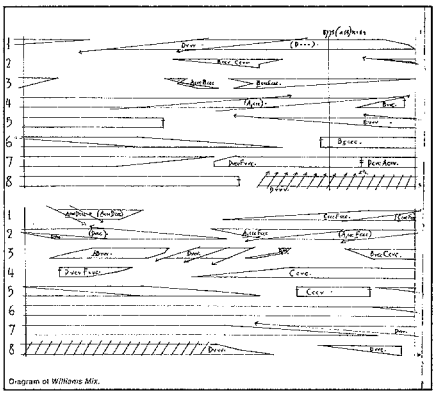
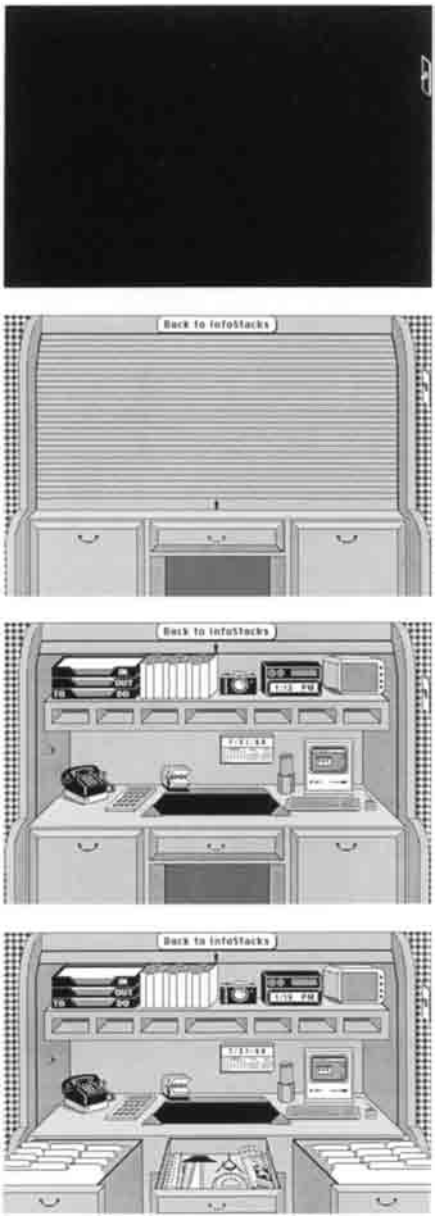


Diagram of *Williams Mix* (1952) by John Cage, in which the composer used eight tracks of magnetic tape to create a pattern for cutting and splicing tape-recorded sounds. Cage employed chance operations derived from the *I Ching* (Chinese *Book of Changes*) to create the composition.

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.

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



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.

Massachusetts Institute of Technology Media Laboratory

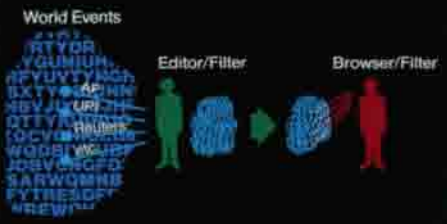
The Media Laboratory is a pioneering interdisciplinary center that is a response to the information revolution, much as the Bauhaus was a response to the industrial revolution. It is a place that aspires to eliminate the isolation of separate media by bringing together the most advanced thinking about applications with the most advanced research in imaging technologies, interactive systems, theories of computation, and the human cognitive system.

To support this vision, Nicholas Negroponte, founder of the Architecture Machine Group, and Jerome Wiesner, President Emeritus of MIT, brought together a group of computer and social science mavericks with visual studies groups in a new building that houses both the Media Laboratory and its educational counterpart, the Media Arts and Science program. The early history of some of its progenitors — the Architecture Machine Group, the Logo Group, the Artificial Intelligence Laboratory of the 70s, Electronic Music, and the Visible Language Workshop — reveals how much of the work has already permeated our daily computer and communication environment.

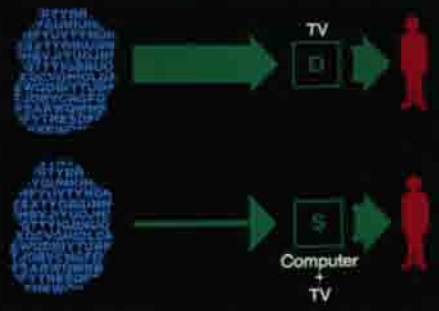
The interdisciplinary environment of the Media Lab stimulates collaboration between educators, social scientists, artists, scientists, computer scientists, technologists, and engineers. The diverse groups work both individually and collaboratively to address cognitive, educational, visual, aural, multi-sensory aspects of art, science,

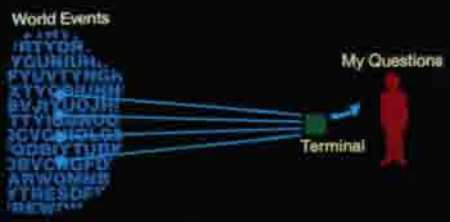
Professor Nicholas Negroponte is Director of the Media Lab in which a diversity of experimental work brings together communications technologies in an effort to personalize, and thus humanize, computers and their relationship with the mass media. Software for the digital system called "New Paint" was created in the Visible Language Workshop by Bob Sabiston.

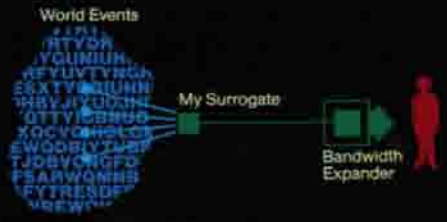
To further understand the relationship of the computer to the mass media, the Media Lab created a diagram describing how we relate to information. The media places the audience in a passive role—a "take it or leave it" relationship to world events. The computer gives the user control and thus a more active relationship to information. It then allows the user to personalize data: with a database you can manage the news. Finally, the user teaches a surrogate (the computer) to filter information and organize it. The stumbling block in this system would be the loss of serendipity, although it is possible for the surrogate to learn to accept chance.



Newspaper







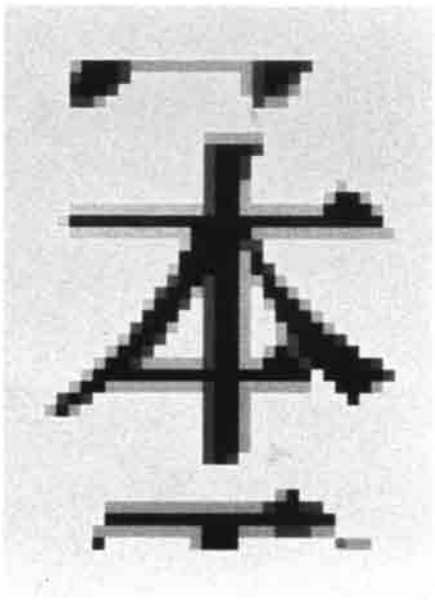
The Hennigan School is an inner-city Boston elementary school in which Professor Seymour Papert of the Media Lab started a computer learning program in 1985 for children in the K through 6 age groups. The project shown is called LEGO/Logo; it adapts a traditional toy to new uses. The Logo program is connected via sensors and actuators to LEGO modules that are controlled on personal computers. This program's significance lies in giving students the power to program and build what computer scientists call "micro-worlds" in which to test ideas about the physical world and the way it works.

and technology. They are attempting to broaden the scope of various media technologies by exploring the differences in the development of content and the channeling media they employ. The cultural and language differences among the groups is both a challenge and a dilemma, and a microcosm of the challenge that faces our culture. New conventions for communicating the qualitative nature of the making of art and the quantitative requirements of science and technology need to be forged.

The Media Lab's greatest strength may prove to be the collision of the disparate disciplines and values represented there. The valuation models of a scientific community do not easily mesh with those of the art community although they avowedly seek the same grail. In much the same way, the meaning of the Bauhaus was in the conflict between painters like Klee and Feininger, and technocrats like Moholy-Nagy.

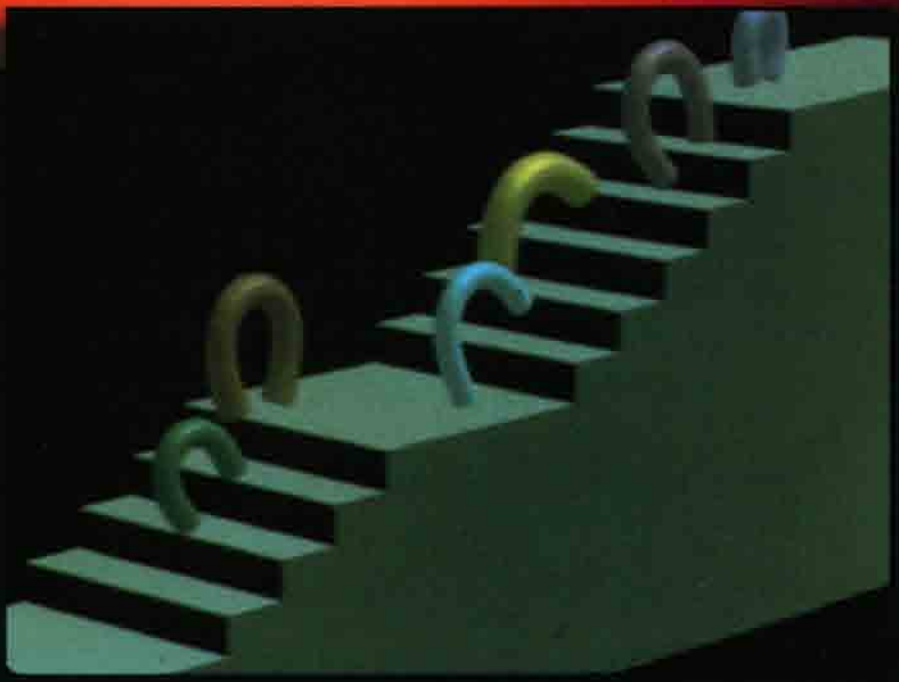
The Media Lab is currently configured in twelve research groups: Human Interface; Epistemology and Learning; Computers and Entertainment; Electronic Music, Performance and Technology (The Cube); Computer Animation and Graphics; Electronic Publishing; The Visible Language Workshop (graphics); Film/Video; Spatial Imaging; Vision Sciences; Speech Recognition; Advanced Television; and Telecommunications. Of particular interest to the design profession are projects in education, visual and performing arts and technology, and electronic publishing.

Anti-aliased type, or "fuzzy fonts," in which gradations of gray are used to mitigate the stepped edges of computer type, was pioneered by the Media Lab in 1972.



NewsPeek is an electronic publishing system developed under the direction of Walter Bender. News from various sources is brought together with real-time television transmission to create a personalized newspaper.

The Spatial Imaging Group, under the direction of Professor Steven Benton, produced the first synthetic hologram of a car computed from a database rather than by photographing the object with lasers, which is the standard holographic technology.



These computerized, segmented creatures are modeled mathematically on the way worms move in relation to their environment—an animation technique that may be applied to the scientific visualization of many things.

In an electronic environment, the volume of real-time information will outstrip our ability to process it. The use of graphics as a filter for this complex information, as a means of making it both meaningful and expressive, is the critical research challenge of the Workshop. In its interdisciplinary setting the VLW's graphics and computer science members explore two rapidly merging research concerns. The first is the development of a seamless multi-media environment that will serve as a testing ground for the design and use of interconnected multi-media information in both electronic and traditional forms. The second is the investigation and testing of the acquisition and use of design knowledge and process by bridging the gap between the disciplines of design practice, theory, and artificial intelligence.

Visible Language Workshop

A broadband multi-media test bed provides opportunities to design for electronic communication that will continue to function (no doubt in new ways) in relation to the printed page or to other media such as the telephone, radio, television and video, and as a medium unto itself. The study of linear and simultaneous communication, of designing for processes as product, of designing for user-design interaction will allow us to test and articulate a new set of characteristics of this new medium. We investigate these issues through direct visualization and rapid prototyping. We assume the availability of very high resolution, full and powerful graphics capabilities in hardware, lots of territory, memory, speed, and bandwidth; a rich array of input and output devices; a set of image and text sources both external and internal; complex editing and manipulation capabilities; intelligent graphic assistance that is responsive to use; configurable, personalized, and graphic user programming.

A set of graphic tools and editing modules developed to be integrated into the multi-media environment includes: electronic light table, object and pixel-based paint, anti-aliased typographic and notational editor, typographical and image processing tools, three-dimensional and translucent text and images, three-dimensional spline editor, and animation, image, sound, and multi-media scripting.

At the VLW, artificial intelligence programmers and graphic designers are collaborating to develop graphic interfaces that will bridge the gap between the "hands-on" world of the designer and the more abstract symbolic world of programming. Design rules that have been articulated in manuals (such as corporate identity programs) are seen as a useful paradigm of graphically expressed spatial and relational instructions

This is a prototype workstation for designers. The tools to generate graphics will eventually include sound and video in a seamless fashion, and all of the elements will be linked together in real time. High-resolution translucent text and images will be a part of these environments.

The upper screen image shows some of the tool modules developed for a multi-media graphics environment: paint, translucent and animated anti-aliased bitmaps and text. The screen image below uses graphic, photographic, and image processing tools. The editor at lower left allows the user to modify the gamma curves* of the images. Images by David Small (1987), VLW.

** gamma curves = degree of contrast in a photographic or television image*

The RGB cube

RED

GREEN

BLUE

notes

left

up

right

down

The HSL cylinder

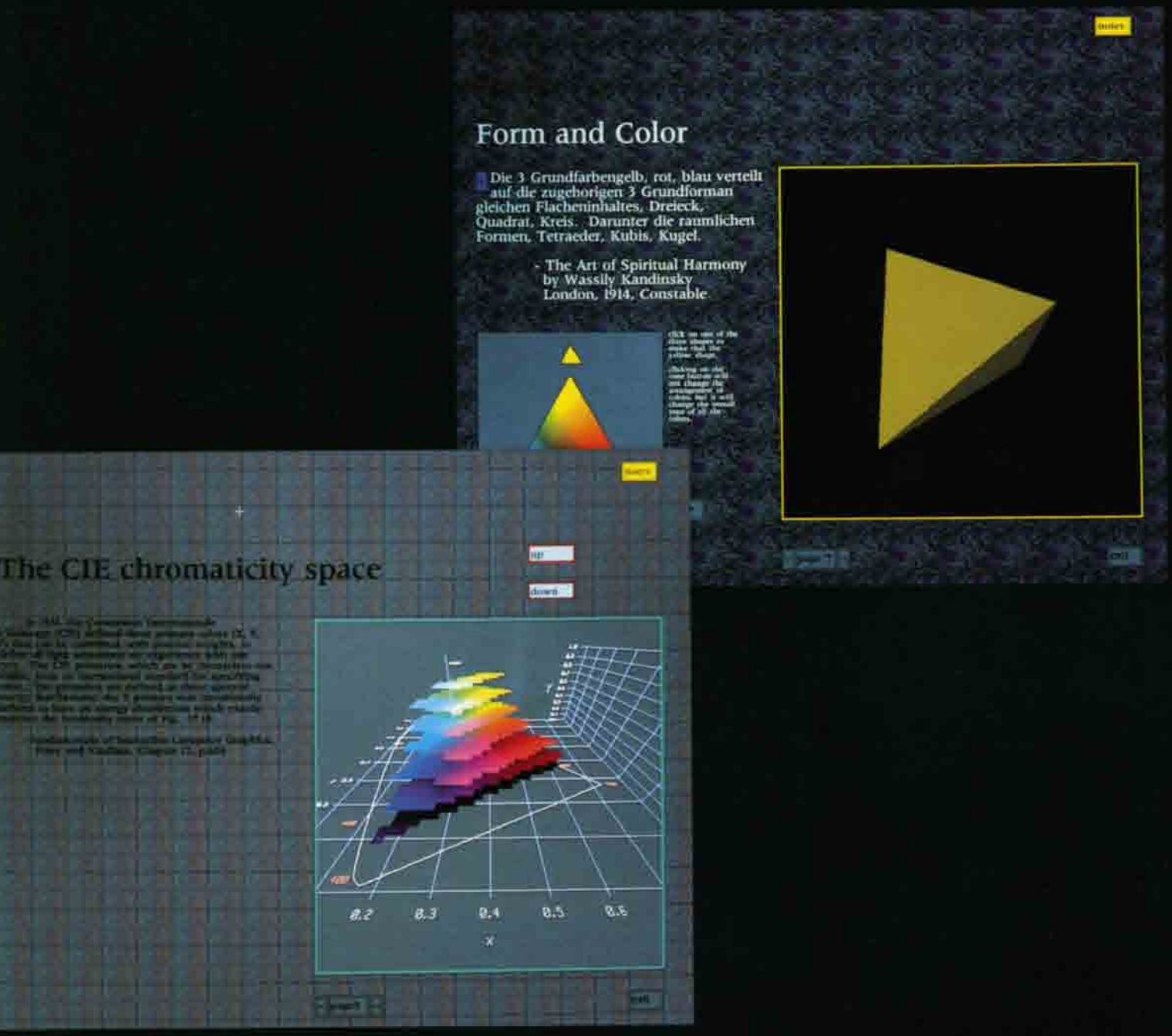
notes

left

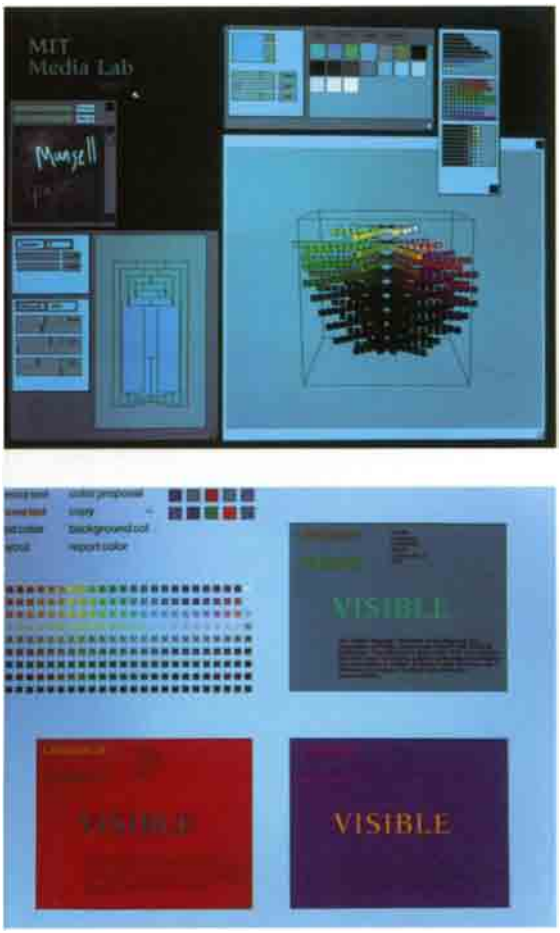
up

right

down



The Fundamentals of Color **is an electronic book that demonstrates the use of dynamic interactive, mathematical illustrations, made possible by the graphic hardware of the machine. It also uses translucency to make shifts from English to German translations of the text, and includes an annotation editor that will save comments and replay them. Program by David Small (1987-1988), VLW.**



Computerized color systems are moving toward the development of color palettes. With sixteen million available colors it is necessary to design systems that will permit the user to determine schemes, not individual colors. Munsell System Palette by David Small (1988), VLW; Intelligent Color Editor by Suguru Ishizaki (1988), VLW.

that ranks information for the viewer, influences emotional responses, and often embodies hidden aesthetics. Design research has dealt with the analysis of design process, most particularly in fields such as architecture and engineering, which have well-defined conventions. Advances in artificial intelligence technologies — in rule-based and expert systems, in constraint systems, and in frame-based systems — have given new impetus to the field of design theory.

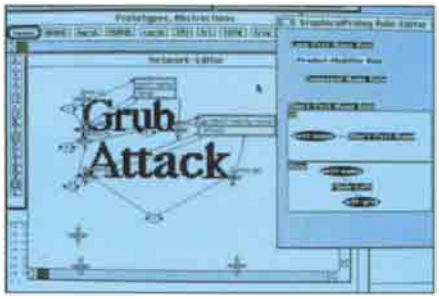
We are exploring simple design tasks that would be amenable to such machine modeling. They have been based on locally developed rules or existing expert systems and include a study of personalization through visual types in a business card experiment, design prototypes expressed in variable proportions and sizes in the domain of packaging, and grid-constrained layout suggestions based on priorities and graphic sketches established by the user. Automatic layout for print is of great interest, but as applications for multi-media develop, such as electronic documents, electronic mail transactions, and financial trading, the need for automatic layout and design intelligence will be crucial to the naive design user. Designers will simply be unable to produce the number of individual solutions required for the vast number of variables implicit in real-time interaction. Design will of necessity become the art of designing processes.

Progress in designing intelligent interfaces for graphic design applications, such as electronic publishing and illustration, will depend on the application of symbolic programming techniques from artificial intelligence. But the traditional "expert systems" methodology breaks down when applied in fields where visual problem solving, as opposed to verbal or symbolic problem solving, is paramount. Expert graphic designers are fluent in the generation and criticism of visual examples, rather than in the articulation of such abstract principles as if-then rules. However, a machine learning technique that holds promise for capturing the expertise of skilled problem solvers in visual domains is "programming by example." In this technique, the designer constructs and edits examples using an interactive graphic interface, such as a graphic editor for illustration or page layout. The system simultaneously records the

designer's actions, using a symbolic procedural representation. The designer may then converse with the system, and work out ways to generalize actions to apply to future examples.

Ron MacNeil is investigating methods of designing two-dimensional complex graphics by building prototypes composed of a network of constraining relations and the conditions for applying them. These mechanisms allow users to build their own personal abstractions as well as add new commands to the system.

Traditional information graphics are rich in the history and methods of information slicing and reality abstractions devised to graphically edit and represent the telling aspects of complex information. The need to interactively correlate dynamic information with abstract graphic design and full representational information provided by satellites, image processing, and holography is apparent in fields such as finance, mapping, education, medicine, and air transportation, and poses a new and challenging set of design problems for the electronic medium. Questions of design interpretation, visual standards, interface organization, presentation methods, browsing and navigation, collaboration and annotation, and relationships to other media such as print remain to be investigated.



In "Grub Attack," Ron MacNeil demonstrates a program in which a series of constraints based on size and proportion uses artificial intelligence, under various conditions, to provide a designer with ways to apply or express graphic relationships.

Perspectives is an early "expert grid system" that lays out pictures that have been chosen and cropped by the designer using a simple set of fixed rules. The constraints of the grid limit the machine's proposals, which are remarkably acceptable.

Long-Range Research

Important work in laboratories around the world contributes to the next generation of graphic and visual computers. The fundamental themes of interactivity, multi-media, and multi-modal interfaces, machine and human intelligence and creativity, and new kinds of computational models recur with different emphases and in different intellectual and technological milieus. Research in these areas would be illuminated and enriched by the participation of members of the visual design community. Journals and conferences reveal a broad and intensive concern with the "visualization" of complex data and with the understanding of human and machine design intelligence on all levels of computation. Visual thinking is complex and not well understood, but its value is apparent in the recognition of information relationships and contextual cues, coupled with abstraction in the notational or graphical domain. Collaboration of artists and designers with scientists and technologists will provide new professional opportunities and pave the way for greater cross-cultural communication, which may help heal the unnatural separation of the arts and sciences.

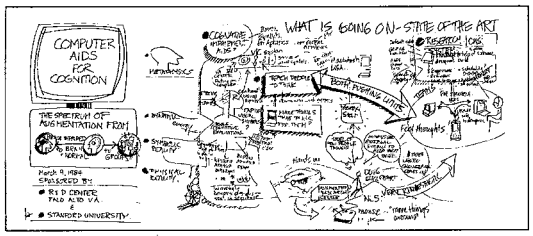
In this demonstration of "smart typography," type automatically becomes white on a dark ground and black on a light ground. The changes are much subtler in actual use; the goal is to maintain legibility over an unpredictable, changing background.

The Mickey Mouse image is composed of various bi-dimensional elements such as parts that were scanned, and self-generated fractals in a three-dimensional environment. Designed by Massimo Ontani using the Crystal 3D and Lumena 16 software running on the IBM PC/AT compatible.

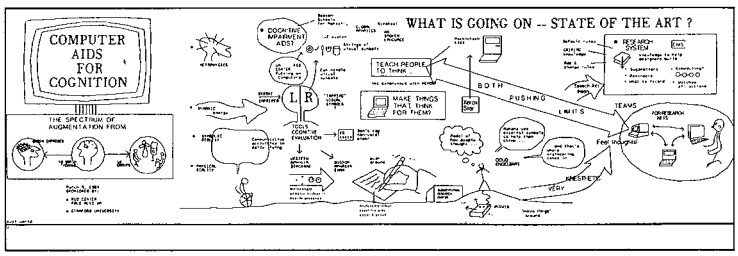
Although the longer range, more fundamental research concerns having to do with the development of machines that will become "creative" and autonomous are beyond the scope of this essay, it should be recognized that they represent a challenge to our world as profound as the continued destruction of our ecosystems, and the threat of nuclear war. The ultimate interface may well be a robot that can learn and think for itself.

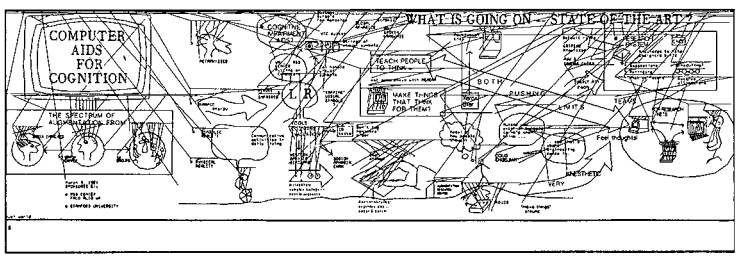
The thrust of this long-term research has intellectual underpinnings that are supported by government and industry, and one must be alert to the intentions that drive such support. There is an inevitable Jekyll-Hyde syndrome that must be recognized and managed by us all. The changes that will be effected by the computer and the information revolution are pervasive. Every aspect of every profession and every life will be changed by it. Little of that change to date has been in the hands of the design professions, the educators, or the citizenry. It is imperative that we all spend less time ignoring or challenging the threat of computers, and educate ourselves and participate in the direction of this polymorphous medium.

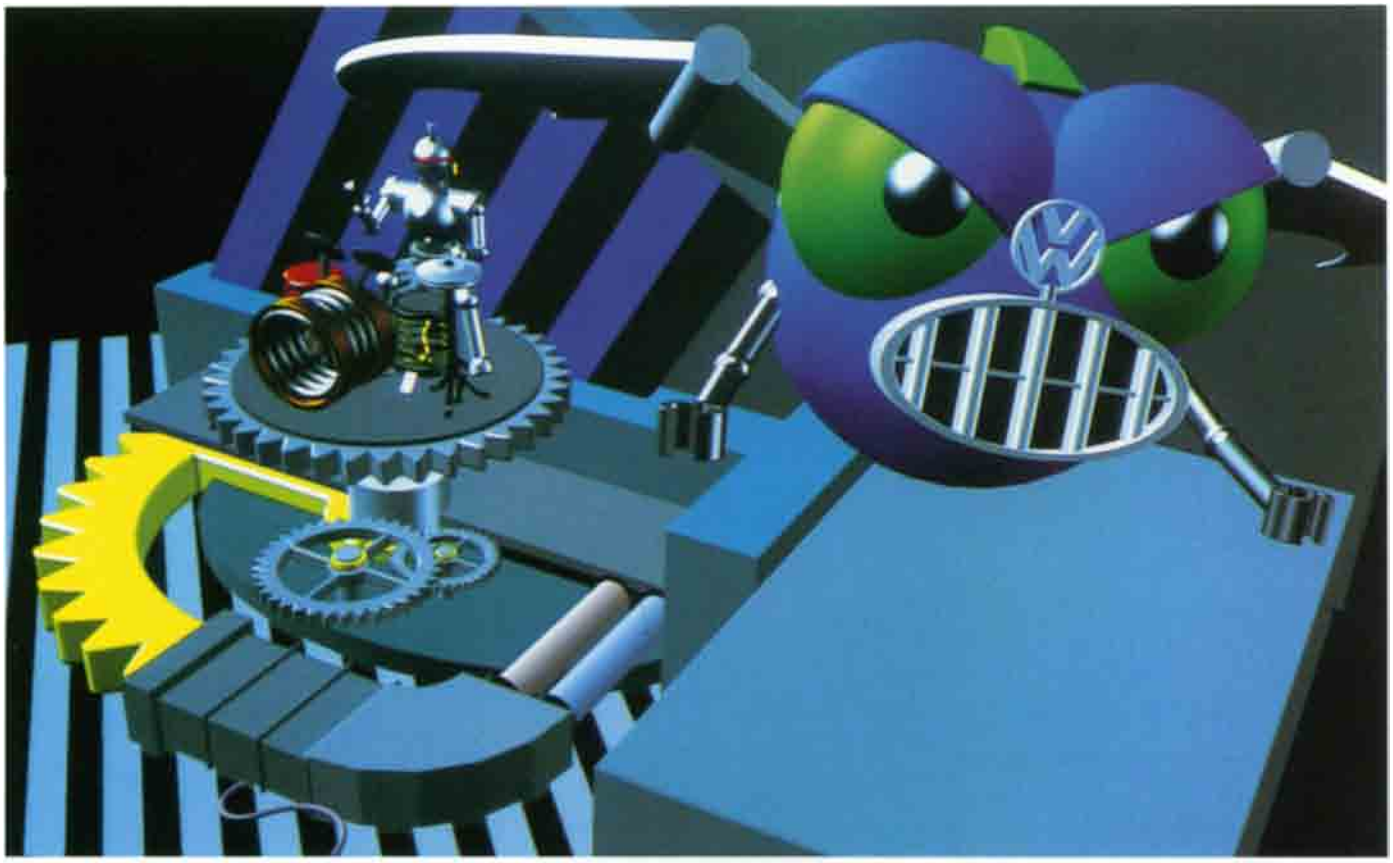
In the next decades, the computer will evolve from a set of tools for traditional design tasks into a valued assistant that can learn from its mentor. As bandwidth and networking expand, synthesized media in an electronic communication environment will be coupled with traditional modes of communication such as print, video animation, sound and gesture, providing new opportunities for integrated design. Visualization and graphic manipulation of information, interface, and interactive design will be valued not as cosmetics, but as vital necessities in an information society.



The transcription of a blackboard "transaction" by David Sibbet into a form that can be processed in a computer is a project of Fred Lakin. He uses the blackboard as a natural model of interactive graphic communication which he develops into a conventionalized graphic system.







Two animated frames—the fly and the cootie—represent two distinct approaches to image making with computers, approaches that will someday come together, merging the phenomenal power of the machine with the phenomenal creative power of the human being. The fly is drawn using a computer animation system. The objects are three-dimensional and can be grouped together and scripted by selecting key frames. The computer interpolates between them. The cootie, by contrast, was created mathematically. A set of programs that knows about the insect's behavior was built by a number of people and brought together into a computer script.

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Four images and three text segments are used to explore ways simultaneously to represent multi-tiered information using changes of size, placement, color, and translucency. Each frame will change as the "reader" browses in real time with text and image cues dependent on the linkages that have been designed for browsing. On one level this series is analogous to a book printed on transparent paper, but it takes advantage of the potential for change inherent in the computer. Priorities may be achieved in terms of color, size, leading, or copy width. The tools for this series were developed at the Visible Language Workshop by Suguru Ishizaki; the series was designed by Muriel Cooper (1988).