



Print Tips

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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 *PrintTips* 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 printing, a slab of stone is ground to a level surface (either a coarse or fine texture). Next the image to be reproduced is drawn in reverse directly on the stone using a lithographic crayon or ink containing soap or grease. The fatty acid of the imaging material interacts with the lime in the stone, forming an insoluble lime soap that accepts greasy printing ink and rejects water.

Because the 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 and up to about a hundred copies could be produced. Later the mimeograph was licensed to the A.B. Dick Company 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 photo-composition 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 Robin Smucker or Cary Bowman, sales representatives.

words

a vocabulary of the graphic arts

Continuous tone: images that have a virtually unlimited range of color or shades of grays. For example, photographs and television images are continuous-tone images.

Four-color process: printing in full color using four color separation negatives (yellow, magenta, cyan and black).

Lithography: also known as *planographic printing*. A method of preparing a printing surface so that ink will adhere only to parts of it.

Half-tone process: a continuous tone image that has been converted into a black and white image. In conventional printing, halftones are created by photographing an image through a screen. Desktop publishing systems create halftones by simulating the conventional photographic process.

Photolithography: also known as *offset*, *litho-offset* and *offset lithography*. The most widely used form of planographic printing in which a rubber-covered cylinder is between

the printing (or *plate*) cylinder and the impression cylinder. The plate cylinder transfers the image to the rubber (or *blanket*) cylinder which in turn offsets the image on to the paper carried by the impression cylinder.

Process: a general term used to describe the photo-mechanical process by which illustrations are reproduced in printing. See *half-tone process* and *four-color process*.

Q. What is dithering and how does it differ from line art and gray scale?

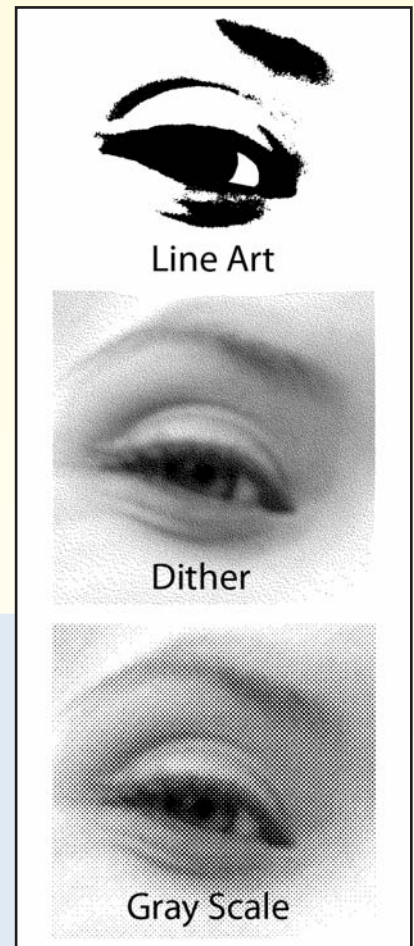
A. *Dithering* is the term for creating the illusion of new colors and shades by varying a pattern of dots. Look at the differences in the illustrations:

In the first example, called line art, the image is created with black and white lines only. Type, solid black and white logos, icons, or pen and ink drawings are all examples of line art.

In the second example, *dithering* has been used to create the illusion of tones of gray by varying the pattern of black and white dots. If you look closely, you will see that in fact, there are no gray dots. The greater the number of dither patterns that are used, the more shades of gray that can be represented.

Finally, the third example demonstrates *gray scale* in which individual dots may be different shades of gray. In conventional printing, gray scale, which is known as *half toning*, is produced by photographing an image through a screen. The *screen frequency*, meaning the number of lines per inch, determines how many dots comprise each gray dot.

Desktop publishing systems create conventional printing half tones by simulating the photographic process and may allow the user to specify a screen frequency even when no actual screen is being used.



Using End Marks

Newsletter editors may appreciate this tip: to add a nice touch to the articles or stories in a newsletter, use an end mark at the end of the text. An end mark is a small graphic element that clearly notifies the reader that the end of the article or story has been reached.

Look at your favorite literary journal or scholarly magazine to find an example of an end mark. It could be a geometric shape such as a circle or square; a decorative element; or even a small rendition of the publication's logo or identifying mark.

If you'd like to try an end mark in your

publication, a good source is a collection of dingbats. A *dingbat*, also known as a *printer's ornament*, is a font composed of symbols and shapes instead of alphabetic or numeric characters. One of the best known dingbat fonts is Zapf Dingbats, designed by the famed typographer Hermann Zapf. Other dingbat fonts you may be familiar with are Wingdings and Webdings.

To place an end mark, position it on the baseline of the type, or center it against the type. Within any single issue of your newsletter or publication, keep the end mark consistent (though you can vary the end mark with each issue if you wish).

The New Apprentice in 1904

A poem by Frank Granger

I like this printing job I just got.
But there are things I wish were not.
For example, some task
assigned just today
Were useless work, I'd hazard to say.
"A paper stretcher!" the pressman
did call,
"You might find one over by the wall."
I looked and looked, but couldn't find it.
Later he said to never-mind it!

But the engraver needed
some halftone dots,
And by the paper drill I found
lots and lots!
The Linotype man was very concerned.
He had a serious problem,
I later learned.
The type lice had invaded our shop
And I was sent out and told not to stop
Until I had warned every printer near,
Which I did and then came
right back here.

Note: *Good-natured tricks were commonly played on the novice printers – "paper stretchers" and "halftone dots" were common. Type that was not cast at the right temperature had tiny pinholes and "type lice" were blamed. A printer's "pi" was a jumble of type. Pi Sheng was the first inventor of printing in China over a thousand years before Gutenberg. It is thought that printers honored Pi by naming odd type characters and jumbled letters after him.*

I got back just a little bit after lunch
A little too late, I had a hunch.
Because the "pie" they said
I could clean up
Was all gone and all I got was
to pick-up
Some jumbled type spilled on the floor.
It was a tedious job and quite a bore.

When I went for the poke-a-dot ink,
I thought I saw the foreman wink
At the guy needing the
left-hand wrench,
Which was supposed to be at the
bindery bench.
Yes, they sure keep me on the run,
But, I don't mind since I am having fun,
And our shop is a right friendly place.
When I come in there's a
smile on every face.

PRINT. IT WORKS.

There's nothing experimental about print. It just works.

Whether direct mail, branding materials, investor relations or your corporate identity, a well-printed piece makes you look your best. Give them something tangible to keep your message top-of-mind.

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