

How'd They Do That: the Evolution of Modern Printing and Copying

In today's world of easily-accessible ways to reproduce documents, from laser printers on the desktop to high speed copiers, it is interesting to pause and remember a time not too long ago when making a copy took considerably more effort. Back then, printing was distinctly different from copying, both in quality of the reproduction and the effort it took to make the copies.

In this issue of *Your Printing and Mailing Resource* we'll recall some of the early machines and technologies that serve as a basis for what has become digital printing. We hope you'll enjoy reminiscing and perhaps learn something you didn't know.

The foundation of modern printing

As a contributor to modern printing, there is no individual of greater renown than Johann Gutenberg. Born in 1398 in Mainz, Germany, Gutenberg is responsible for these innovations in printing technology: movable type; the printing press; molded type; and printing ink. The first book to be printed with Gutenberg's movable type was the Latin Bible, comprising two volumes of 300 pages each. Since each page had 42 lines of type, the Bible today is alternately known as the Gutenberg Bible or the 42-line Bible.

For the next 300 years there were improvements to Gutenberg's innovations but no significant new technologies. Then in 1796, a Bavarian playwright named Aloys Senefelder invented *lithography* (from the Greek *lithos*, meaning *stone*, and *graphia*, meaning *to write*).

Lithography is a type of planographic or surface printing and is based on the chemical principle that oil and water don't mix. To produce the image for early lithographic printing, a slab of stone was ground to a level surface (either a coarse or fine texture). Next the image to be reproduced was drawn in reverse directly on the stone using a lithographic crayon or ink containing soap or grease. The fatty acid of the imaging material interacted with



the lime in the stone, forming an insoluble lime soap that accepted greasy printing ink and rejected water.

Because today's lithographic process produces tones of intense black and light gray as well as a full spectrum of colors, it is used both as an art process and as a commercial printing process. In commercial printing, the term *lithography* is used interchangeably with offset printing, and grained metal or plastic plates are used instead of a stone to carry the image.

The foundation of modern copying

Although printing technology was well developed by the mid-19th century, it was not a practical solution for reproducing small quantities of documents. The use of carbon paper to make more than one copy of a document while it is being written dates back to the early 1800s. After the typewriter was invented in 1868, carbon paper became even more widely used for copies.

In 1887 Thomas Edison and Charles Batchelor invented the mimeograph machine. After using a pen, typewriter, or other device to cut a stencil of the document and mounting the stencil on a desktop rotary press, the mimeograph forced ink through the stencil; up to about a hundred copies could be produced. Later the mimeograph was licensed to the A.B. Dick Company

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who sold a version through the 1970s. Other versions of the mimeograph were developed by Gestetner and Roneograph and an updated version of the technology, called *risography*, is still being sold today by Riso.

The spirit duplicator was invented in 1923 by Wilhelm Ritzerfeld. A master sheet, consisting of a smooth paper master sheet and a paper sheet coated with a waxy compound, was typed or written on. The waxy paper original was discarded and the master wrapped around the drum of the spirit duplicator. As the drum rotated, a duplicating fluid coated the master and slightly dissolved or softened the dye on the master, transferring the image to the paper pressed against the master. The best known brand of spirit duplicator was Ditto.

Even though machines like the mimeograph and spirit duplicator were a marked improvement over using carbon paper to make copies, they could not be used to make a copy of an existing document. That possibility was dependent on the invention of photography. This enabled machines that could take a picture of an existing document and make photographic copies. The drawback to early machines (such as those developed by Kodak, 3M, and the Ozalid division of General Aniline & Film Corporation) is the requirement for special paper because the machines used either heat or light to make the copies. Also, after copying, the paper often curled and was unstable so it deteriorated quickly.

The runaway success in copying technology was the technology developed by Chester Carlson and named xerography by Carlson's partner, the Haloid Company in Rochester, New York. It took ten years to develop a copying machine that really worked but when the Xerox 914 copier was released in 1959, it was an immediate success.

The foundation of desktop publishing

Gutenberg's invention of movable, molded type was refined but not significantly changed until Ottmar Mergenthaler introduced the Linotype line-casting typesetting machine in

1889. Operated from a keyboard like that of a typewriter, the machine assembled brass matrices into a line, cast the line, and distributed the matrices. Line-casting allowed type to be selected, used and returned for re-use automatically. Besides reducing printing time by about 85% and saving a huge amount of labor, the line-casting machines eliminated the need for a large inventory of metal type.

Linotype (and its mate Monotype) machines dominated typesetting until the 1950s. At that time, photocomposition devices (the French *Photon* and Intertype's *Fotosetter*) began to catch on. A photocomposition device uses a film master that projects the characters onto photosensitive paper. Because adjustments in the size of the type are made by lenses, photo composition largely eliminated optical scaling of type.

Starting in 1973, photocomposition began giving way to computer-based typesetting. Early computers each had its own unique command language for communicating with output devices and all had their own font formats. Then in the late 1980s, PostScript began to emerge as the *de facto* standard for digital typesetting due to its powerful handling of graphics and the fact that it was included in the Apple Laserwriter printer. Combining the Laserwriter with a Macintosh computer and PageMaker desktop publishing program pushed PostScript to dominance.

Merging technologies blur distinctions

The universal adoption of digital technology for typesetting, page layout, photography, and platemaking, coupled with new generation high resolution laser printers, has blurred the distinction between printing and copying. This is good news for you, our customers, as it gives us more flexibility to meet all the requirements of your printing project – quality, turnaround time, and cost. For more information about our capabilities, or to arrange a tour of our facility, please contact Jeannette, Louisa or Nancy at 909.981.5715.