rotogravure presses are also used for magazines with a very high circulation.

1.1.1.3 Newspapers

The newspaper is still one of the most significant mass media today. The first *newspapers* appeared at the start of the seventeenth century. Pamphlets in the sixteenth century were the precursor of the newspaper. Most newspapers are produced daily and have a high circulation. Some daily papers even appear a few times per day, to ensure that their content is very up-to-date. The two most important categories of newspapers are daily papers (dailies) and weekly papers.

The external appearance of newspapers differs considerably from that of magazines. Newspapers normally consist of large-size loose sheets. Several of these loose sheets are combined during production and form an individual section of the paper. A newspaper consists of several sections/parts with varying content called "newspaper books."

Generally, newspapers are produced on special newspaper printing presses. These presses are highly productive web presses, which can print on uncoated paper, at low cost. The traditional newspaper used to be black and white. Modern printing presses are able to print in color economically. This has created the opportunity to adapt the newspaper's appearance to today's expectations (color photographs, color TV), but also to conform to the wish of many advertising customers that their advertisements be published in color. The production of a newspaper is mainly financed by advertising inserts and advertisements. For this reason the ultimate consumer price for a newspaper is relatively low.

1.1.1.4 Brochures

Along with advertising inserts, which we come across every day in newspapers and magazines, there is a large market for leaflets and product descriptions. Such printed matter is referred to as *brochures*. Unlike magazines and newspapers, they are not published periodically. Brochures are commercial print work. Another significant difference from newspapers or magazines is the usually low print volume of brochures.

Today, brochures are generally printed in color and are available either as folded individual sheets or bound copies. They are of better quality than newspapers. Brochures are mainly used to describe something particular (e.g., company, product). Brochures are mostly used for advertising; therefore production costs are normally borne by the advertiser and not by the reader.

1.1.1.5 Other Printed Media

Packaging represents another important group of printed products. It can be made of very different materials such as paper, cardboard, plastic, metal, glass, and so on. In the first place, packaging is used to protect the actual goods inside, but it also makes for an attractive presentation. At the same time packaging is also printed on to provide information about the package content. All the major printing technologies are used for printing packaging – often in a combination of several technologies.

1.1.2 Electronic Media

Electronic media were developed in the twentieth century and together with printed products (print media) became important for communicating information. This trend continues today and is characterized particularly by the use of computers and the Internet. In addition to the latest developments in the Internet and World Wide Web, electronic media also include the more conventional radio and television along with the corresponding forms of storage such as video and audio recordings on CD-ROM and DVD-ROM as well as animations.

Electronic media, as is the case with print media, also involve a chain of creation and transmission which depends on the specific form of the media. As a rule, the first stage in this process consists in generating the *contents*, for instance, for recordings onto audio or video tape. In some cases, information is converted from one medium to another, such as from conventional film to video. In the case of web pages though, content can also be computer-generated, thus allowing for the use of content from both the real and the virtual worlds.

Animations may describe scenes and "tracking shots"; in the end, running an animation results in a chronological sequence of pixel images, that is, almost a video flow. The description of an animation can be considerably more compact and efficient than the transmission of the video sequence. Therefore, the actual animation may only be executed on a final output device such as a powerful presentation computer.

In the preliminary phase, scripts are usually compiled (at least in a professional environment) as we know them from traditional film. In the case of electronic media products, the specific demands on the *presentation* must already be taken into account in the design stage. The reasons for this include the low local resolution (in comparison to print products) and the restriction of the output format (e.g., the size of the monitors or even windows within the overall monitor display).

Distribution may be in a saved form on data media (CD-ROM, video tape/audio tape, and storage medium for sound) or be live, for instance, for transmission of a concert or sports event. In both cases, an attempt is made to restrict the volume of data because of the limited capacity of the storage media or because of the limited bandwidth of communication channels. *Compression techniques* play an important role here. They permit the reduction of data without a noticeable loss of quality. The underlying transmission technologies may be varied, ranging from Internet connections via dedicated switched connections, such as satellite routes, or high-speed links via cable or glass fiber, to private or company networks, also with various technology (company television, Intranets).

The presentation systems, for instance, computer monitors, television screens, projector devices, audio reproduction systems (loudspeakers, headphones) are generally at the end of the transmission chain. Before these systems can respond though, codings and compression processes might have to be reversed with corresponding components (software and hardware) to represent the transmitted data. In the place of presentation systems, *memory* can also be found there that records the data transmitted, for instance, to reproduce it at another time.

The use and dissemination of electronic media can be regulated with protection rights which are, however, relatively easily infringed; this applies particularly to digital data where the copy is just as good as the original. Modern procedures deal with protective mechanisms against unauthorized copying both in the

- *cryptography* field, that is, encoding data to prevent unauthorized use
  as well as
- in the *digital watermarking* field, that is, importing information into the digital data stream which is not visible to the normal observer, but which can be detected in order to determine the location at which the data was made available.

In a broader sense, electronic media also include in particular *interactive applications*: media which appear differently depending on user intervention. These include computer games, interactive simulations, or virtual reality applications. This leads directly on to multimedia concepts which are described in the following section. Please refer to chapter 11 for more details.

1.1.3 Multimedia

The term "multimedia" is closely connected with today's computers and output devices such as monitors, loudspeakers, and printers and their capacity for reproducing various types of information (text, images, sound, animation, etc.). Multimedia systems do not just output these different types of information; these systems make it possible to simultaneously create multimedia information and interact with other multimedia documents (data files on data storage units, such as a server and CD-ROM).

Although the term "multimedia" is relatively new, what lies behind it is not (see also sec. 11.7). *Multimedia* means nothing more than making use of several types of information (text, images, graphics, animation, video and audio sequences) in one publication. As illustrated in figure 1.1-3, this also includes print media (e.g., CD-ROM in a book).

Human communication is multimedial as humans transmit information, for instance in a conversation, by talking and gesticulating simultaneously. The technical application of using several media simultaneously to reproduce content is not new either. Thus, for example, television can simultaneously transmit information using text, image, and sound. The addressing of several sensory organs combined with the advantages of using individual media has synergetic effects making the multimedia product an attractive option.

The success of the multimedia concept becomes clear with television and the so-called "new electronic media" such as the Internet or CD-ROM publications. CD-ROM publications are not multimedia documents as such. A CD-ROM is merely a medium on which various types of information (such as text, sound, video, etc.) can be stored. Only if, for example, text, sound, and animation are combined on a CD-ROM, could one speak of a multimedia CD-ROM. *Types of information*

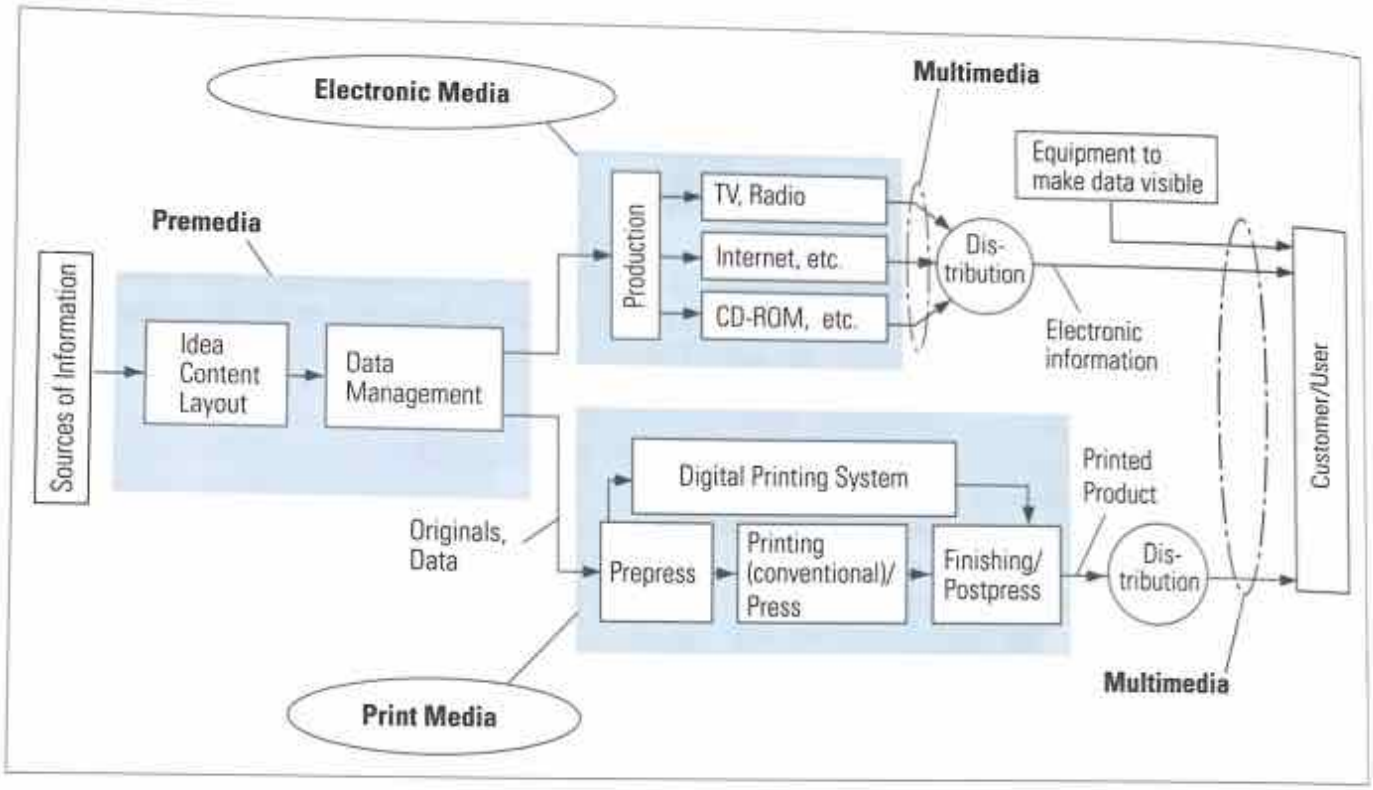


Fig. 1.1-3 Structure for producing electronic media, print media, and multimedia documents

(text, sound, image, video) must not be confused with *medium* (data carrier, e.g., paper, CD-ROM, disk, etc.).

The same applies to *Internet publications*; here too, different types of information have to be linked with one another before you have a multimedia presentation. *Hypertext* as an additional type of information is in itself not a multimedia document; only when hyperlinks point to multimedial contents does a hypertext become a *multimedial hyperlink document*.

The play-back devices (computer, television, etc.) for electronically stored information are not even close to addressing all the sensory organs of a human being. Today's multimedia products are not yet able to invoke the senses of smell and touch. A medium which can be used to pass on a fragrance to consumers, or to call on the sense of touch by certain surface properties in addition to transmitting text and visual information is, for example, paper. One might therefore say that paper is a multimedial product. However, printed information lacks dynamism and interaction. With play-back devices for electronically stored information there is also a potential for appealing to the senses of touch and smell in the future (e.g., transmission of vibrations/oscillations and temperature via operating elements).

1.1.4 Distribution and Market Volume

The printing industry is a sector consisting predominantly of small and medium-sized companies. Around 90% of all printing companies worldwide employ less than twenty people (fig. 1.1-4).

The growth of the printing industry is influenced essentially by macroeconomic factors such as economic development and consumer demand. Worldwide, the printing industry contributes 1–12% to the gross added value of the processing industry.

In the industrial countries the production volume of the printing industry has a share of 0.5–4% in the gross domestic product (GDP). In emerging markets this share may even amount to 20% of the gross domestic product. In the USA the printing industry is the sixth largest industrial sector and has therefore a clear economic significance for the country.

In 2000 the 430 000 printing companies worldwide will achieve a turnover in the range of 430–460 billion US dollars. Figure 1.1-5 shows the distribution of this volume according to individual product segments. The areas of advertising and commercial printing as well as packaging and label printing make up the most im-

and equipment, and for efficient, high-quality, and economic production.

Figure 1.2-1 shows that the content, layout, and form of the printed product are based on information in the form of originals and also particularly on data. Figure 1.2-1 also depicts how the printed product is delivered via the distribution system to the end-user/consumer; here, too, organization and distribution benefit from the data technology.

The production chain of prepress, press, and postpress is logistically interlinked through storage areas for the materials needed for the production as well as by storage areas for the semi-finished and end products of the printing job. The use of efficient production management and archive systems for data to link and support all the manufacturing stages in the creation of printed products is becoming increasingly the state of the art.

The individual stages and areas involved in the production of printed matter are explained below. Full descriptions with numerous details will be found in later sections of the book.

The quality of a printed product is ultimately determined by its content, effect, and benefit to the client/consumer. The visual quality is obviously affected by high-grade processes and procedures for producing the print media. However, it is to a large extent determined by the *conception of the print medium* in text, graphics, and pictures, the representational form of the contents, that is, by *layout*, *typography*, and *graphic design*.

Before going into the actual production process – the economical and high quality duplication of information through printing tailored to the customers and the market – we will describe the rudiments of design.

1.2.1 Layout, Typography, Graphic Design

The development of type, typography, and graphic design is an important part of the history of culture as a whole. Although knowledge of other spheres of culture such as painting, music, and literature is much more widespread, it is the symbols constituting language that make communication and the dissemination of knowledge throughout the world possible. These three areas are inextricably linked: *type* is an essential element of *typography* and typography is (besides illustration and photography) an essential part of *graphic design*. Each of these means of communication and design has its own subtly different historical development, which can provide detailed insights into the whole of human development from a historical, technical, and aesthetic perspective.

1.2.1.1 Type

Origin of Type

Type first developed over the course of time as a magical feat on man's journey out of the unknown. It was a *pictographic system* of type that probably grew out of the human craving for knowledge and communication. These pictographic symbols lacked accuracy and precision, they were ciphers in need of interpretation. As human understanding grew deeper and more refined, so too did the need to design and set down clearer, more universal and accessible codes.

Pictographic system was followed by *logograms*, which were derived from the sound of the spoken word (fig. 1.2-2). Each word had its own symbol, and the more distinctive and developed a spoken language was, the greater the number of symbols it had. There were well developed writing systems in China, India, Egypt, Mesopotamia and some other countries.

Around 3000 BC the Sumerians developed *cuneiform script*, a syllabic writing system made up of about six hundred characters. The next decisive step was the de-

Fig. 1.2-2 Minoan hieroglyphs (above), Minoan linear type (below)

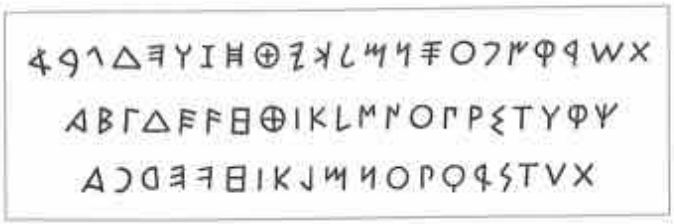


Fig. 1.2-3
Alphabets (Phoenicia, Greece, Rome; sixth to third centuries BC)

velopment of the *consonant alphabet* by the Phoenicians around 1400 BC. This alphabet consisted of twenty-two letters. It was derived as a simplified version of Egyptian hieroglyphs and Babylonian cuneiform script. The Phoenician alphabet (fig. 1.2-3) formed the basis of all European writing systems.

Around 1000 BC the Greeks adopted Phoenician script and introduced the symbols a, e, i, o, and u. The Roman alphabet was based on this development by the Greeks. The Roman capital script "Capitalis monumentalis" was developed (fig. 1.2-4), the increasing use of which led to the formation of the first *lower case type*. These early centuries AD also saw the move away from scrolls to the form of books still in use today.

Fig. 1.2-4
Roman capitals "Capitalis monumentalis"; alphabet on the plinth of Trajan's column in Rome (AD 113)

The Middle Ages (fourth to fifteenth centuries) was a time of extensive writing and design. The carriers of written characters and text were clay, stone, wood, silk, papyrus, and then parchment. In the 7th century *paper* from China reached the Middle East, and from there Spain and the rest of Europe. The invention of duplicable printing first in China (c. 870), then in Korea with *movable metal type* (c. 1403), and finally Gutenberg's technical developments in letterpress printing (c. 1440) heralded a new era of communication, replacing the hitherto handwritten one-off texts which required rewriting in order to be passed on.

While at first old types were simply molded in lead for the new technology, new *typefaces* soon developed which have retained their formal elegance and character as model typefaces to this day: important designs originate from Claude Garamond (1480–1561), Nicolas Jenson (1420–1480), and Aldus Manutius (1459–1515). Soon after Gutenberg's invention two distinct technical concepts regarding typeface co-existed in parallel: the Roman types Antiqua and Cursive, and the broken types Fraktur, Gothic, and Schwabacher (fig. 1.2-5). From these basic forms, which were derived from the handwritten script, thousands of different typefaces were developed that had slight but important differences between them. Technical innovations as well as the quest for aesthetic improvements each led to yet more variants.

Fig. 1.2-5 Types
a Roman types: Antiqua and Cursive;
b Broken types: Fraktur and Gothic

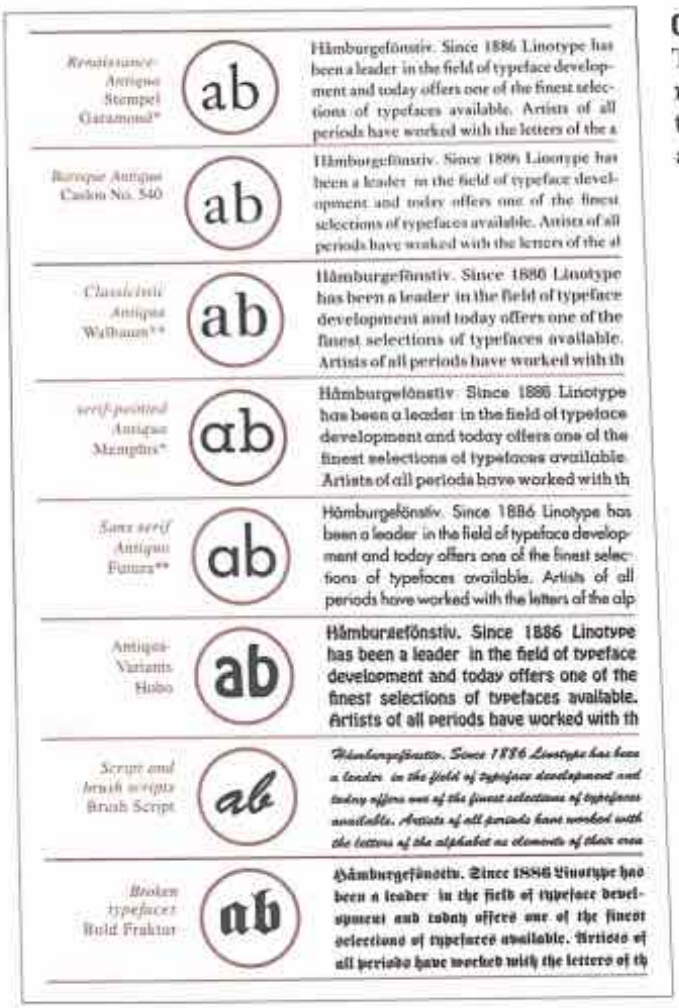


Fig. 1.2-6
Classification of typefaces (examples from DIN 16518, engl. version available)

Classification of Typefaces

The classification of typefaces formulated in 1964 (DIN 16518) allows the technical differences of all typefaces to be grouped into eleven distinct styles (see also examples of type in fig. 1.2-6):

1. Venetian Renaissance-Antiqua (Venitian)
2. French Renaissance-Antiqua (Old Face)
3. Baroque-Antiqua (Transitional)
4. Classical-Antiqua (Modern Face)
5. Serif-pointed Linear Antiqua (Slab Serif)
6. Sans Serif Linear Antiqua
7. Roman Variants (Decorative and Display)
8. Script
9. Handwritten Antiqua (Handwriting)
10. Broken types
11. Foreign types (non-Latin, non-Roman).

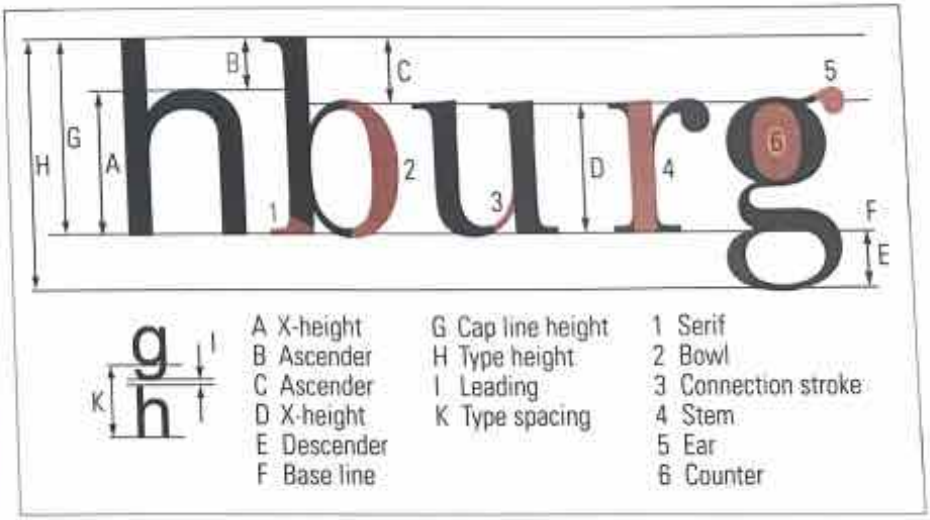
Even the latest typefaces may be technically understood and classified using these groups. At present there is a new amended DIN classification in preparation, the content of which is, however, still under discussion.

The basic construction of letters with their corresponding descriptions is shown in figure 1.2-7. The construction of letters in digital form is explained in section 3.1.1.3 and figure 3.1-2.

Design of Typefaces

Despite the numerous alphabets in existence, surprising new typefaces continue to be invented whose form best fits the spirit of their age. Some of the most important designers of the past were Anton Janson

Fig. 1.2-7
Construction of letters and naming of elements



(1620–1687), William Caslon (1692–1766), John Baskerville (1708–1775), Giambattista Bodoni (1740–1813), and Justus Erich Walbaum (1768–1837). Important typeface designers of the twentieth century were Emil Rudolf Weiss (1875–1942) with Weiss Antiqua and Weiss Gothic, Rudolf Koch (1876–1934) with Wallau and Cable, Paul Renner (1878–1956) with Futura and Plaque, Eric Gill (1882–1940) with Gill and Perpetua, Georg Trump (1896–1985) with City and Delphin, Karlgeorg Hoefer (1914–2000) with Salto and Permanent, Hermann Zapf (b. 1918) with Palatino and Optima, and Günter Gerhard Lange (b. 1921) with Arena and Concorde.

Among the typeface designers who create today's significant and widely used alphabets are Hans Eduard Meier (b. 1922) with Syntax and Syndor, Ed Benguiat (b. 1927) with Souvenir and Barcelona, Adrian Frutiger (b. 1928) with Meridien and Frutiger, Matthew Carter (b. 1937) with Galliard and Bitstream Charter, and Gerard Unger (b. 1942) with Swift and Gulliver. In the immediate present the new designs of Hermann Zapf and Adrian Frutiger are receiving particular attention. With his Zapfino typeface (1998), Zapf developed a calligraphic typeface that has achieved surprising technical versatility in this group of typefaces (fig. 1.2-8) by drawing on the possibilities of computer technology.

Frutiger's typeface Univers (fig. 1.2-9) was developed during the years 1953 to 1957 and became a classic of the modern age. In 1997 it was revised within the Linotype Library as Linotype Univers with 59 type styles (up to then, there were 21 type styles), making it all the more versatile in use.

Despite all the changes and advantages brought by technology compared to the Middle Ages, the design of typefaces is still a process which has lost nothing of the seriousness of the original way of thinking, of knowing what constitutes technical and aesthetic quality, and of the need to familiarize oneself with the essential elements of symbols for communication. Only few designers have so far succeeded in achieving the highest quality with their typefaces.

Besides Western typefaces (see DIN 16518 classification), there is an extremely large group of non-Latin, foreign types that have developed in their own way and have highly elaborate technical requirements: among others, there are Greek, Cyrillic, Hebrew, Arabic, Chinese, or Japanese types, which, with slight differences in typeface design, represent the languages of those regions and provide a diverse range of alphabets permitting typographic forms rich in detail (fig. 1.2-10).

Fig. 1.2-8
Zapfino of Hermann Zapf (1998); Zapf wrote this text in his notebook in 1944; the characters were the beginnings of Zapfino

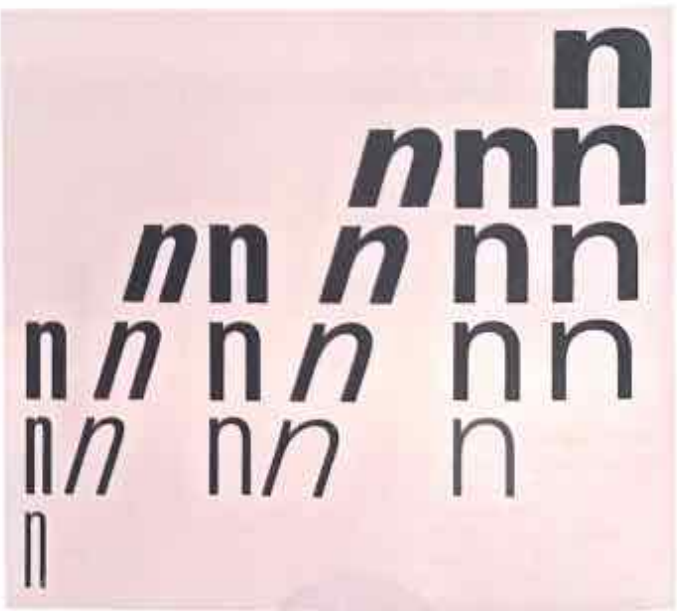


Fig. 1.2-9
Univers of Adrian Frutiger; examples of the various type designs (around 1955)

體育之宜提倡人盡皆知以其
能增進健康也德國各學校各

Chinese

מַה־נִּשְׁתַּנָּה הַלַּיְלָה הַזֶּה מִכָּל־הַלֵּילוֹת שֶׁבְּ
הַלֵּילוֹת אֲנוּ אוֹכְלִין חָמֵץ וּמַצָּה הַלַּיְלָהכֻּל

Hebrew

وان كانت مسلوبة لها فان الزاوية ايضا مساوية وان
كانت ناقصة فالزاوية لكن قرس اضعاف لقرس وقوس

Arabic

Функциональные системы управления и автоматизации листовых офсетных машин фирмы Heidelberg

Cyrillic

Fig. 1.2-10 Examples of non-Latin script

- **Point** system (**DTP**-point)
  (mainly used nowadays)
  1 pt = 1/72 Inch = 0.353 mm
  12 pt = 1 Pica = 4.23 mm
  6 Pica = 1 Inch
- **Point** system (**Pica** system)
  1 pt = 0.351 mm
  12 pt = 1 Pica = 4.21 mm
- **Didot** system in photosetting
  (Franco-German standard system), [lead type]
  1 p = 0.375 mm [0.376 mm]
  12 p = 1 c (Cicero) = 4.5 mm [4.51 mm]

Fig. 1.2-11
Comparison of typographic and metric systems of measurement

1.2.1.2 Typography

Type in its various forms is a fundamental requirement of typography. To put it simply, typography is basically the *design of printed text* using and arranging typefaces to create continuous text on a printed page. The selection of available typefaces used to portray texts and textual content and the layout of words and texts on pages or other text carriers such as boards and signs is an area of design requiring many years of apprenticeship or study, followed by consistent practice for purposes of refinement, improvement, or change.

All printing elements such as text or lines, but also the non-printing segments such as empty areas or spaces, have their own measuring system, the *point system* (fig. 1.2-11). It was developed in 1795 by Francois Ambroise Didot and his son Firmin. One point (pt) measures about 0.38 mm. One Cicero corresponds to 12 points or 4.5 mm. In Anglo-American countries the unit pica/point is used, which, at about 4.2 mm, is smaller than the Franco-German system.

Choosing the individual *design elements* for the typographical job at hand is done by selecting from a system consisting of many interrelated parts. As with all design problems, there are no hard and fast rules for making this selection, but only approximations gained from experience, which can vary over time and from different perspectives. The designer's ability to interpret form is very important in choosing the font. The Linotype FontExplorer can be very helpful in this respect. This new typeface browser enables selection of the correct fonts according to many design criteria.

It is apparent that the sensitive use of typeface determines the quality of the typography and that a fresh approach must be used for every job. After the choice of *font* comes the setting of the *font sizes* (fig. 1.2-12) for the various parts of the text, the setting of the *type styles* (e.g., light, regular, or semi-bold), and the *inclination* (e.g., normal or italic). The font color and style (e.g., upper case, lower case, mixed) must also be determined.

Once these have been decided it is necessary to establish the *text structure*: how far apart the individual lines are, what degree of line spacing (leading) there will be, what column width should be set and which *justification* will be selected. There is a distinction between justified (fig. 1.2-13a), unjustified (fig. 1.2.-13b), and centrally justified. It is important to establish whether each of the text paragraphs is to have an *indent*.

A few of the recommendations for good, *legible typography* indicate what the basic problems of design are: there should be a maximum of around 60 characters per line and around 40 lines per page. Lengthy texts should be set no smaller than 9 point and no larger than 11 point. The leading (line spacing minus size of type height) should be 2 point.

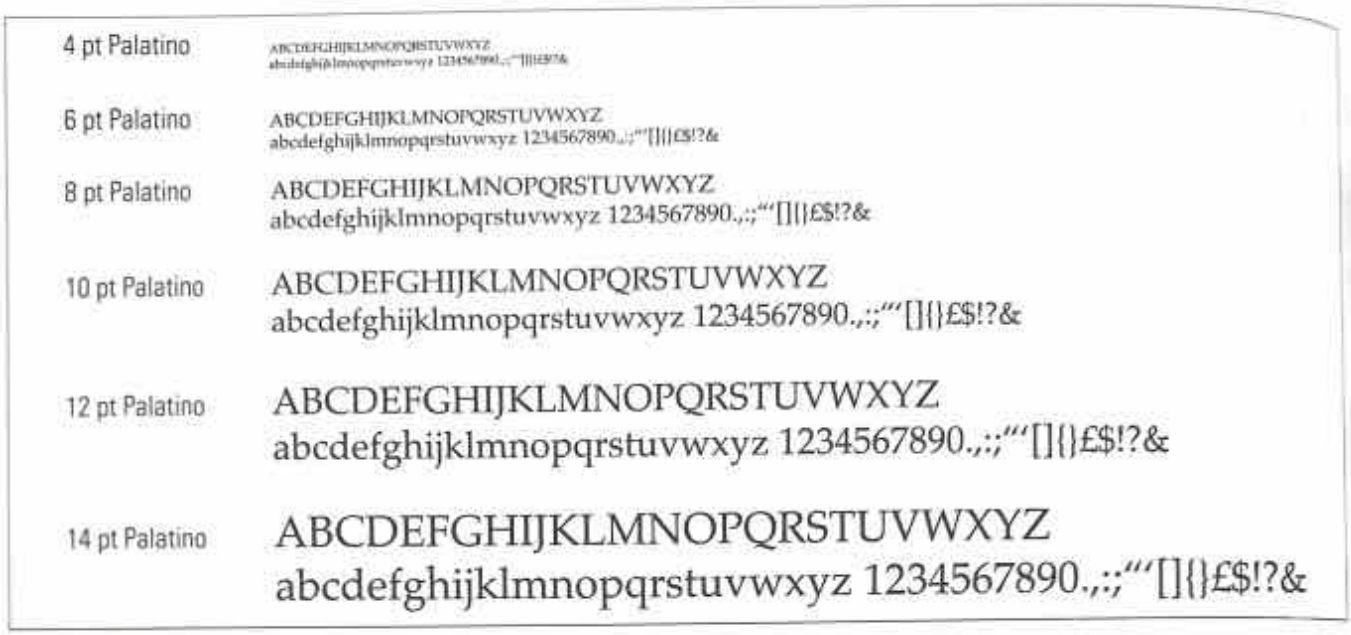


Fig. 1.2-12 Example of type sizes in Palatino

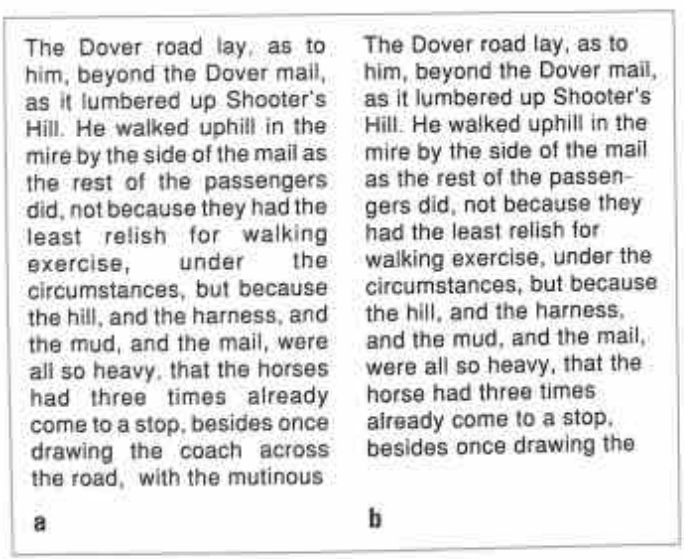


Fig. 1.2-13 Layout.
a Justified;
b Unjustified

The technical requirements of lead type and the typesetting system created for it determined to a large extent the form typography was to take. As a rule right angle designs with horizontal lines were created. Various aesthetic ideas repeatedly gave rise not only to new typefaces but also novel typographical styles.

The twentieth century saw the appearance of historically oriented shapes (figs. 1.2-14 and 1.2-15) and expressionist and pictorial styles. There were functional and elemental styles, as well as experimental fads such as psychedelic or punk typography (figs. 1.2-16 to 18). Typography used graphic and pictorial elements as typefaces or alternatively created pictures using lettering. However, the basic typographic styles for reading matter have not changed since Gutenberg's time, but have been continually refined.

Layout and Typography of the Present Book

The technical construction of the present book was established at the planning stage by making various mutually compatible decisions about the design. Taking this as an example the extracts show the best methods of designing a book to optimize its legibility and aesthetic impact.

Typefaces

Basic Typeface/Body Type:
Springer Minion Plus Regular, 10/11.3 pt (type size/ line spacing);
for marking (emphasis): Springer Minion Plus Italic, 10/11.3 pt.

Headings:
Linotype Univers Condensed Bold, in color (similar to Pantone 647c),

Fig. 1.2-14
Cover page of the trade journal Graphische Technik (July 1940)

Fig. 1.2-16 Expressionist book jacket (Ernst Ludwig Kirchner 1924)

Fig. 1.2-15
Cover page of price list done in Art Noveau (approx. 1900)

Fig. 1.2-17
Event poster with functional elements for representing the content (Max Huber 1948)

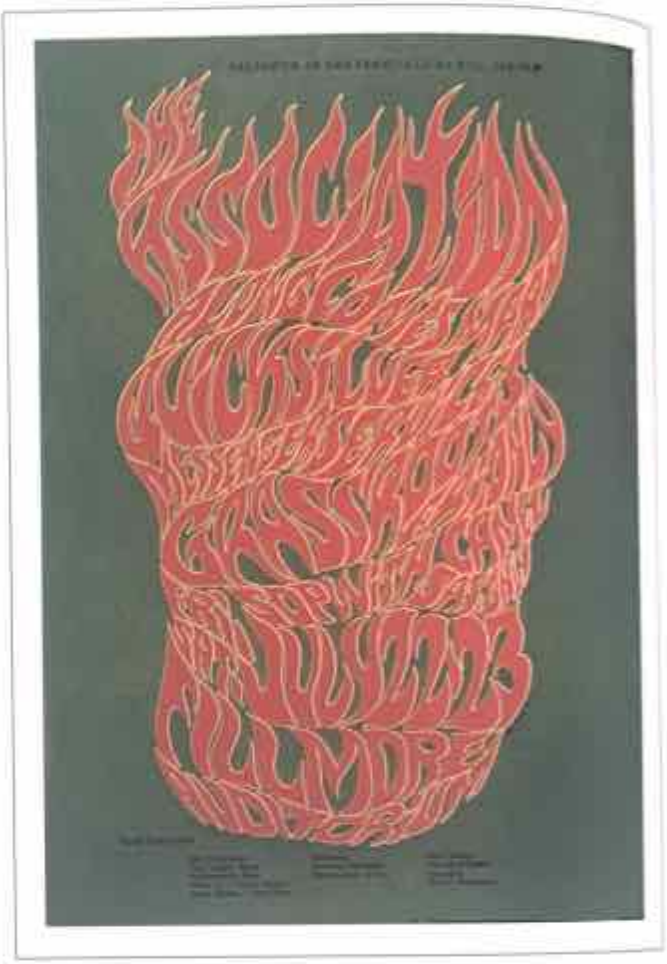


Fig. 1.2-18
Psychedelic poster for a concert from the flower-power movement (Wes Wilson 1966)

First-Level (title): 36/36 pt;
Second-Level: 18/19 pt;
Third-Level: 12/13 pt;
Fourth-Level: 10/11.3 pt.

Headers (Headings without Order Numbers):
First-Level: Linotype Univers Condensed Bold, 10/11.3 pt, black;
Second-Level: Springer Minion Plus Bold, 10/11.3 pt.

Numbering of Figures and Tables:
Linotype Univers Condensed Bold, 9/9.5 pt, in color.

Figure Inscriptions:
Linotype Univers Condensed Light, 9/9.5 pt, black.

Typeface for Captions:
Linotype Univers Condensed Light, 9/9.5 pt, black.

Column Lines/Running Head:
Linotype Univers Condensed Light, 9/9.5 pt, in color.

Special Typefaces:
Springer Symbol, Heidelberg Symbol.

Page Layout

The text is set justified on the base line grid in two columns; highlights are italicized; paragraphs start with a 3 mm indent in the first line.

A bullet is used as the first-level numbering symbol; a dash (en rule) is used as the second-level numbering symbol. There is an empty line spacing before and after a list. The following paragraph is not indented.

Besides pure typeface decisions all other aspects of the book were also determined:

- the page format (193 mm × 242 mm),
- the type area with two columns (156 mm × 200 mm),
- the column width (76 mm).

The figures are preferably single column, double column, or 1.5 column width; the frames are 100% colored and 0.4 pt thick (for figures without a background), all figures with a background (e.g., photographs) remain frameless; pictures are centered within the frame.

Figure captions appear below the figure and are set justified; for 1.5 column width figures they are next to the figure and unjustified; the distance between the caption lines and the edge of the picture is 3 mm.

The figure number stands on its own if the caption text is longer than one line, otherwise it is at the beginning of the line without a following period. The part-figure designations (a, b, c, etc.) are printed black and in bold. They are always placed on their own line.

1.2.1.3 Graphic Design

For many centuries design was of a conservative nature and governed mostly by religious content. The demand for consumer goods that increasingly accompanied the expanding economic systems after the French and particularly the industrial revolutions led to an avalanche of printed matter. Up to the late nineteenth century, designs were mostly black and white, printed on paper, and relatively rare. In the twentieth century printed products such as posters, advertisements, prospectuses, magazines, and of course books, became important media and were widely distributed. This meant that information had to be continually designed to attract attention. This was achieved through long print runs, large formats, a striking amount of color, but also topical subjects. Photographs soon came to be used as well as illustrations.

Design in the Twentieth Century

The first high points of this new age were the great number of artistic-illustrative posters of surprising design produced by designers such as Henri de Toulouse-Lautrec, Jules Cheret, Eugène Grasset and A. A. Mucha (fig. 1.2-19). These designers were situated between the fine and applied arts, between the personal and general form. Informational subject matter also increased: the design of packaging, direction indicators, forms, charts, and corporate literature became tasks that no longer had to be solved with ardent artistic feeling but with clear conceptual designs.

It was the American William Addison Dwiggins who in 1922 first used the professional title "Graphic Designer" to describe more accurately the new type of designer, who was no longer to be an artist in the traditional sense. This title describes someone who has specialized in the *design of visual communication* and brings together the design tools of typography, illustration, photography, and printing with the aim of informing, teaching, or influencing. The term soon caught on.

Fig. 1.2-19 Illustrative poster (Jules Cheret 1893)

The development of graphic design was influenced from widely divergent directions. On the one hand there were the traditionalists, who created designs using traditional artists' tools. On the other hand methods using new ideas of form and content arose, which made this new area of design an unmistakable part of twentieth century culture. The greatest contribution to this was the work of the "Bauhaus", a design school in Germany (fig. 1.2-20). The teachings of this school, which was in existence from 1919 to 1933, were further developed in Switzerland (fig. 1.2-21). After

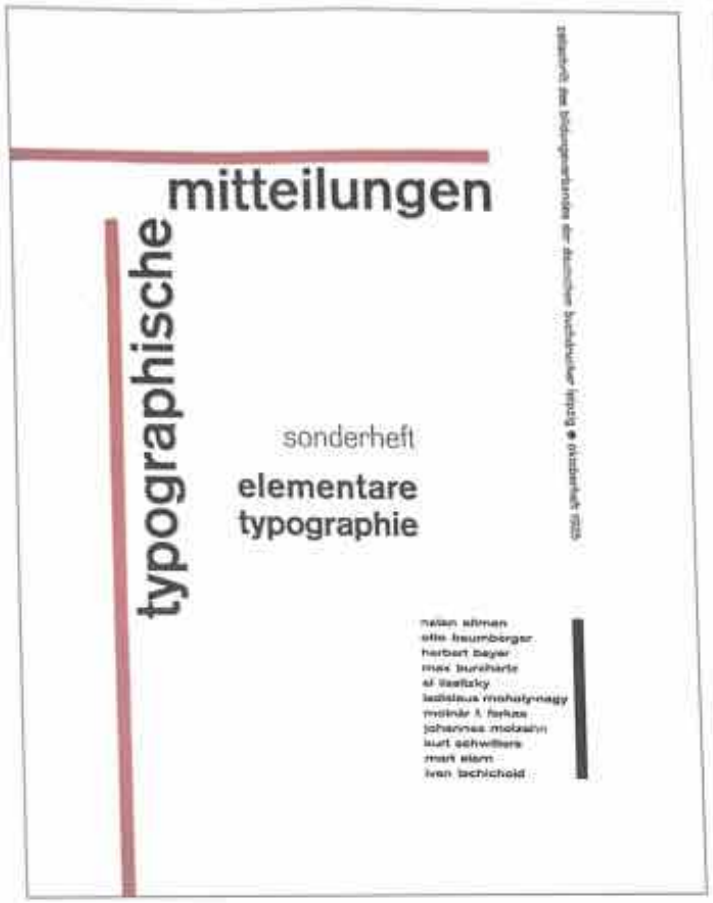


Fig. 1.2-20
Magazine cover in elemental design (Jan Tschichold 1925)

Fig. 1.2-21
Concert poster in the style of "Swiss typography" (Josef Müller-Brockmann 1960)

1945, exemplary achievements from the USA transformed this European development into the varied and differentiated field which characterizes graphic design in the world today (fig. 1.2-22).

1.2.2 Prepress

Prepress includes all the steps which are carried out before the actual printing, the transferring of information onto paper or another substrate (fig. 1.2-23). Traditional prepress is divided into three areas:

- *composition*, that is, recording text, formatting text, and pagination;
- *reproduction* of pictures and graphics, and particularly color separations for multicolor printing;
- *assembly and platemaking*, i.e., the assembly of text, picture, and graphic elements into complete pages, (page layout/make-up), from pages to print sheets,

Fig. 1.2-22
Advertisement for a magazine in contextual text-picture combination (Gene Federico 1953)

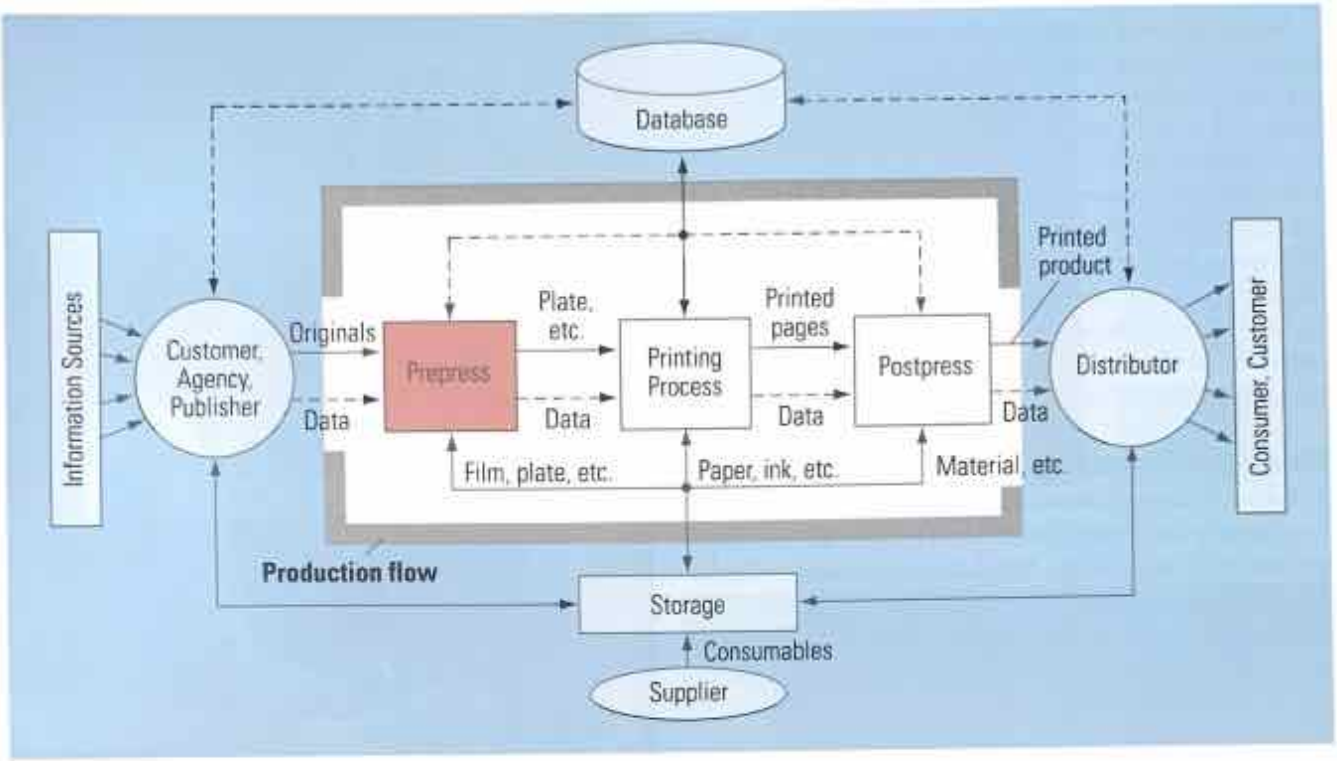


Fig. 1.2-23 Prepress in the production flow for the generation of printed products

and also the making of the printing plate as the vehicle of information in the printing press (fig.1.2-24).

Chapter 3 gives a detailed description of both so-called conventional prepress (sec. 3.1) and digital prepress (sec. 3.2).

Composition Technology

For centuries *composition technology* was dominated by the pioneering invention of Gutenberg – the letterpress with movable type. This process remained practically unchanged from the fifteenth until the end of the nineteenth century. Letters molded from lead were assembled into words, lines, and blocks of text (manual typesetting). Composition only became mechanized towards the end of the nineteenth century in the wake of industrialization. In 1885 Ottmar Mergenthaler developed a line casting machine, which became known by its trade name "Linotype." It made it possible to compose whole lines of matrices by means of a keyboard and to fill them with molten lead. This machine dominated composition until the 1960s – along with "Monotype", which operated in a similar way but produced individual letters, and the still indispensable manual typesetting.

Fig. 1.2-24
Prepress with conventional film stripping and digital master preparation (text, images, graphics) with EDP systems

As quicker and more effective printing technologies began to replace letterpress, particularly offset and gravure printing, the traditional lead composition was improved by innovations. *Photocomposition* began to be developed in the 1940s – at first, as an analog process, in which text was exposed letter by letter onto film through matrices. The breakthrough for photocomposition, and with it the decline of lead composition, first came at the beginning of the 1970s with *digital photocomposition systems*. This involved the transfer onto film of lines of text entered via a keyboard into the processor of a computer by means of cathode ray tubes and later by laser.

Pictures and Graphics

In the early days pictures and graphics were integrated in printed products in the form of woodcuts, and copper and steel engravings. *Reproduction technology* in the modern sense did not come in until the end of the nineteenth century as photographic procedures made it possible to capture pictures on film and to screen them, that is, to break them up into small dots. (*Screening* is necessary because with conventional printing technologies it is only possible to produce solid tints and not continuous tones. The continuous tone effect is simulated for the human eye by printing a number of tiny halftone dots of varying sizes next to one another.) An extra step with multicolor printing is the *separation of colors*, that is, the breaking down of color photos into the process colors used for the print (usually cyan, magenta, yellow, and black).

In *letterpress printing* the screened and separated film served first as an original for etching a relief in a metal surface (plate or printing block) from which prints were made. In *offset printing* the films can be used directly for platemaking. To check color reproduction quality before printing, a test print or proof can be made. This proof is produced photomechanically from the color separation films and simulates the result of the printing process.

In the 1970s the *scanner* emerged, which is used to optoelectronically scan, separate in colors, and screen originals and either directly record them on film by laser or first store them as digital data for further processing in a image processing system. Figure 1.2-25 shows a scanner for producing color separations, such as the ones for a four-color print shown in figure 1.2-26.

Fig. 1.2-25 Drum scanner for image capture (Tango, Heidelberg)

Platemaking

The task of platemaking is to assemble text, pictures, and graphics into pages and pages into sheets. Since the printing formats of most printing presses are essentially larger than the page format of the printed product, several pages are almost always printed on one sheet. The next step is to produce the plate for the particular printing technology.

The image carriers used for letterpress printing were traditionally made by combining blocks of text (consisting of individual letters or lines that were prepared in typesetting) and the blocks from reproduction to produce large metal forms. The platemaking for letterpress printing "flexography" is discussed in detail in section 2.3.3.

For offset printing the process films (text, graphics, and pictures) in accordance with the page arrangement are first mounted onto a film in the size of the printing format (offset assembly). The assembly then serves, at the subsequent stage for the purposes of photographic image transmission onto an offset plate in a contact method (offset platemaking). At the next stage the plate

Fig. 1.2-26
Color separations for four-color printing (Heidelberg)

serves as the image carrier for the offset press. In every printing technology a plate must be produced for each color to be printed.

Figure 1.2-24 shows how conventional methods (film assembly) as well as computer systems are used for artwork preparation (text, image, graphics) in prepress. Figure 1.2-27 shows how film assembly is set in the copying frame for platemaking in conventional copying process. Both films or plates can also be exposed using digital systems directly based on digital data, as is explained later.

For gravure printing, so-called Helioklischographs have been in use since the 1970s to make printing plates. Here, the films are mounted on the copy drum and the signals produced by an optoelectronic scanning head are transmitted to control an engraving stylus. This simultaneously engraves the image onto a copper cylinder which serves as the image carrier for gravure printing.

Fig. 1.2-27
Positioning of the film assembly in the copying frame for platemaking (Heidelberg)

Digital Prepress

Through innovations aimed at achieving digital prepress, an evolutionary change has taken place since the end of the 1980s in prepress which has almost entirely eliminated the classical division into the three areas of composition, reproduction, and platemaking.

During the 1980s, desktop publishing (DTP) became a serious alternative in prepress. This came as a result of the development of personal computers (PC) with full graphic capacity (e.g., Apple Macintosh), workstations, professional layout, graphic, and image processing software, the page description language PostScript, and high-resolution laser imagesetters with raster image processors (RIP).

Desktop publishing means that the capture and editing of text, the capture of pictures (scanning) and their editing, and designing of graphic elements, as well as the completing of pages (layout) can be carried out at one computer station. Used together with an output unit (imagesetter) the PC can also carry out color separations and screening of the finished pages, so that the whole page is exposed on a film (full-page film).

Obviously there are also programs for the digital sheet assembly which take over imposition and the positioning of printing aids (register marks, cutting

marks, etc.). With the help of a large-format imagesetter, films can also be produced in the format of the printing press. *computer to film technology* is the state of the art.

At the beginning of the '90s DTP took over the prepress almost overnight and has now almost completely replaced the specialized composition and image editing systems as well as photomechanical reproduction. Since around 1995 (even earlier for gravure printing), *computer to plate technology* (CtP) has played an increasingly important role. CtP means that the printing plate is imaged directly and the intermediate step of imaging a film is abandoned. In gravure, the cylinder is directly engraved using digital information. A further step in the production flow is therefore eliminated and ultimately all the prepress steps are carried out from a single computer workstation. There are already offset printing presses that use integrated exposure units to expose the plates in the press (direct imaging). Since no film is used in CtP, a previous proof must be made digitally, usually in the form of a proof print on a special dye sublimation, ink jet, or thermal printer.

Figure 1.2-28 shows how a full-page film is made in digital prepress with a computer to film unit and laser imaging of the film. Figure 1.2-29 shows how the printing plate is produced directly from the database of the digitally described printing sheet.

These technological changes in prepress have also brought about fundamental changes in the types of job offered in prepress. The tasks of the three classical occupations of compositor, reproduction technician, and platemaker can today be carried out at one work place by a single skilled worker. This was taken into account in Germany in 1998, when a new course training candidates to become "media designers" (see sec. 13.1.2) was created. After successful training the media designer is proficient in all prepress processes. Consequently, it is considered by many to be the most demanding occupation in the graphics industry.

Thanks to DTP practically any author or graphic artist who has access to a PC and the appropriate software can perform at least some of the steps involved in prepress. Although this has opened up many opportunities to individuals, it has, unfortunately, also resulted in an increasing flow of poor-quality printed products flooding the market. The creation of printed products by computer requires not only mastery of the program used and the necessary typography and design know-how, but above all an accurate understanding of the subsequent printing and finishing processes. It is usually only trained experts who are endowed with this expertise.

Fig. 1.2-28
Full-page film output on a computer to film system (Herkules, Heidelberg)

The diagrams in figure 1.2-30 show the process of evolution in prepress from the individual steps of composition, reproduction, and assembly to an integrated process for platemaking.

1.2.3 Printing

Printing is described as the process of transferring ink onto paper (or another substrate) via a printing plate (fig. 1.2-31). In the course of the centuries many different printing technologies have been developed and these can be divided into four main technologies according to the type of image carrier used as shown in figure 1.2-32.

In section 1.3 (and in particular in chaps. 2 and 5) the different printing technologies are dealt with in detail. In section 1.6 printing presses and systems are described in detail. First, a short overview.

Letterpress (Relief) Printing. Here, the printing elements (letters, lines, dots, etc.) are raised. When the printing plate is inked, the ink adheres to the raised (printing) parts and is then transferred under pressure onto the printing substrate. The main examples of this printing technology are *letterpress* which, until a few decades ago, was the dominant printing technology and *flexography* which, by the middle of this century, had started to be used more and more in packaging printing. With traditional letterpress

Fig. 1.2-29
Computer to plate system for digital imaging printing plates (Trendsetter, Heidelberg/Creo)

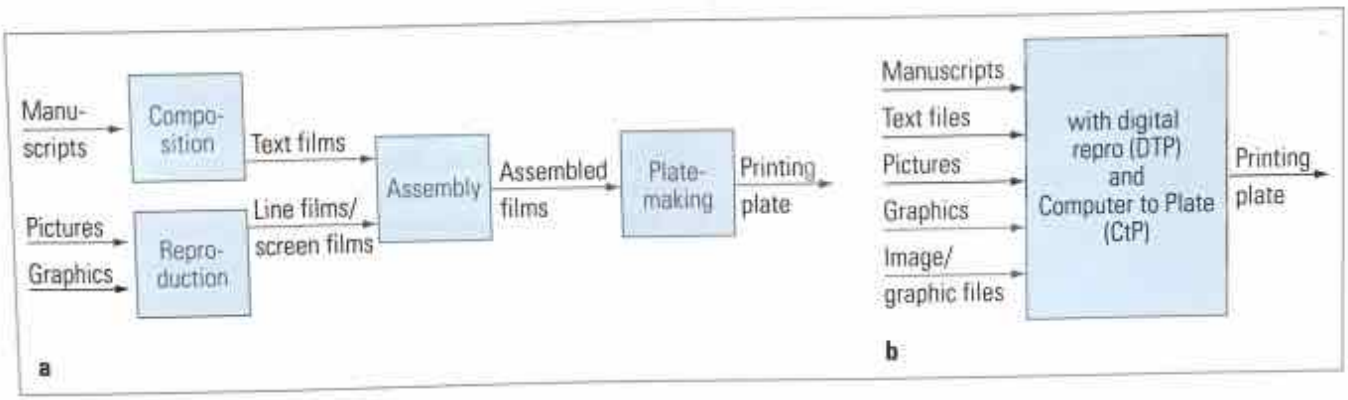


Fig. 1.2-30 Evolution in prepress through digitalization of the processing sections.
a Conventional prepress (around 1980);
b Digital prepress (around 1997)