The Digital Revolution and Beyond

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During the last quarter of the twentieth century, electronic and computer technology advanced at an extraordinary pace, transforming many areas of human activity. Graphic design was irrevocably changed by digital-computer hardware and software and the explosive growth of the Internet. The Industrial Revolution had fragmented the process of creating and printing graphic communications into a series of specialized steps. After phototype became prevalent during the 1960s, skilled specialists included graphic designers, who created page layouts; typesetters, who operated text and display typesetting equipment; production artists, who pasted all of the elements into position on boards; camera operators, who made photographic negatives of the pasteups, art, and photographs; strippers, who assembled these negatives together; platemakers, who prepared the printing plates; and press operators, who ran the printing presses. By the 1990s digital technology enabled one person operating a desktop computer to control most—or even all—of these functions. New photo-optical printing machines used computer-controlled lasers to photosensitize printing drums, making short-run and even individualized full-color press sheets possible.

In spite of strong initial resistance by many designers, the new technology improved rapidly, inviting widespread acceptance. Computer users were empowered by greater control over the design and production process. Digital technology and advanced software also expanded the creative potential of graphic design by making possible an unprecedented manipulation of color, form, space, and imagery.

The growth of cable and satellite television in the last quarter of the century expanded the number of broadcast channels, inspired creative and technical advances in broadcast and motion graphics, and paved the way for consumers to embrace the power and flexibility of the Internet. The rapid development of the Internet and the World Wide Web during the 1990s transformed the way people communicate and access information, generating a revolution surpassing even Gutenberg in its magnitude. By the early twenty-first century, many people had become dependent on the Internet for access to both information and entertainment, a phenomenon that has affected all aspects of society and culture. Technology has transformed the era of corporate communications for mass audiences into a period of decentralized media offering near limitless options for individuals. Computer graphics experimentation churned through

modern and postmodern design ideas, retro revivals, eccentric work, and explored electronic techniques to create a period of pluralism and diversity in design.

The origins of computer-aided graphic design

The digital revolution came to the desktop of individual graphic designers as a result of affordable yet powerful hardware and software initiated primarily by three companies during the 1980s: Apple Computer developed the Macintosh computer; Adobe Systems invented the PostScript programming language underlying page-layout software and electronically generated typography; and Aldus created PageMaker, an early software application using PostScript to design pages on the computer screen.

Apple Computer's 1984 introduction of the first-generation Macintosh computer, based on technology pioneered in its Lisa computer, foretold a graphic revolution. The Macintosh displayed bitmapped graphics; that is, its screen presented information as dots called pixels, with 72 dots per inch (dpi) on a black-and-white screen. Its interface with the user was achieved via a desktop device, called a mouse, whose movement controlled a pointer on the screen. By placing the pointer on an on-screen icon (Fig. 24–1) and clicking a button on the mouse, the user was able to control the computer intuitively, and so to focus on creative work rather than machine operation or computer programming.

The first mouse, a small wooden box on steel wheels, was invented by scientist Douglas C. Engelbart (b. 1925) in the 1960s at the federal government's Augmentation Research Center. It was called an "*x*-*y* position indicator for a display system" in the patent. A colleague dubbed Engelbart's little position-indicator device "the mouse," and the name stuck. The mouse made computers accessible through intuitive processes rather than tedious mathematical coding and empowered thousands of people, from accountants and writers to artists and designers, to use computers.

24–1. Susan Kare (graphic designer) and Bill Adkinson (computer programmer), icons for the 128K Macintosh computer, 1984. The pictograph is the symbolic medium permitting a new interface between man and machine.

24–2. Susan Kare, screen fonts for the Macintosh computer, 1984. The low-resolution dot pattern dictates the letterform design and jagged edges.

24–3. Sumner Stone, digitized data for Stone Medium b, 1985. The outline Bézier curves and filled laser-printed output are shown.

Engelbart has been lauded as a visionary whose early innovations humanized computers by making their technology more accessible. Decades ago his research foreshadowed electronic mail systems, icon- and window-based computer operating systems, the Internet, networking software allowing several users to work on a document at the same time, and videoconferencing.

Apple released software applications for word processing, drawing, and painting. Early bitmapped fonts (Fig. 24–2) were designed by Susan Kare (b. 1954), then of the Apple Computer design department. Letterform design was controlled by the matrix of dots in these early fonts.

Adobe Systems' PostScript page description language enabled printers to output text, images, and graphic elements, and determine their placement on the page. PostScript fonts are not simply made up of bitmapped dots; rather, they are stored as graphical commands and data. Type characters are generated as outlines that are then filled in as solid forms. The curved lines of the characters are formed of Bézier splines. Named after the French mathematician Pierre Bézier (1910–1999), who invented them, these are mathematically generated nonuniform curves (in contrast to curves with uniform curvature, called arcs)

defined by four control points. Bézier curves can create complex shapes with smooth endpoints, making them particularly useful for creating letterforms (Fig. 24–3) and computer graphics.

In 1985 Apple Computer introduced its first laser printer, whose 300-dpi output of PostScript fonts enabled its typographic proofs to more closely duplicate typesetting. A controversy about resolution quality ended after the arrival of 600-dpi laser printers and high-resolution image-setters such as the Linotron, capable of either 1,270- or 2,540-dpi output.

Page-layout programs made possible by PostScript permitted the design of complete pages on the screen. In 1984 a thirty-six-year-old former newspaper editor named Paul Brainerd formed a company called Aldus (after the fifteenth-century printer Aldus Manutius) to develop software enabling newspapers to produce advertisements more efficiently. In July 1985 Aldus introduced PageMaker software for the Macintosh computer. PageMaker could alter type size, choice of font, and column dimensions. It integrated text type with other elements, such as scans of pictures, ruled lines, headlines, and borders. A desktop metaphor enabled the user to create elements on the computer screen, then position these on the page in a manner similar to the traditional way elements are prepared and pasted into position for offset printing. Brainerd coined the term *desktop publishing* for this new method.

Desktop publishing saved significant amounts of time and money in preparing pages for printing. Procedures including layout, typesetting, making position photostats, and pasting elements into position were all combined into a seamless electronic process. A comparison can be made to George Eastman's invention of the Kodak camera. Just as photography was wrested from the exclusive use of specialists and made available to the general public in the 1880s, typography left the exclusive domain of professionals and became accessible to a larger sphere of people in the 1980s.

Earlier digital hardware included digital typesetting systems, powerful electronic image processors such as Scitex systems, which electronically scanned images and permitted extensive editing, and Quantel Video and Graphic Paintboxes, which permitted precise color control and allowed images to be overlapped, combined, and altered. The LightSpeed system was a sophisticated early page-layout machine. All of these systems were very expensive and rarely available to designers for experimentation; the profound significance of Macintosh computers and software stems from their broad accessibility to individual graphic designers and laypersons.

By 1990 the color-capable Macintosh II computer and improved software had spurred a technological and creative revolution in graphic design as radical as the fifteenth-century shift from hand-lettered manuscript books to Gutenberg's movable type. An unprecedented expansion of design education and professional activity produced a larger field with vast numbers of trained practitioners. The number of individual designers and firms producing fine work rose exponentially. On the other hand, digital technology also enabled untrained and marginally trained practitioners to enter the field.

Pioneers of digital graphic design

By providing designers with new processes and capabilities, new technology often enabled them to create unprecedented images and forms. While many designers rejected and decried digital technology during its infancy and called designers who did explore it "the new primitives," others embraced it as an innovative tool capable of expanding the scope of design possibilities and the very nature of the design process. Using a computer as a design tool enabled one to make and correct mistakes. Color, texture, images, and typography could be stretched, bent, made transparent, layered, and combined in unprecedented ways.

Early pioneers who embraced the new technology and explored its creative potential included Los Angeles designer April Greiman, *Emigre* magazine designer/editor Rudy Vanderlans (b. 1955), and typeface designer Zuzana Licko (b. 1961).

April Greiman explored the visual properties of bitmapped fonts, the layering and overlapping of computer-screen information, the synthesis of video and print, and the tactile patterns and shapes made possible by the new technology. In
her first graphic design using Macintosh output (Fig. 24–4), bitmapped type and computer-generated textures were photostatted to a large size and pasted up through conventional typesetting.

When asked to design an issue of *Design Quarterly* magazine for the Walker Art Center in Minneapolis, Greiman created a single-sheet magazine (Fig. 24–5) with a 61 cm by 183 cm (2 by 6 feet) digital collage executed entirely on the Macintosh computer. She explored capturing images from video and digitizing them, layering images in space, and integrating words and pictures into a single computer file.

As computers and their software became more powerful, a new spatial elasticity became possible in typography and imagery. In 1988 Greiman expressed an obligation to "take on the challenge of continuing forward toward a new landscape of communications. To use these tools to imitate what we already know and think is a pity." In addition to using the new technology to make decisions about type and layout, she said, "I think there has to be another layer applied here. And that's about ideas."

In 1984 Rudy Vanderlans began to edit, design, and publish a magazine called *Emigre*. Joining him were two Dutch friends whom he had known at the Royal Academy of Fine Arts at The Hague and who were at that time also living in San Francisco. They originally intended to present their unpublished works along with creative works by others. The journal's name was selected because its founders believed exposure to various cultures, and living in different cultural environments, had a significant impact on creative work. Vanderlans used typewriter type and copier images in the first issue, then used low-resolution Macintosh type for early subsequent issues. A magazine with a printing run of seven thousand copies became a lightning rod for experimentation, outraging many design professionals while captivating those who embraced the potential of computer technology to redefine graphic design. *Emigre*'s experimental approach helped define and demonstrate the capabilities of the new technology, both in its editorial design (Figs. 24–6 and 24–7) and by presenting work and interviews with designers from around the world whose work was too experimental for other design publications.

24–4. April Greiman, poster for the Los Angeles Institute of Contemporary Art, 1986. Computer output, printed as layers of lavender, blue-gray, red-orange, and tan, overlap and combine into an even fuller palette of color.

24–5. April Greiman, graphic imagery for Design Quarterly, no. 133, 1987. This poster composed of digitized images was output by a low-resolution printer.

24–6. Rudy VanderLans, cover for Emigre, no. 11, 1989. Three levels of visual information are layered in dimensional space.

24–7. Glenn A. Suokko (designer) and Emigre Graphics, cover for Emigre, no. 10, 1989. Traditional typographic syntax yielded to an experiment in unconventional information sequencing for a special issue about a graphic design exchange between Cranbrook and Dutch designers.

24–8. Zuzana Licko, digital typefaces, late 1980s. Oakland, Emperor, and Emigre were originally designed as bitmapped fonts for 72-dpi resolution. Modula and Matrix are higher-resolution versions of the latter two fonts.

24–9. Katherine McCoy, Cranbrook recruiting poster, 1989. A photographic collage of student projects is layered with a listing of polemic oppositions and a communications-theory diagram.

24–10. Edward Fella, mailer for Detroit Focus Gallery, 1987. The "transparent" typography of mass communications yields to a typography that references its form, history, and production processes.

In 1987 Vanderlans left his newspaper design job and formed a partnership, Emigre Graphics, with designer Zuzana Licko, whose educational background included computer-programming courses. Dissatisfied with the limited fonts available for the early Macintosh, Licko used a public-domain character-generation software called FontEditor to create digital typefaces. Her first fonts were designed for low-resolution technology (Fig. 24–8), then converted to companion high-resolution versions later as font-design software and printer resolution improved. Licko recalls how the unpleasant experience of a college calligraphy class, where she had been forced to write with her right hand even though she was left-handed, contributed to her original approaches to font design; she had rejected calligraphy, the traditional basis for conventional fonts.

Many art school and university design-education programs became important centers for redefining graphic design through theoretical discourse and experimentation with computer technology. The design department at Michigan's Cranbrook Academy of Art, where graphic designer Katherine McCoy (b. 1945) cochaired the design department with her husband, product designer Michael McCoy, from 1971 until 1995, became a magnet for people interested in pushing the boundaries of design. Then a small graduate school with 150 students in nine departments, Cranbrook has long emphasized experimentation while rejecting a uniform philosophy or methodology. The faculty believed students should find their own directions while interacting with others engaged in similar searches. McCoy likened Cranbrook to "a tribal community, intense and immersive," where she functioned as "a parade director and referee."

During McCoy's twenty-four years at Cranbrook, the program evolved from a rational, systematic approach to design problem solving influenced by the International Typographic Style, through an approach that questioned the expressive limits of this style, into one where complexity and layering, vernacular and premodern forms, and the validity of normative rules and conventions were explored. McCoy's poster (Fig. 24–9) challenged norms of college recruiting materials and demonstrated a complexity of form and meaning. Breaking away from prevailing notions of simple, reductive communications, McCoy overlaid different levels of visual and verbal messages, requiring her audience to decipher them.

Edward Fella (b. 1939), a Detroit graphic designer with whom McCoy worked at the Designers & Partners studio before her appointment at Cranbrook, was a major inspiration within the program. After serving as a frequent Cranbrook guest critic for many years, Fella attended the academy's graduate program from 1985 to 1987, then accepted a California teaching position. With roots in American vernacular design and early modernist typography, Fella's experimental work became a major influence on a generation of designers. From 1983 until 1991, Fella contributed graphics to the Detroit Focus Gallery and produced flyers (Fig. 24–10) whose typography and lettering challenged the reader in the same way advanced art in the gallery challenged the viewer. He explored entropy, the disintegration of form from repeated copying, and an unbounded range of techniques, from found typography, scribbles, and brush writing to typesetting, rubdown letters, public-domain clip art, and stencils. Echoing futurism, Fella investigated the aesthetic potential of invented letterforms, irregular spatial intervals, eccentric characters, personal glyphs, and vernacular imagery. He combined these materials with great compositional skill (Fig. 24–11) and often attached asides, notes, and addenda to the primary message. Fella wryly observed, "Deconstruction is a way of exposing the glue that holds together western culture."

24–11. Edward Fella, announcement for a lecture, 1995. A medley of personal and eccentric letterforms is composed with connective logic and visual whimsy.

24–12. David Carson (art director) and Pat Blashill (photographer), “Hanging at Carmine Street,” Beach Culture, 1991. Responding to the title of an editorial feature on a public swimming pool, Carson was inspired to “hang some type.”

24–13. David Carson (art director) and John Ritter (photographer), “Is Techno Dead,” Ray Gun, 1994. Text type and spatial intervals join with computer-manipulated photographs in a rhythmic melody of white and dark shapes.

24–14. David Carson (art director) and Chris Cuffaro (photographer), “Morrissey: The Loneliest Monk,” Ray Gun, 1994. The unusual photographic cropping and deconstructed headline convey the musician’s romanticism and mystery.

By the mid-1990s, the complexity of form, theoretical concerns, and computer manipulations found in the work of
early pioneers made their way into the mainstream of graphic communications.

Revitalizing magazine design

During the early 1990s accelerating progress in computers, software, and output devices enabled graphic designers to achieve results virtually identical to those of conventional working methods, for the promise of seamless on-screen color graphics had been fulfilled. Designers explored the unprecedented possibilities of computers and graphics software while at the same interest in handmade and expressionist lettering and images was renewed.

QuarkXPress, another page-design application, enabled designers to place elements on a page in increments of one hundred-thousandth of an inch and to kern type in intervals of one twenty-thousandth of an em (a horizontal measurement equivalent to the width of the letter *m*). Adobe Photoshop, an application initially developed for electronic photographic retouching, enabled unprecedented image manipulation and creation.

New developments migrated from personal exploration and design education to the mainstream as editorial designers for specialized magazines applied computer experimentation to their pages. David Carson (b. 1956), a former professional surfer and schoolteacher, turned to editorial design in the 1980s. Carson eschewed grid formats, information hierarchy, and consistent layout or typographic patterns; instead, he chose to explore the expressive possibilities of each subject (Fig. 24–12) and each page or spread, rejecting conventional notions of typographic syntax and imagery. As art director and designer for *Transworld Skateboarding* (1983–87), *Musician* (1988), *Beach Culture* (1989–91), *Surfer* (1991–92), and *Ray Gun* (1992–96), Carson flouted design conventions. His revolutionary layouts included page numbers set in large display type, and normally diminutive picture captions enlarged into prominent design elements. Carson often letterspaced his article titles erratically across images or arranged them in expressive rather than normative sequences. He also required his reader to decipher his message by slicing away parts of letters. Carson’s text type often challenged the fundamental criteria for legibility. He explored reverse leading, extreme forced justification, text columns jammed together with no gutter, text columns the width of a page (and, on at least one occasion, a double-page spread), text with minimal value contrast between type and the image or color underneath, and text columns set in curved or irregular shapes (Fig. 24–13). White display type placed over text covered some of the words, but the text could still be understood. Writing and subject matter receive Carson’s careful attention, for his designs emerge from the meaning of the words, or comment on the subject, as he seeks to bring the layout into harmony.

Unconventional treatment of images included “unnatural” cropping to express content. Although he was viewed as the epitome of the computer revolution, *Ray Gun* 14 (Fig. 24–14) was the first magazine Carson sent to the printer as electronic files. Before that he had generated elements by computer, then prepared camera-ready art on boards.

Carson became quite controversial during the early 1990s. He inspired young designers while angering others who believed he was crossing the line between order and chaos. Carson's typography was decried and denounced, but as he and others pushed their work to the edge of illegibility, designers discovered many readers were more resilient than they had assumed, and noted that messages were often read under less than ideal circumstances. Film and video techniques informed Carson's magazine designs, for the hierarchical and regularized structure of page design yielded in his work to a shifting, kinetic spatial environment where type and image overlap, fade, and blur. Disparate visual and verbal elements jostle and collide in space the way sound and image bump and shove in film and video. Carson consciously made his pages cinematic by letting articles and headlines flow from spread to spread and by wrapping pictures around the edge of the page onto the other side.

During Carson's tenure as art director of *Ray Gun* magazine he provided a rare open forum for major illustrators and photographers while introducing new artists and turning a half-dozen pages over to readers to display their illustrations for song lyrics. This populist gesture recurred as *zines*, self-published personal magazines using desktop-publishing software and cheap printing or copier reproduction, began appearing in magazine racks. Carson left Ray Gun in 1996 and applied his approach to print and other media communications for mass-media advertisers such as Coca-Cola and Nike. He believes one should not mistake legibility for communication, because while many highly legible traditional printed messages offer little visual appeal to readers, more expressionist designs can attract and engage them.

24–15. Fred Woodward (art director and designer) and Andrew Macpherson (photographer), "Sinead O'Connor…,"Rolling Stone, 1990. This breakthrough layout used large-scale display type over two pages as a dynamic counterpoint to the photographic portrait.

24–16. Fred Woodward (art director), Gail Anderson (designer), and Matt Mahurin (photographer), "The Making of the Soviet Bomb," Rolling Stone, 1993. Blocky sans-serif letters evoke Russian constructivism, while reversed Bs, Rs, and a K connote the Cyrillic alphabet used in Russia.

24–17. Fred Woodward (art director) and Lee Bearson (designer), "Cyber Nation," Rolling Stone, 1994. Typeface selection, its computer manipulation, and the color palette all signify and express the article's content.

24–18. Fred Woodward (art director), Geraldine Hessler (designer), and David Cowles (illustrator), "Man of the Year: David Letterman," Rolling Stone, 1995. Visual cohesiveness between type and image is achieved, as both are constructed from broad flat shapes of interlocking color.

24–19. Erik Adigard/MAD (designer), John Plunkett, Barbara Kuhr, (art directors), WIRED magazine contents spread with publishing mission, premiere issue, March 1994. Publisher Louis Rossetto's manifesto of WIRED's editorial mission was conveyed by the text of the opening paragraph of Marshall McLuhan's 1967 book, The Medium is the Massage.

After art-directing *Texas Monthly* and *Regardie's*, Fred Woodward (b. 1953) became art director of the semimonthly rock-and-roll magazine *Rolling Stone* in 1987; Gail Anderson (b. 1962) became deputy art director later that year. As intuitive designers, Woodward and Anderson tried to match typefaces and images to the content. *Rolling Stone*'s tradition of editorial and graphic excellence (see Fig. 19–46) dated to its 1967 inception, so pressure to compete with this legacy prevailed. A turning point occurred when Woodward reinstated the Oxford rules (one name used for multiple-line thick-and-thin borders) found in the magazine's earlier periods. He felt these borders gave him great license, almost as though anything he put within them would look like *Rolling Stone*.

The magazine had a Phototypositor and hundreds of typefaces; Woodward added to this stock and made audacious typography a hallmark of his work. A breakthrough design (Fig. 24–15) used large-scale type

and a full-page photograph to make a strong visual statement about singer Sinead O'Connor. This layout changed the look and feel of *Rolling Stone*, for Woodward felt challenged to build on it. Text pages were punctuated by expansive double-page opening spreads juxtaposing full-page portraits opposite title pages dominated by display type; frequently these had little or no text. Content was expressed through unexpected selection, scale, and placement of type.

Although the magazine converted to Macintosh computers in the early 1990s, Woodward sought a handmade look. *Rolling Stone* used a wide range of fonts, freely exploiting not only digital manipulation but calligraphy, handlettering, found type, and graphic entropy achieved by running type through a copier many times. When Woodward said he preferred never to use a typeface more than once he was expressing an interest in dynamic change, and in creating a publication that constantly reinvented its design in response to content. Figure 24–16 demonstrates how the typeface, its treatment, the color palette, and the image all emerged from associations with the article topic.

Typography's new elasticity permitted outline letters in the title for an article about computers (Fig. 24–17) to be extruded into perspective forms and combined with wireframe drawing for a kinetic three-dimensional effect. Display type on the box form was skewed into perspective, as was the text type that became the front plane of the box. Computer software allowed designers to control type interactively (Fig. 24–18) by changing the scale, color, and overlapping of forms until a dynamic equilibrium was achieved. The software gave illustrators and photographers the latitude and openness to achieve their finest work.

In the mid-1990s, as the U.S. economy recovered from a devastating recession, a new cultural paradigm was emerging: personal computers and the Internet were launching the information age. The magazine that would give voice to and act as a virtual roadmap of the new "digital generation" was *WIRED*.

WIRED magazine's design team, John Plunkett (b. 1952) and Barbara Kuhr (b. 1954), principals of Plunkett + Kuhr located in Park City, Utah, envisioned a magazine that would do for the emerging information highway what *Rolling Stone* had done for rock and roll a generation earlier: define it, explain it, and make it indispensible to the magazine's readers.

Plunkett and Kuhr came to *WIRED*, a San Francisco publication, via Paris, France, where they had met the magazine's future founding publisher, Louis Rossetto, in 1984. In 1991, Kuhr designed a color-xeroxed prototype for *WIRED*, and after much searching for funding by Rossetto and his partner Jane Metcalf, *WIRED* was born in 1994 (Fig. 24–19). Plunkett imagined the design problem as that of finding a way to use the convention of ink on paper "to report on this emerging, fluid, non-linear, asynchronous, electronic world."

The pulse of the information age was presented in a decidedly nonlinear fashion, with florescent and PMS inks rarely, if ever, used in magazine publishing. "Electronic Word," an eight-page front-of-book section of news and products (Fig. 24–20) was often cited as difficult to read but was, in fact, a layered design meant to emulate the emerging visual nervous system of the Internet, with its often overlapping and simultaneous information streams. The design was decidedly influenced by Quentin Fiori's 1967 design for Marshall McLuhan's *The Medium is the Message*. Feature article designs, clearly postmodern, used a wide range of edgy fonts in headlines (Fig. 24–21). *WIRED*'s designers soon ordered their own text font, Wiredbaum, designed by Matthew Carter (see p. 500), and based on the modern serif font Walbaum.

There was no other magazine that looked like *WIRED*. The timing was perfect, following on the heels of the debut of the Internet, and *WIRED*'s machine-aesthetic design debut was an overnight sensation.

The digital type foundry

Early digital type-design systems such as the pre-PostScript Ikarus system, used in the 1980s by typesetting machinery manufacturers, were very expensive. When font-design software for desktop computers—for example, Fontographer—became available, it enabled designers to design and market

original typefaces as electronic files on computer disks, with significant reductions in the high cost of designing and distributing fonts. A virtual explosion in the release of new typefaces occurred in the 1990s, as large type vendors were joined by independent type manufacturers.

Adobe Systems became a prolific and influential digital type foundry. An early type family developed for its PostScript page-description language was Stone (Fig. 24–22), designed by Sumner Stone (b. 1945). Trained both as a calligrapher and as a mathematician, Stone was type director of Adobe Systems before opening his own type foundry in 1990. The Stone family has three versions—serif, sans-serif, and informal—that share basic letterform proportions and structure. Each version has three roman and three italic fonts, for a total of eighteen typefaces in the family. Reproduction quality on 300-dpi laser printers was a major consideration in its character designs.

In the past when designers developed a typeface for a proprietary system such as Linotype or Monotype, they took the specific nature of the typesetting equipment into account. Contemporary typeface designers create fonts for use on many output devices, including low- and high-resolution display screens, inkjet and high-resolution printers, and output systems that do not yet exist. Moreover, the environment in which type is used has expanded dramatically, with people in many fields, not just designers and typesetters, making typographic decisions and creating typeset documents.

Carol Twombly (b. 1959) and Robert Slimbach (b. 1956) emerged as outstanding staff typeface designers at Adobe, creating original designs and respected digital adaptations of classical typefaces. Twombly's numerous typefaces include three masterful families (Fig. 24–23) inspired by historical lettering. These were the first three display fonts in the Adobe Originals type program, a series of new designs created for digital technology. Charlemagne is freely based on the decorative capitals used as versals and titling in Carolingian-era illuminated manuscripts. Lithos was inspired by the monoline simplicity and even-textured economy of Greek stone inscriptions, but Twombly transformed these carved letters into a highly original family of five weights, with inventive characters and a distinctive appearance. After its release, Lithos was adopted for on-screen graphics by the MTV cable-television channel and became wildly popular. The time-honored inscription on Trajan's column (see Fig. 2–17) has inspired numerous fonts, including Twombly's version. Her font closely paraphrases the source, but the conversion from stone to a typeface required a less heavy *N*, a bolder *S*, and more prominent serifs.

A master calligrapher, Robert Slimbach seeks inspiration from classical typefaces as he designs text faces for digital technology. He also creates vibrant fonts based on calligraphy and hand-lettering (Fig. 24–24). Extensive research and documentation combined with meticulous craft have resulted in typefaces with excellent fidelity to the originals. Slimbach's fonts are hailed for maintaining the spirit of the original while making adjustments and refinements appropriate to digital technology.

In 1992 Adobe released its first multiple-master typefaces. Two or more master designs combine to generate an extensive sequence of fonts. The master designs determine the range of fonts that can be generated through changes in a design axis. The design axis controlled *weight*, determined by stroke thickness and the resulting ratio of black form to white background; *width*, determined by making the letters wider (expanded) or narrower (condensed); *style*, in which visual attributes ranging from no serifs to large serifs, or wedge-shaped serifs to slab serifs, were altered; and *optical size*, involving subtle adjustments in proportion, weight, contrast between thick-and-thin elements, and spacing to optimize legibility and design. The optical size axis was an important consideration. During the phototype era, one set of master characters was drawn for use in all sizes, even though small text characters need sturdier serifs and heavier thin strokes than do large display type sizes. Myriad, a two-axis sans serif (Fig. 24–25), was one of the first multiple master fonts. Twombly and Slimbach executed the actual drawing and digitization over a two-year period.

24–20. John Plunkett, Barbara Kuhr (designers and art directors), WIRED magazine, front-of-book spread. The “Electronic Word” section used layered form, with text often running over layers of images to express the multidimensional content of the Internet and “shape” the readers’ experience, in the words of the designers. Car photograph: Renault, Ltd.

24–21. John Plunkett, Barbara Kuhr (designers and art directors), WIRED magazine feature spread. Photograph of David Byrne by Neil Selkirk. Postmodern text designs and florescent colors signaled a new paradigm for print communication about the new electronic media.

24–22. Sumner Stone, the Stone type family, 1987. This typographic arrangement by Min Wang shows the harmony of the serif, sans-serif, and informal versions.

24–23. Carol Twombly, typefaces Charlemagne, Lithos, and Trajan, 1989. The inscriptional spirit of the ancient world is translated into the digital realm.

24–24. Robert Slimbach, typefaces Adobe Garamond, 1989; Myriad (designed with Carol Twombly) and Minion, 1990; Caflisch script, 1993; Poetica, 1992; Adobe Jenson, 1996; and Cronos,1997.

Many cottage-industry type foundries vaulted into existence around the globe, owned and operated by independent designers and entrepreneurs who were empowered by the new technology to create and distribute their original typefaces. A rift arose between designers who believed the traditional values should be maintained and designers who advocated experimentation and even eccentricity. Quite often this split formed along generation lines. Young designers were not trying to expand the range within existing categories of typefaces (for example, the way Univers extended the range of sans-serif types, see Fig. 18–13) or create new decorative and novelty types (Fig. 11–32); rather, they sought to invent totally new kinds of typefaces. These fonts could not be evaluated against proven typographic traditions.

By 1990 Emigre Fonts began receiving many idiosyncratic and novel fonts from outside designers. Licko and Vanderlans recognized the inherent formal inventiveness and originality of many of these submissions and began to license and distribute the designs. Often these fonts proved extremely controversial (Fig. 24–26) even as they were rapidly adopted and extensively used in major advertising campaigns and publication designs. Later in the decade Licko designed two significant revivals: Mrs Eaves is an exemplary interpretation of John Baskerville’s eighteenth-century transitional fonts (see Figs. 8–12 and 8–13), and Filosofia captures the spirit of modern-style fonts (see Figs. 8–17 and 8–18) while actually resolving some of the legibility issues inherent in the eighteenth-century originals.

From 1955 until 1957, London-born Matthew Carter
(b. 1937) learned to cut punches for metal type by hand at the type foundry of the Enschedé printing house in the Netherlands. For over forty years Carter designed scores of typefaces, as typographic technology evolved from metal type to phototype, then digital type. During an association with Linotype from 1965 to 1981, Carter’s designs included the ubiquitous Bell Centennial (1978), created for early high-speed digital and cathode ray tube (CRT) technology. It was designed for outstanding legibility in telephone directories using small type on coarse newsprint. After cofounding and directing the type-design activities of the Bitstream digital foundry from 1981 to 1992, Carter formed Carter & Cone Type of Cambridge, Massachusetts.

Carter designs outstanding fonts based on earlier models (Fig. 24–27). Galliard, issued in four weights with italics, is a masterful adaptation of a sixteenth-century design by Robert Granjon. Mantinia is a titling face inspired by painted and engraved capital letters by the Renaissance painter Andrea Mantegna. Sophia is an original display typeface inspired by hybrid alphabets of capitals, Greek letterforms, and uncials from sixth-century Constantinople; it contains ten joining characters that fuse with other letters to form ligatures. While there are many twentieth-century revivals of William Caslon’s text types, his vigorous and

somewhat eccentric display types had not been redesigned for digital typesetting until Carter released his Big Caslon CC.

Standardization and interchangeable parts became the norm of the Industrial Revolution; in typography this conformity was realized through repetition of letterform parts and redundant layout formats. The digital revolution ushered in
an era of individualization, flexibility, and customization.

Matthew Carter's typeface Walker (Fig. 24–28), designed for the Minneapolis-based Walker Art Center, provides a stunning example of expanding typographic possibilities. Sturdy sans-serif capitals have a series of five add-on serifs called "snap-on (née Deputy) serifs" by Carter, that can be attached at will to the vertical strokes of each letter; further, these are available in a variety of widths. Carter also designed a series of ruled lines running over, under, or both under and over the letters, linking their forms into a dynamic unity. Of the basic letterforms, Carter said, "I think of them rather like store window mannequins with good bone structure on which to hang many different kinds of clothing." Ligatures and alternate characters complete a character set, permitting the Walker Art Center to modulate forms to suit the message at hand (Fig. 24–29). The typeface, or rather its function through various permutations, becomes the corporate identity. Laurie Haycock Makela (b. 1956), Walker's design director from 1991 until 1996, and Matt Eller (b. 1968), a senior designer who became design director in 1996, used the Walker system to achieve a freedom of typographic expression appropriate to a center for art, design, and performance.

24–25. Robert Slimbach and Carol Twombly, Myriad, a two-axis multiple-master font, 1990. From left to right, the set width of the characters goes from condensed to extended; from top to bottom, the stroke weight becomes thicker.

24–26. Emigre fonts include P. Scott Makela, Dead History, 1990; Jonathan Barnbrook, Exocet, 1990; Jeffrey Keedy, Keedy Sans, 1989; Frank Heine, Remedy, 1991; Rudy VanderLans, Suburban, 1994; Barry Deck, Template Gothic, 1990; Zuzana Licko, Totally Gothic, 1990, Filosofia, 1997, and Mrs Eaves, 1996.

24–27. Matthew Carter, typeface designs: Galliard, 1978; Mantinia, 1993; Sophia, 1993; and Big Caslon CC, 1994.

24–28. Matthew Carter, Walker typeface, 1995. Snap-on serifs and other variables extend the formal range.

The digital type foundry decentralized and democratized the creation, distribution, and use of type fonts. The 1990s experienced increased access to typography and the proliferation of experimental and novelty typefaces. Excellent and mediocre versions of traditional typefaces were released, and the glut of new designs included unprecedented innovations along with ill-conceived and poorly crafted fonts.

24–29. Laurie Haycock Makela and Matt Eller, Walker Art Center graphics, 1995–96. Early applications of the Walker typeface system explore only a small portion of its infinite range of possibilities.

24–30. Pat Gorman of Manhattan Design, MTV press kit cover, 1982. Randomly generated color combinations were selected and composed in a repeat pattern; visual elements convey the network's character in a nonverbal manner.

24–31. Woody Pirtle, digital illustration for Mead Paper Company, 1985. Original photographs, the wireframe construct of early high-end digital editing devices, and the printed image are shown.

24–32. April Greiman, "Shaping the Future of Health Care" poster, 1987. Color and composition transform easily comprehended symbolic images into a potent expression of future possibilities.

Digital imaging

The photograph lost its status as an undisputed documentation of visual reality, because electronic imaging software allowed seamless and undetectable image manipulation. The boundaries between photography, illustration, and fine art began to crumble along with those separating designer, illustrator, and photographer. However, access to early image-manipulation systems was very costly, and often designers were denied hands-on access; they could only direct technicians rather than actually work on the system. Before the advent of the Macintosh computer, the creative potential of electronic technology was seldom explored, because artists and designers rarely had unfettered access to sophisticated technology; hourly rental fees for mainframe computers and video-editing facilities were often prohibitive. An MTV press kit cover (Fig. 24–30) designed by Pat Gorman of Manhattan Design is a forerunner of the image invention made possible with digital computers.

Gorman created color variations of the MTV logo by exploring editing controls in a television studio. The studio engineer became so upset over her experimentation that he left her alone with the equipment, locking her in the studio so others would not observe her audacious behavior. Gorman called this design the "bad television" logo because it stands in stark contrast to broadcast television's focus on "correct" color fidelity. Widely reproduced, and making an appearance on the cover of *Billboard* magazine in 1983, this design illustrated the creative potential of electronic image manipulation.

In an image for Mead Paper Company, designer Woody Pirtle created a surreal book whose pages open to allow objects and figures to float out into an expansive sky (Fig. 24–31). Many photographs were digitized, silhouetted, and electronically combined into an electronic montage.

To create an advertisement for a health-care symposium (Fig. 24–32), April Greiman "built" a poster by combining digitized images—photographs of a flag and an eagle, an X-ray, and a drawing of the medical profession's traditional caduceus symbol—with color shapes and gradations and a video clip of hands shot live into the Paintbox program. A wide variety of effects, including mosaic, fading, outline, overlap, and increasing and decreasing levels of transparency, enable complex iconography to evolve as an integrated and organic whole.

These uncommon electronic montages from the 1980s were harbingers of the current revolution in image making, when thousands of designers, illustrators, and photographers use desktop computers with drawing, painting, and image-manipulation software to create imagery. The potent merger of video and print technology unleashed new graphic possibilities. Optical disks, video capture-and-edit capabilities, and interactive print- and time-based media expanded graphic-design activity further.

Interactive media, the Internet, and the World Wide Web

Hypertext is text on a computer screen containing pointers to other text, which are instantly available simply by placing a cursor on the key word or icon and clicking the mouse. Hypertext can be accessed in a nonlinear way. For example, by clicking on the name *Marco Polo* within a world-history text, a reader can get another page with a biography and portrait of Polo to open onto the computer screen. The Macintosh Hypercard software designed by computer programmer Bill Adkinson was an early application of the concept.

24–33. Bill Hill and Terry Irwin (creative directors) and Jeff Zwerner (designer), MetaDesign San Francisco (design firm), VizAbility Interactive CD-ROM, 1995. A coordinated design system unifies booklets, packaging, and screen design.

24–34 through 24–35. Bill Hill and Terry Irwin (creative directors) and Jeff Zwerner (designer), MetaDesign San Francisco (design firm), VizAbility Interactive CD-ROM screen designs, 1995. A consistent yet lively format design becomes an important aid to the user. Clicking on icons along the bottom of each screen lets users navigate through the program.

Interactive media, also called *hypermedia*, extends the hypertext concept to a combination of audio, visual, and cinematic communications connected to form a coherent body of information. These materials are linked to permit viewer access in a nonlinear way, allowing each viewer to pursue information along a personally chosen path. Unlike books or films, which present information in linear sequences, interactive media has a nonlinear structure. Interactive media is usually created by teams of professionals, including audiovisual specialists, authors, computer programmers, content specialists, directors, graphic designers, image makers, and producers. Interactive media presentations are stored on DVDs and CD-ROMs or housed on Web sites, offering an ever increasing ability to store diverse media including animation, illustration, still photography, sound, text, and video.

VizAbility (Fig. 24–33) was an exemplary interactive CD-ROM program that taught concepts relating to visual perception and helped users develop heightened visual awareness. The main screen became a contents page using the metaphor of an unfolded cube for the six chapters; clicking on an image took the user to a title page for that chapter (Figs. 24–34 and 24–35). VizAbility was designed by MetaDesign San Francisco. An information-graphics firm with offices in Berlin, London, and San Francisco, MetaDesign is headed by German designer Erik Spiekermann (b. 1947), designer of the Meta type family and founder of the FontShop digital type foundry.

In contrast to printed communications that are finalized after they flow from the printing press, some interactive media programs are open-ended. Unlimited revisions are possible, and content can continually be added or modified. Seven basic structural methods are used, often in tandem, to bring order and cohesion to the viewer's experience: linear series, spatial zooms, parallel texts, overlays, hierarchies, matrices, and webs or networks. A *linear series* is a sequence of screens, much like the pages of a book or images in a slide show, which can be called up on the screen one after another. A *spatial zoom* lets the viewer acquire closer or more detailed data by clicking on a word to see its definition or by zooming in on a detail of a map or diagram. *Parallel texts* are modified versions of the same document. *Overlays* are different views of the same information—for example, a series of maps showing the Roman Empire at different stages of its history. *Hierarchies* are branching structures organized like a family tree; these permit one to select options that lead down the various branches. A *matrix* organizes data on a grid of interconnected pathways; these intersect at appropriate tangential points. Networks or *web structures* are constructed with links designed to guide the viewer through interconnected information.

Computer communications took a quantum leap forward with the development of the Internet, a vast network of linked computers. The Internet had its origins in the late 1960s, when scientists at the United States Department of Defense Advanced Research Projects Agency (DARPA) established the ARPAnet computer network so they could transfer data between sites working on similar research projects. Supercomputer sites around the United States were connected by the National Science Foundation (NSF) into NSFNET in 1986; this totally replaced ARPAnet within two years. In 1991 the United States Congress passed legislation widening access to public schools, two-year colleges, and business organizations, generating a dramatic expansion of what was now called the Internet. By early 1997 over thirty million users in more than one hundred countries were linked into an electronic global community. In early 2005, there were over 800 million Internet users in the world, more than 200 million in the United States.

The now omnipresent *World Wide Web* provided a means to easily organize and access the vast and ever increasing content on the Internet, including text, images, sound, animation, and video. The Web was

first developed in 1990 by physicist Tim Berners-Lee at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland. Berners-Lee developed the three main building blocks of the Web, the Hypertext Transfer Protocol (HTTP), the Hypertext Markup Language (HTML), and a specification for the "address" of every file on the Web called the Uniform Resource Locator (URL). One navigates the Web via *hyperlinks*, which are highlighted or underlined words, phrases, icons, or images linking elements in one document to other documents existing anywhere on the Web. At first limited to the scientific community, the Web started to take off in 1993, with the development of the graphical Mosaic browser at the National Center for Supercomputing Applications (NCSA) by a team including Marc Andreessen. Leaving NCSA, Andreessen cofounded Netscape Communications to produce the first major commercial graphical browser in late 1994, Netscape Navigator, which caused the number of Web users to mushroom. Expansion of Web use continues at an incredible rate to this day, as the Web has become a ubiquitous tool of commerce, research, and expression for users and corporations around the world.

In the 1990s the phrase *information superhighway* was used to express the global access to enormous amounts of information provided by the Internet and the Web. In 1997 an estimated 150 million Web pages were online, and in 2005 there were over eight billion Web sites.

The Internet represents an unprecedented advance in human communications. Its explosive growth through the late 1990s opened new horizons for graphic design by professionals and individuals using computers and Internet access to produce Web sites. A previously inconceivable decentralization of media communications has occurred.

The early years of Web-page design posed significant constraints for graphic designers. A computer's screen size and typographic defaults often reconfigured the intended page design until more sophisticated software downloaded fonts. Early in the Internet revolution, many feared a collapse of design standards due to the limitations of the HTML programming language and the widespread access to Web-page design by individuals without design training. Nevertheless, in the infancy of the medium, many designers, including Jessica Helfand (b. 1960), whose distinctive Web projects include the initial design for the Discovery Channel's site, demonstrated that graphic designers can create identity, aid navigation, and bring visual interest to Web sites. The Discovery Channel Web site became a paradigm of Web design. The title page (Fig. 24–36) and secondary opening pages (Figs. 24–37 and 24–38) use geometric zoning to create areas for titles, subtitles, and a sidebar of information. Images are used as signifiers to direct viewers as they navigate the site. Opening screens for editorial features (Figs. 24–39, 24–40, and 24–41) use arresting images and understated typography, in contrast to the strident jumble of competing small elements on many Web sites.

In 1976 architect and designer Richard Saul Wurman
(b. 1935) coined the term *information architecture* and predicted it would become a new profession of individuals who made complex information understandable. Twenty years later this term became widely used to denote a process of analyzing complex information and giving it structure and order, enabling audiences to glean its essence in an efficient and agreeable manner.

24–36 through 24–41. Jessica Helfand (creative director), Melissa Tardiff (art director), Jessica Helfand Studio; Interactive Bureau (agency); John Lyle Sanford (Discovery Channel design director), Discovery Channel Web site, 1994–95. Three goals—effective visual identity, functional wayfinding through the Web site, and editorial presentation of broadcast programs—are achieved with clarity, cohesiveness, and a clear design aesthetic.

24–42. Clement Mok and Brian Forst (designers), Scott Peterson (photographer), and Studio Archetype (design studio), iQVC main categories screen for Internet shopping, 1995. Drawers and cubbyholes make this screen adaptable to new and seasonal promotions, just like a storefront.

24–43. Bob Aufuldish, fontBoy interactive catalogue Web site title page, 1995. The uninhibited aesthetic of the typefaces is conveyed.

24–44. Bob Aufuldish, fontBoy interactive catalogue Web site main holding page, 1995. The viewer has clicked on the floating g, bringing the typeface name and weights onto the screen.

24–45. Charles S. Anderson Design Co., Web page for CSA Archive, 1996. The tactile informality of a collage with found materials avoids the strident sameness of most Web sites.

Clement Mok (b. 1958), an Apple Computer creative director who left to open Clement Mok Designs in 1987 (renamed Studio Archetype in 1996), emerged as an early advocate of the graphic designer's role in the rapidly changing world of interactive media. Mok realized that the digital revolution was merging commerce, technology, and design into a symbiotic whole (Fig. 24–42). Mok believed design should be defined not as an isolated entity, such as packaging or graphics added on to the product or service, but as an integral part of an organization's overall vision and strategy.

Interactive media permits small firms and individuals to efficiently communicate with audiences and market products or services. This is demonstrated by the first fontBoy interactive type catalogue (Fig. 24–43), designed by Bob Aufuldish (b. 1961). On the main holding screen, letterforms float randomly in space. When a viewer passes the cursor over a letterform, its movement stops and the font name appears (Fig. 24–44); double-clicking on the letter opens another screen showing the entire font. Typefaces can be accessed from a menu page as well. This electronic typebook of "baroque modern" fonts by Aufuldish and Kathy Warinner (b. 1957) enables viewers to print bitmapped specimens, obtain ordering information, review future releases, and read brief biographies of the typeface designers. Aufuldish started a type foundry because he believed there was still room for experimentation and exploration in font design. He expressed interest in "a new typography waiting to happen—what I call baroque modernism for the new millennium—and I want to make and release type to inspire that new typography."

Whimsy pervaded fontBoy designs, in the form of funny sounds, unusual colors, and playful shapes that ranged from comical paraphrases of vernacular forms to abstract images inspired by modern painters such as Matisse and Miró. A sophisticated aesthetic parodied itself, in contrast to the restrained utilitarian focus of many interactive designs. Likewise, the Web site for the CSA Archive (Fig. 24–45) demonstrates the ability to bring an inventive resonance to the Internet rather than let the medium drive the design approach and the message.

With access to personal computers now almost universal, the control of text and images has become the domain of any designer. As mentioned earlier, increasingly sophisticated programs enable designers to assume the roles previously performed by typesetting and production businesses. The crest of the graphic design profession was once largely dominated by a few individuals, while today the playing field is far more level. The widening of the design profession occurred not only through the creation of new computer software and the Internet, but also as a result of both the expansion and increased quality of design education.

The new conceptual poster

In spite of advances in technology print design continues to thrive in the Internet age. Some designers, such as Helmut Brade (b. 1937), remain faithful to the more traditional methods as well. A native of Halle, Germany, Brade works as a graphic and stage designer. Displaying wry humor, his colorful and highly illustrative posters effectively penetrate to the core of the subject depicted (Fig. 24–46).

In addition to being a poster artist and textile designer, Gitte Kath (b. 1948) is scenographer and director at the Mill Theatre in Haderslev, Denmark. Except for a few posters for organizations such as Amnesty International, the Paralympics in Sydney, Australia, and the Umbrella Theatre in Copenhagen, Kath has created most of her posters for the Mill Theatre. Intensely meditative, the posters usually take several months to produce. Her design process involves collecting material, photographing it, and then introducing paint and text, the latter often her own handwriting or enlarged typewritten letters. Many of these visual elements reflect the transitory nature of life, and she has sometimes used a worn and discolored wall in her home as a