

# POCKET PAL

A GRAPHIC ARTS PRODUCTION HANDBOOK



INTERNATIONAL  PAPER

# foreword

Ever since its debut in 1934, the *Pocket Pal* has been an authoritative introduction to the graphic arts for many artists, designers, publishers, advertisers, students and buyers of printing. Acclaimed by many as the best publication of its type, *Pocket Pal* is now in its 17th Edition as International Paper has continued to strive to keep its content current and accurate.

At the time of *Pocket Pal*'s first edition, the term *printing* meant *letterpress*, and *lithography* and *gravure* were fledgling processes used mainly for special purposes or to imitate letterpress at lower cost. In the more than 60 years since the first edition, the situation has changed dramatically. Now the word *printing* encompasses not only all the graphic arts but also all the graphic communications and digital printing processes that output hard copy or print on paper or other substrate.

This 17th Edition is the fifth since 1983 when digital imaging beyond electronic typesetting and scanning began to exert a major impact on prepress operations. Since the 15th Edition in 1992, updated in 1994, digital printing has become a major factor in reshaping the future of printing. This edition attempts to put conventional and digital printing into proper perspective. It describes the conventional printing processes and the new digital printing systems, and what impact the new systems are having on the present and future uses of and markets for printing.

The new information for this major revision has come from many sources and authorities. The editor thanks these for their contributions to this edition. In particular, he wishes to commend Frank Romano, Melbert B. Cary Professor of Graphic Arts, Rochester Institute of Technology for his updating and reorganization of the typographic section, revision of the digital prepress section, and help with the new digital printing section.

Michael H. Bruno  
Graphic Arts Consultant  
*Editor*

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# HISTORY



## INTRODUCTION

Printing is a means of graphic communications. It is the reproduction of quantities of images mostly on paper which can be seen or perceived visually. Regardless of the great number and variety of printed products they all have one thing in common: each has a visible image produced in quantities of one or more.

Printing and publishing is a big business in the U.S.A. which altogether represents about 3 percent of the gross domestic product (GDP). Among all U.S. manufacturing industries, it ranks first in total number of establishments — more than 60,000 — with about 80 percent having fewer than 20 employees. In 1996, there were almost \$300 billion in shipments, including printing for packaging, in-plant and quick printing.

Today's printer owes much to the Age of Science, particularly to electronics, computers, chemistry, optics and mechanics. Modern printing has become highly sophisticated. As new pre-press systems, lasers, plates, presses, inks, papers, electronic controls and digital imaging and printing systems have been developed, printing has gradually been transformed from an art to a science.

## THE EVOLUTION OF PRINTING

Man's earliest known attempt at a visual record of his life and times dates back 30,000 years. These were wall drawings called pictographs, superseded by the more complex ideographs. They in turn were succeeded by the Persians' cuneiforms, and then by hieroglyphics, perfected by the Egyptians around 2500 B.C. Ten centuries later, the Phoenicians used the first formal alphabet. These were all art forms and not printing, which is the reproduction of art forms in quantity.

Evidence of the first example of printing from movable type was discovered in 1908 by an Italian archaeologist on the island of Crete. He found a clay disc in the ruins of the palace of Phaistos in a stratification dated about 1500 B.C.

Printing from movable type appeared in China and Korea in the 11th century. In 1041, a Chinese, Pi-Sheng, developed type characters from hardened clay. They were not wholly successful. Type cast from metal in Korea was widely used in China and Japan, and by the middle 1200s type characters were being cast in bronze. The oldest text known was printed from such type in Korea in 1397 A.D.

Half a century later in 1440, probably unaware of the crude type developed in the Orient, Johannes Gutenberg introduced to the Western world his invention of printing with ink on paper, using movable cast metal type mounted on a converted wine

press. Until Gutenberg's invention, all books were laboriously handwritten by scribes. Little wonder that historians credit his invention of printing as coinciding with the end of the Middle Ages and the beginning of the Renaissance and Modern History.

Paper and printing ink were not new when Gutenberg's type appeared. A Chinese, Ts'ai Lun, is credited with the invention of paper in 105 A.D. By the time Gutenberg was born, papermaking was a well-developed industry throughout the Western world with paper mills existing in Spain, France, Italy and Germany. The Chinese also led the world in making ink for printing. Wei Tang perfected an ink for block printing using lampblack in 400 A.D. Viscous or tacky inks, essential to printing, were already in use in Germany for block printing and for stamping titles on manuscript bookbindings. To Gutenberg we credit the invention of combining movable cast metal type, ink, paper and a press to produce printing that changed the world in the middle of this millennium.

## TYPE BEGINNINGS

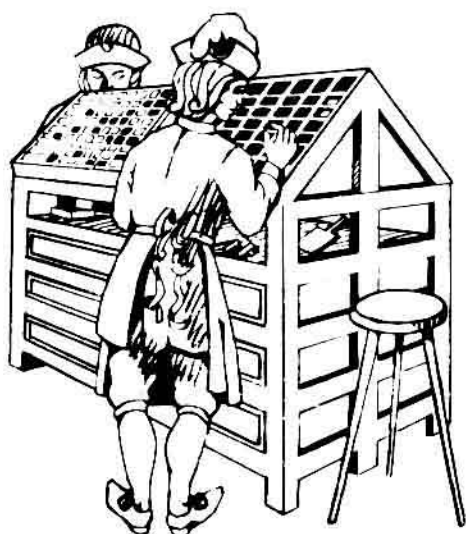
Our common typefaces are either imitations of early handwritten letters or represent a modification of early typefaces which, in turn, were modeled after the lettering in manuscript books.

The standard *Roman* lower-case letters and capitals assumed their current form about 1470 in a face cut by Nicolas Jenson. While Jenson, a Frenchman, learned printing in Germany, he did his first printing in Venice, Italy. The letters inscribed in manuscript books by Venetian monks were Jenson's models. His types served as a pattern for later faces. Jenson was not the first to use Roman letters, but he must receive credit for developing a beautiful face upon which no later designer has been able to improve significantly. Typefaces similar to Jenson's models are often called Venetian types.

The first books in Europe were printed in block-letter or *gothic* type. They were designed to imitate the style of letter used by religious scribes living in the vicinity of Mainz, Germany, where Gutenberg began his printing activities. John Fust and Peter Schoeffer, who entered the printing field through business relations with Gutenberg, continued to use the gothic letter form. Thus, it became firmly established in Northern Europe.

To avoid confusion, it must be pointed out that the term "gothic," as used by some modern type founders to designate sans serif types, has no relation to gothic as a description of early typefaces. Gothic, as a term applied to architecture and other forms of art, designates the style characteristic of Northern and Western Europe from the 12th to the 16th century. It is in this sense that gothic is also applied to letter forms.





Roman Type

a

Gothic Type

ā

## ROMAN LETTER DEVELOPMENT

The manuscript hand of the Venetian scribes, which Nicolas Jenson followed as his model, developed apart from gothic lettering. It had evolved from Roman capital letters. In formal writing and inscriptions the early Romans used square capitals, with slight modifications, in the form of our upper-case alphabet. For correspondence and documents not requiring formal writing, large cursive or running capitals were used.

Many national styles in writing developed as learning was carried from Rome throughout the rest of the known world. The influence of the Roman characters might have been lost, however, had not Emperor Charlemagne taken an interest in the revival and spread of ancient learning. Charlemagne encouraged the establishment of a school at Tours by an English scholar named Alcuin. The calligraphy of this school became the model for the rest of Europe, and the introduction of what is now called lower case.

By the 10th century, the use of letter forms from which we derive our lower case was quite universal. However, these letters did not assume the fixed form with which we are familiar until they were cast in type by Jenson.

## ITALICS AND DISPLAY TYPES

Practically all Roman typefaces in common use today have accompanying *italics*. This was not true of early Roman faces. Jenson, for example, did not produce *cursive* type; italics were a separate development.

Italics were first used to print small, compact books. Early books were large and cumbersome, and gothic type used in these books was large. When Roman type came into use, it was cast smaller than gothic, and letters and lines were fitted more

closely. But even this economy in page size did not satisfy Aldus Manutius, a Venetian printer around the turn of the 15th century. Sensing a growing trend for cheaper books, he tried to meet the demand by cutting a font of type to imitate the informal handwriting of his time. Aldus called this type *Chancery*; his Italian contemporaries called it *Aldine*; but in the rest of Europe, the face was called *italic*. This latter designation has continued in use to the present time.

Display types of today are difficult to trace historically. All were derived from hand-drawn letters. They may have been specifically drawn as a type-design or developed from a letter drawn for another purpose.

## EARLY PRINTING IN ENGLAND

Early printing in England is interesting because it was through England that printing came to the American colonies. Printing was introduced in England about 1476 by William Caxton, who brought equipment from the Netherlands to establish a press at Westminster. Among the books issued from Caxton's press were Chaucer's *The Canterbury Tales*, *Fables of Aesop* and many other popular works.

The predecessor of the modern Oxford University Press was established in 1585. Since that date the press has operated continuously, probably the longest period of any printing establishment in history.

Richard Pynson, who printed in England during the latter part of the 15th and early 16th centuries, is believed to have been the first to introduce Roman types in England. John Day, who began printing on his own account in 1546, was the first English designer of a Roman typeface.

## TWO FAMOUS ENGLISH TYPE DESIGNERS

William Caslon, born in 1692 in Worcestershire, was destined to change the appearance of English printing through the design and casting of a new typeface. Not only is Caslon type still used, but his style of design is still consciously or unconsciously followed by many contemporary typographers. An axiom of printers with a type problem is, "When in doubt, use Caslon!" Although Caslon's letters are not perfect in themselves, a page of Caslon type produces a simple, pleasing and balanced effect.

The English printer and typographer, John Baskerville, born in 1706, is regarded by some students of printing history as the father of fine printing in England. Baskerville, after having accumulated a fair-sized fortune in other fields, established a paper



mill, printing office and type foundry at Birmingham in 1750. Baskerville spent several years experimenting with designs for type. He also tried to improve the surface of sheets of paper by pressing them between hot plates after printing, and he mixed special inks which were used in producing his first book. Consequently, when he offered his first printed works to the public around 1757, they gained wide acclaim.

The types designed by Baskerville are usually considered to represent a halfway step between the *old-style* Roman letter which Caslon so clearly exemplified and the *modern* style of Roman letter which is best illustrated by the face developed by the Italian printer, Bodoni.

## EARLY PRINTING IN AMERICA

Printing was used to promote colonization of the New World. On file in the New York Public Library is a copy of such a promotion piece dated 1609. It is entitled, "Offering Most Excellent Fruites by Planting in Virginia." One historian, observing the fact that 750 of the first 900 settlers in the Virginia colonies died during the first winter, marvels at the force of the printed word. It not only induced new settlers to come to the New World, but also influenced the 150 survivors to remain.

The extent to which printing was used in promoting the New England colonies is not known. The first printing press made its appearance in Massachusetts in 1638, soon after the first settlers established themselves. The first piece printed on the new press was *The Freeman's Oath*. The *Bay Psalm Book*, 11 copies of which are still in existence, was produced in 1640. It was printed on an early colonial press procured in England by Rev. Jose Glover. When he died on the voyage to America, his wife assumed responsibility for setting up the press in Cambridge. Stephen Daye, who had been indentured by Glover to operate the press, was placed in charge and, with his son, Matthew, continued its operation until 1647.

In the meantime, Glover's widow was married again, this time to President Dunster of Harvard College. Upon her death the press was moved to Harvard and used in close association with the college. In a sense, this represents the beginning of Harvard University Press, the oldest continuously-operated printing activity in America.

Printing did not make headway in the southern colonies to the extent that it did in the Massachusetts colony. By 1770, there were at least a dozen printers in Boston. By 1763, there was a press in operation in Georgia, the last of the 13 colonies to be settled. Printing came to Kentucky, Tennessee, Ohio and Michi-

gan in the 1780s and 1790s. In 1808, printing had moved west of the Mississippi to St. Louis. Thus, as migration continued west, printing followed.

## TWO PRINTER PATRIOTS

Benjamin Franklin was born in Boston in 1706. As a boy he learned printing in the shop of his brother. In 1723, he quarrelled with his brother and went to New York. Unable to find work, he continued on to Philadelphia where he worked for a French printer named Keimer.

At the suggestion of the governor of Pennsylvania, Sir William Keith, young Franklin went to England to buy a printing outfit. Money which he had been promised was not forthcoming, so for two years he worked in famous English printing plants, including that of William Watts. In 1726, he returned to Philadelphia. By 1732, he had his own printing office and became the publisher of the *Pennsylvania Gazette*. Among his publications, *Poor Richard's Almanack* became the most famous.

Throughout his life, Franklin was active in promoting printing. Although he disposed of his business in Philadelphia in 1748 to devote his time to literary, journalistic and civic activities, he assisted in the establishment and promotion of about 40 printing plants in the colonies. Franklin's high regard for his craft is revealed by the words with which he began his will: "I, Benjamin Franklin, Printer . . ."

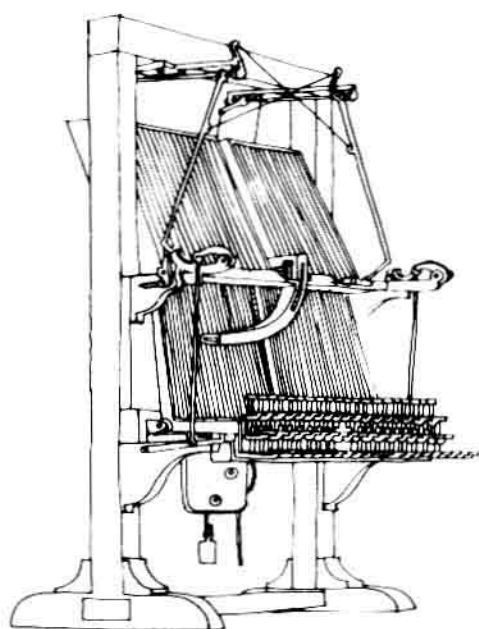
Franklin is not the only printer of the Revolutionary Period who is celebrated as a great patriot. Isaiah Thomas, born in Massachusetts in 1744, was actively engaged in printing early in his life. In 1770, he began publication of the *Massachusetts Spy*, a newspaper in which he supported the cause of the patriots. He served during the Revolutionary War as printer for the Massachusetts House of Assembly. Following the war, he re-established his business, which had been destroyed. As a printer he prospered and became the leading publisher of books in the period following the Revolution. In 1810, he published a two-volume *History of Printing in America* which, even today, remains the best source on colonial printing.

## TYPE AND TYPECASTING MACHINES

For more than 400 years after the invention of printing, all type was set by hand. In the 19th century, men began to consider the possibility of creating typesetting machines. Numerous machines intended to replace hand composition were invented. The first of these was designed by an American, Dr. William Church, in 1822; others soon followed. While many of the first

typesetting machines functioned satisfactorily, none were sufficiently practical for commercial operation until the invention of the linotype by Ottmar Mergenthaler in 1886.

#### CHURCH'S TYPESETTING MACHINE



Of the various metal composing machines developed, only two kinds remained in use. These are machines such as the Linotype, Intertype and Ludlow which cast *slugs* (one-piece fully spaced lines); and the Monotype which casts *individual pieces of type* in justified lines.

The Monotype was invented in 1887 by Tolbert Lanston of Washington, D.C. The Ludlow Typograph was suggested by Washington I. Ludlow in 1906 and later perfected by William A. Reade. Intertype, a later development in 1911, used the Mergenthaler principle. New developments in typographic composition started with phototypesetting, introduced in 1949, followed with electronic typesetting in 1970, and the plain paper digital typesetter in 1985.

### PLATEMAKING BEFORE PHOTOGRAPHY

The first illustrations in books were made from woodcuts. They were tooled out of wood blocks by hand, leaving raised surfaces. The earliest known book using woodcuts was printed by Albrecht Pfister in Bamberg about 1460.

Books printed between 1570 and 1770 were usually illustrated by copperplate engravings, resulting in a decline in the making of woodcuts. In 1770, however, a revival was started by Thomas Bewick of England who developed the technique of using a special engraving tool for cutting *across* the grain, instead of *with* the grain. Today, woodcuts are used only to give an "artistic touch" to certain types of printed pieces.

Engraved copper intaglio plates, the forerunner of steel engravings and gravure, were first used in France and Italy



around 1476. Copper engraving offered competition to woodcuts in England about 1545, and in France about 1569. Copperplate engraving has continued to be practiced through the years and is still used for invitations and announcements.

## PHOTOGRAPHY AND PHOTOMECHANICS

Photography for graphic arts involves the photographic processes and techniques used to reproduce illustrations and art subjects; photomechanics or photoplatemaking, like photoengraving, photolithography, photogelatin, photogravure, etc., is the means of using light sensitive coatings and halftone and line films to make plates and cylinders for printing. The invention and use of photography and photomechanics completed the mechanization of the printing process, made illustrations practical and economical to produce and reproduce, and fostered the phenomenal growth of advertising, periodical, book and commercial printing.

In 1839, the year Daguerre invented photography, Ponton discovered the use of potassium bichromate as a sensitizer, and in 1852, Fox Talbot used it to sensitize gelatin and produced a halftone engraving by laying a screen of fine gauze between the coated metal and a negative of the original picture. This is the first known use of the screen principle which created the "dot pattern" as it is known today. In 1855, Poitevin invented photolithography based on bichromated albumin. Photoengraving developed rapidly in America, and by 1871, it was commercially practicable for letterpress printing. By 1880, photoengraved prints were replacing woodcuts as illustrations in books, magazines and newspapers.

The first commercial halftone screen was produced in 1883 by Max and Louis Levy of Philadelphia. Two years later, Frederick Ives improved on their technique by developing the earliest version of the glass crossline screen. Although the first halftones were black and white, the application of halftones to color process printing was not far behind. The first color process work was printed successfully in 1893, and was displayed at the Columbian Exposition that year.

## DEVELOPMENT OF THE PRINTING PRESS

While hand composition did not change much through the years, a number of changes were made in transferring the impression to paper. Benjamin Franklin worked on a wooden-frame press in the printing office of William Watts in London. This press used a torsion screw for making the impression and was provided with a clever mechanical arrangement devised to