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A TAPESTRY OF CHANGE

PRINTING TECHNOLOGY AND PUBLISHING IN THE NINETEENTH AND TWENTIETH CENTURIES

A Dissertation
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Temple University Graduate Board

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in Partial Fulfillment
of the Requirements for the Degree
DOCTOR OF PHILOSOPHY

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by
Richard P. Moses
May 1998

ABSTRACT

A TAPESTRY OF CHANGE

PRINTING TECHNOLOGY AND PUBLISHING IN THE NINETEENTH AND TWENTIETH CENTURIES

Richard P. Moses

Doctor of Philosophy

Temple University, 1998

Major Advisor: Morton P. Levitt

The nineteenth and twentieth centuries have been the scene OF explosive technical changes in bookmaking: typesetting by Linotype; power cylinder presses, offset lithography; machine-made paper; mechanical binding techniques, the application of both photography to the printing processes of letterpress and lithography; computer applications for both control and actual production--all have completely changed the face of bookmaking since 1800.

Coincident with the introduction of process changes came changes in publishing which reordered author-publisher-printer-bookseller relations. Printers and booksellers became specialists in their fields, publishers found a new interface between author and reader as they concentrated on securing manuscripts and marketing.

As a part of the publishing process, printing changes enabled publishers to lower costs, to develop new markets for wider readership well beyond the scope of the Book Trade alone, with an annual torrent of about 45,000 titles in America alone, and in many formats tailored to specific markets.

The nineteenth century was a time in the Graphic Arts when machines and steam power brought changes to the publishing process--more books sold, more titles published, broader readership, new entertainment.

Publishing in the twentieth century has become a highly sophisticated manufacturing business and less and less reflective of the literary canon, using modern merchandising methods to move books off shelves into readers' hands. Merchandisers are now marketing books at any place where retail traffic can be expected; and publishers and printers use the most modern merchandising tools and methods to keep books in stock for sale, such as including bar codes on every book for inventory control, computerized accounting, and aggressive pricing, as well as new communication technology on TV and on the computer web. It must be remembered, too, that it has become clearer that the major competitors for book sales are not other books, but other media; increasingly books are priced based on their own costs, not on what similar books are selling for. Manufacturing methods are central to the merchandising equation as well, by ensuring availability of stock for sale at the right price, using modern and efficient machines and processes.

TAPESTRY

A heavy, handwoven
reversible textile
used for hanging,
curtains . . . characterized by
complicated pictorial designs

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PREFACE

This paper embarks on a difficult task--relating two centuries of technical explosion in printing to the similar explosion of authorship and publishing over the same period. There is, moreover, a very human element in this study--the writer's own involvement in a professional life of over fifty years of dealing with both book publishing manufacturing and with printing. Many events which should normally be documented solely from scholarly research have occurred within the writer's own experience or observation; thus, this might be viewed in part as a lengthy interview, using various materials to validate personal experiences and observations. For example, when his career began in 1940, the Linotype system was barely fifty years old and was a rock-hard foundation for all printing; yet less than thirty years later, in 1968, no hot-metal typesetting machines were built anywhere in the world, and none has been built since. The lifetime of this basic technology was shorter than the life expectancy of a present-day American male.

On occasion, the author uses an anecdote from his experience to illustrate a point. Generally, these are reported in the first person in a footnote, rather than in the text itself.

Original data on printing developments are mostly in patent applications, manufacturer catalogues (when available), and corporate histories. Authorial information is largely in letter collections and biographical allusions. The combination of these sources turns one quickly to use secondary sources in which accuracy may be subjective. Not surprisingly, lovers of printing have written about each segment of the industry--these are invaluable sources of data, and as far as one can tell, they are accurate. There is also the American Printing History Association, whose journal Printing History opens many tantalizing windows.

Illustrations have been chosen to point to a key mechanical application, such as a diagram of a perfecting press, or the making of type by hand; to identify a particular historical process, as hand paper-making; or to illustrate a part of the developing processes of the Graphic Arts, such as the use of wood engravings both as an art form and as an associated technology.

Fortunately, too, most of the inventors were anxious to protect their inventions and patented their work, and, in addition, the same data can turn up from several directions. (We know, for instance, that the first power cylinder press produced the November 29, 1814 issue of The Times, since the paper reported the event in an editorial on that date [Moran: 108].) Industry histories are generally accurate, and cross-checking of important dates can establish them precisely. Thus, this paper relies both on the writer's own recollections and on significant secondary sources.

CHAPTER 1
INTRODUCTION

This work is about change: first, about basic changes which profoundly affected communications, and then, about the incremental changes which refined and improved them. It is useful to imagine Johann Gutenberg returning in 1800 and finding how little had changed in print shops since 1450; but, were he to return today, the levels of both technology and of change would be overwhelming. It is also fashionable today to point out that Pi-Sheng in China had already used hardened clay types in the year 1040, and that the Koreans were using crude sand-cast bronze types two centuries later. However, there is no evidence that word of these efforts had ever reached Gutenberg in Mainz in the mid-1400s (Bruno: 8-9).

Gutenberg's particular contribution in 1435 was to combine successfully several existing techniques into his new and different means of communicating. It has been said that he was trying to reproduce in printing a manuscript hand as elegant as that of the monastery scribes. That monumental effort demanded that he develop a paper as effective as the scribes' vellum, create an oil-based ink as dense as the water-based inks of the scribes, modify an existing wine press design to press a sheet of paper against his inked type, and create a type-casting technique using a new alloy of lead, tin, and antimony. This last step was helped, no doubt, by his being aware of die-making and metal casting at the local mint in Mainz (Moran: 18). His *42-Line Bible* and other church materials were fine examples both of a successful technology and of printing. The fact that his techniques lasted essentially unchanged for over three centuries testifies to their soundness (McNeil: 620-621).

Between Gutenberg and 1800 there were few developments in printing technique. The first one was a plaster-molded platemaking method patented in 1725 by the Scot William Ged, in which a plaster mold of the type page was filled with type metal and, after trimming to size, the resulting plate could be used in the press form in place of the type itself, thereby avoiding both the necessity of resetting the work for reprints and releasing expensive type in chronically short supply. Unfortunately, this technique soon withered when printers refused to use the plates, saying that they would take resetting work for reprints away from compositors.

At the end of the eighteenth century, however, the ingenious Earl of Stanhope developed three improvements in the printing process, sparking the drive in the new century to bring printing into line with the developments of the burgeoning Industrial Revolution. First, he added a system of levers to the screw linkage of the hand press, creating a heavier and more even pressure by the press platen on the form and at the same time reducing the amount of muscular effort needed to move the operating handle, enabling the production of a better product with less fatigue. Although printers found the Stanhope press far less tiring to operate, production did not increase beyond the level of about 250 sheets an hour.

Stanhope's second achievement was to build presses out of cast iron, replacing what was essentially heavy wooden furniture; although the combination of already heavy pressure on the platen and the improvements in lever action cracked metal frames, printers quickly perceived the advantages of metal presses in rigidity, durability, and quality production.

A third improvement was to develop further Ged's plaster molding process, and by 1784 Stanhope had so improved and stabilized it that it came into general usage (Steinberg: 27) (One might speculate that the nascent growth of printing and publishing markets brought about enough work to keep printers busy).

In this introductory chapter we will note quickly the seminal developments starting at this hinge of change, postponing an examination of their technology and impact to later chapters. There have been two transforming periods of development: the application of steam power to printing machines (mostly presses) in the early 1800s, and the explosive development of computers in the late 1900s, which impacted printing at all levels--typesetting, control, communications, quality, and enhanced productivity. Many events in these periods were incremental, further modifying already developing techniques; others replaced them, or led a leap forward. Although some changes occurred early in the nineteenth century, there was a steady stream of changes and improvements throughout the century.

At the turn of the century, there were other major developments outside the print shop which, when ultimately put to use, remade the printing process almost overnight. In 1796, Louis Robert patented his paper-making machine, created for the powerful Didot family in France, but developed, underwritten , and patented in England in 1802 by the Fourdrinier brothers, who gave the machine their name. Then, in 1798, Strasburger Alois Senefelder discovered the oleophyllic/oleophobic principle of lithography. Thus, changes were coming to printing (and to publishing, too) which would alter all the ways of communicating information. And, coincident with them came fundamental changes in society as it was remade by the Industrial Revolution through applying power, better metalworking, social change, new markets. The application of steam power to machinery, which was occurred in printing in 1814 with the first Koenig & Bauer cylinder press at *The Times* in London, highlights the growing mechanical complexity of the printing processes.

It is unlikely that the precise machining necessary to build these increasingly complex machines would have developed so quickly without new methods of accurate measurement; the first micrometer was created by James Watt in 1795, and the more precise micrometers of Henry Maudsley were not developed until well into the first decade of the 1800s, only then enabling easily inter-changeable parts machined to close tolerances. The ongoing development of printing and its technology can be understood only in the context of the changing society around it. Powered production machinery, such as fast printing presses profoundly changed the relationship of workers to their employers; the role of the generalist printer artisan, working on a single press in a storefront shop, and selling books, paper, broadsides as well, changed to his being a specialist "machine-minder" using a machine furnished by a master, in a factory building owned by that master. These forces, together with rapid changes at all levels of printing technology, made 1800 a hinge of change for printing.

Any discussion of printing must be prefaced by definitions of the major printing processes available. Reaching back to Gutenberg and earlier is the long history of printing from raised type, called letterpress printing, in which the surfaces of the raised type characters are inked and paper is pressed against them. The second major process, developing slowly across the nineteenth century, was lithography, sometimes called "planographic printing," as the inked image is on the surface of a metal plate, and the non-printing areas are moistened, repelling the greasy ink; today the process is known generally as offset lithography, as the image is transferred (offset) to a rubber blanket and thence onto the paper. A third process, whose application is generally limited to extremely long press runs and need not concern us here, is gravure, in which an almost liquid ink is trapped in microscopic wells below the surface of a copper cylinder and is drawn onto the paper by capillary action. Finally, in screen printing, used for short runs and also not a concern here, a paint-like ink is squeegeed through a stencil on a metal or nylon screen, creating an image of the stencil on the sheet of paper below. The nineteenth century was a period of steady improvement in the basics of printing technology: larger, faster presses, machine-made materials, improved and less costly papers, mechanical typesetting, lithography, photography, engravings and color printing are some of the developments which occurred across the century. As these new techniques became available, they affected, directly and indirectly, publishing and authorship.

Spread across the nineteenth century was a steady moving sequence of change; but in the first half of the twentieth century, somehow major change was largely dormant; since World War II, however, the printing and publishing worlds across the globe have seen profound changes. Many of these have come from developments in the printing plant; others have been enabled by new processes, as well as by corporate consolidation and market forces.

Essentially, virtually all the major developments in printing across the nineteenth century were continuing refinements of letterpress, or raised-type printing. It was not until the end of World War II that radically new technology made obsolete nineteenth century developments. As publishing markets expanded with paperbacks, book clubs, mass-market sales, conservative book manufacturers were forced to invest in new high-speed, advanced technology machinery, as well as in corporate combinations to generate the multi-millions of dollars to put into such equipment.

Just as Gutenberg's use of paper enabled him to move ahead with type and press in the fifteenth century, another stage was set in 1800 for machine-made paper. Robert's machine generated a major increase in paper output - from a production of 60 to 100 pounds of hand-made paper a day to 1000 pounds daily by machine (Steinberg: 178); too, machine-made paper was more uniform in size and thickness, allowing better presswork.

Two other developments whose major impacts were long delayed were lithography, discovered in 1798 by Alois Senefelder, and photography, first used in 1837 by Josef Nicephore Niepce. However, the fundamental physics and chemistry of their application were not known until late in the nineteenth century, postponing widespread application of these two processes until then.

Ottmar Mergenthaler's Linotype of 1888 was the first really practical complete typesetting machine, although one had been patented as early as 1822 by Dr. William Church (but never built). Later chapters will deal with changes in major areas of the Graphic Arts: first, with presses and paper and their continuous stream of modifications; second, with typesetting; third, with binding as it developed from a local service for binding a reader's number sheets into a finished book through today's mechanization; fourth, with illustration, particularly photography, and the way in which illustrative material in books changed from working with crude wood blocks in 1800 to sophisticated color process printing today; fifth, with lithography, which exploded late in the twentieth century to give a totally new face to printing and publishing; and finally, computerization, substituting for typesetting on the one hand and providing precise controls on all sorts of mechanical and managerial tasks on the other.

The graphic arts community has remained remarkably stable over the nineteenth and twentieth centuries. Initially the roles of publisher, printer, and bookseller were gathered under the same hat, but as time went on, roles sharpened, and today only one publishing group in America, Doubleday, is publisher, printer, and bookseller, with its Dallas, PA, Berryville, VA, and Hanover, PA plants, its many publishing imprints, and its galaxy of book clubs.

More important than this role-shifting, however, is the mix of books published, both then and now. Literature (fiction, poetry, essays) has always represented only a fraction of publishing production: Bibles, religious works, books for subscription sale, school and college text books, medical texts, scholarly publications have always shared the publishers' lists. Popular literature is rarely as profitable as it seems--the demands on the firm to stay ahead of sales create deep strains in meeting those needs. A truism of the business has always been that a publisher is known by its backlist, books that sell regularly and reprint just as regularly.

Typically, in 1994, publishers in America produced some 45,000 titles, only 5000 of which were fiction and popular writing. The publishing climate of 1800 was vastly different from today's in almost every way. Altick points out that early in the nineteenth century the usual run in Britain for a serious book was 750 copies (Altick: 263); today, with proper promotion and subsidiary sales it can run into millions of copies in varying formats. It seems obvious that serious readership was limited not only by general levels of literacy, but by the production capability of the industry as well, using archaic muscle-powered slow machines, reflecting as well the social climate which feared too much knowledge in the minds and hands of the working classes.

Just as printing was developing from a craft to an industry in the early nineteenth century, so was publishing changing. Authors had little choice but to sell the copyright to their works to publishers for a flat sum, either for a period of years or in perpetuity. And with such a sale, the author effectively abdicated any rights to the text.

Jane Austen reported that "profits" from her books published before her death were less than £700 (J.E. Austen-Leigh: 103). The detailed story of Austen's dealings with publishers is a fine commentary on the literary climate early in the century. Later, George Eliot's experiences were different, with her books bringing her a comfortable living and widespread recognition. Austen sold the rights to her first novel, Susan, to Richard Crosby for £10; and when pressed to publish it, he replied arrogantly that no publication was stipulated, that he was not bound to publish it, and he threatened to sue anyone else who did. She did buy her copyright back years afterwards for the same £10, and the novel was published by James Murray as *Northamger Abbey.* One can only hope that Crosby was at least somewhat discomfited when he learned after he had sold the book, that it was by the author of *Pride and Prejudice*.

Between then and 1872, when George Eliot was negotiating for *Middlemarch*, author-publisher relations changed dramatically. Eliot and John Blackwood argued amiably over royalty rates (she was an early author in pressing for a sliding scale of royalties, based on copies sold). Too, she had a keen appreciation of how to price and market her books effectively.

In general, for much of the century, publishers compensated authors in one of two fashions: by the outright purchase of the author's copyright for a period of time, or through a partnership in which publisher and author shared production costs; from his share, the author then paid the publisher a commission (usually around 30%) to cover his overhead and sales expense. This arrangement postponed payment to the author and left little compensation at the end for his creative effort, and was as well an open invitation for unscrupulous publishers to cheat. Yet as late as 1937, Sir Stanley Unwin, in the third edition of his definitive book *The Truth About Publishing*, argued strenuously for commission publishing as against today's system of a royalty per copy sold. Unwin's seventh edition of 1960 does not include this chapter, suggesting that direct payment of royalties based on sales was both simpler and less likely to be exploitive.

There were substantial differences in the development of publishing and print production on both sides of the Atlantic. These were the outgrowth of two trends: first, Americans moved more quickly to use mechanical resources instead of human muscle since skilled artisans in most trades were in shorter supply than in England; and in the case of printing, the equipment market was larger and more competitive here than in Britain. Obviously, publishers' markets, too, were larger in the United States, a function of sheer population size. Publishing centers quickly grew up as the frontier moved west. Although Boston was early first among equals, it yielded primacy to New York as that city grew and capital markets developed there. Centers such as Philadelphia, Cincinnati, Chicago, and St. Louis followed the westward moving immigration with improving transportation. The printing equipment market had its own dynamic, which brought early leadership to American inventors and builders. Although early developments came in England, particularly Lord Stanhope's metal press and the Koenig & Bauer power presses of 1814, in a very few years the center of graphic arts development moved westward (perhaps as a function of the American R. Hoe's aggressive salesmanship). American leadership was not really threatened until late in this century, when equipment streamed into the world market from Eastern bloc countries and Japan. The impact of equipment coming in from abroad demonstrates how global an industry the Graphic Arts has become. What will be made clear here is that mechanical developments quickly affected publishing, and through it, authorship, as these improvements came on line.

CHAPTER 2

THE NINETEENTH CENTURY OPENS

The year 1800 opened a century of technological change in printing. During the nineteenth century the existing unitary bookseller-printer-publishing functions separated into three different professions, with major impacts on authorship. The rudimentary eighteenth century pattern of distributing reading material through coffee houses, lending libraries, subscription sales was brought about by expensive taxed paper, limited press production, and inadequate transportation and credit. The first impact of the Industrial Revolution on the unwieldy eighteenth century complex of hand-produced printing came from the Times steam-powered cylinder press in 1814.

Population growth in Britain ran parallel to both printing change and the new middle class. Altick points out that there were 9,000,000 people in England and Wales in 1801; at the end of the century population was 32,500,000. Similarly, the Scots population grew from 2,000,000 in 1821 to 4,500,000 in 1901 (Altick: 81). His figures on class levels are equally impressive. Of the total population as of a 17,000,000 in the United Kingdom (including Ireland) in 1814, 1,500,000 were in the upper and middle classes, 1,800,000 were shopkeepers and small farmers, 11,900,000 were menials: mechanics, artisans, servants, paupers servants, paupers. In the thirty years from 1851 to 1881, the middle class nearly doubled from 357,000 to 647,000. Social conditions, poor housing, harsh working hours, rudimentary literacy., poor lighting all made reading essentially a phenomenon of the upper and middle classes (Altick: 82, 83). The combination of the Sunday School movement, its tract publishing, and the continuing growth of public education broadened readership, opening new, middle-class jobs to an increasing number of people.

The great irony of the developing printing technology came from its making possible a strengthening torrent of reading matter, not only literary material, but political tracts, and above all, religious materials for the Sunday School movement, and for the yeasty developing changes in the Church. And, the radical Utilitarians who saw the world in mechanical terms placed their faith in the printing press as the machine to bring useful knowledge to receptive minds--spreading facts for useful good and education in presumably "sound" economics and politics (Altick: 130). That the economics thus taught would be well to the right of today's Tories was only the logical extension of Victorian industrial beliefs; the "political correctness" of the time, if one will.

The roles of bookseller, printer, and publisher shifted and clarified across the nineteenth century into roles similar to today's. The bookseller changed from a risk-taking publisher to a retail outlet, selling books from many publishers; without the publishing role, the bookseller was soon in competition with the chain lending libraries and railway stalls selling reading matter. He was also competing with stationery shops selling books as well as note paper and writing materials; so, in self-defense, many booksellers became stationers, too. Book printers found themselves in a very different role as risk takers; their risks became more and more the credit risks of industry, with increased capital investment in machines enlarging productivity. The publisher, on the other hand, found himself taking large inventory risks, backing his judgement of an author and his manuscript with investment in saleable merchandise (books), and applying his skills to marketing and management. By the mid-nineteenth century his role changed from a primary relationship dealing with fellow booksellers to one dealing with the authors whose books he was publishing.

Though smaller steam power plants were not available till the 1830s, with water-horse- and man-power quickly put to work at driving presses, industrialization of printing picked up speed. Increasing investment in machinery turned the printer from a shopkeeper to a venture capitalist employing others as artisans and operators; and as presses grew more complex, the artisan operator became a pressman in America or a machine-minder in Britain. And author/publisher, publisher/printer relations changed further as Stanhope's stereotype plates began to restrict the free and easy text changes to which authors had become accustomed (Dooley: 4), as well as allowing competition to enter into printer relations. At the same time, co-publishing by author and publisher began to give way to compensating authors with royalty payments on a per copy sold basis. Harper's early adopted a 10% royalty system; George Eliot advocated royalty payments to authors in the 1860s when John Blackwood (Haight: 237) published *The Mill on the Floss* (Haight: 237). This was a major step in developing the specializations of publisher, printer, and bookseller, since royalty compensation shifted the publishing risk from one shared by author and publisher in commission publishing to one solely the publisher's (Davidson: 182).

Nineteenth century books published in the three-format for libraries speedily worked their way into cheaper editions. The popular sales of Dickens' works, with interest titillated by earlier serial publication, demonstrated that, at the right price, people would just as soon go to the bookstore. Interestingly enough, *Middlemarch* sold some 9,000 copies in its first year of publication and in 1871, Harper's put out 3,000 copies in two volumes (Exman: 62). In 1895, George Du Maurier's *Trilby* sold over a million books (Exman: 176).

It is apparent to anyone reading nineteenth-century journals that a major shift in reading material was occurring. *The Quarterly, Edinburgh,* and *Westminster Reviews* occupied somewhat the same position as today's *Time* and *Newsweek*, stimulating thought on issues of the day, though each of these represented particular political and economic bias. Correspondents reporting the Crimean War brought a new dimension to the drab columns of the newspapers; and the mass circulation of Scott, Dickens, and *Uncle Tom's Cabin* demonstrated that new markets for reading material were opening. The power press and paper machine made these market changes possible.

Lord Stanhope's iron hand press with lever linkage improved quality (through even and sharp impressions), gained somewhat greater production (handling larger sheets), and made for a definitely less fatiguing operation. At the same time, Louis Robert's paper machine increased paper production by a quantum leap. And, although Alois Senefelder discovered lithography in 1796, it took a century and a half for it to remake the industry with stone lithography to using lightweight metal plates and the rubber offset blanket; in the meantime, raised letter printing, or letterpress, remained synonymous with printing. Later in the twentieth century photo-mechanical techniques enabled better illustrations and opened opportunities to simplify and steadily to improve processes such as photo-engraving and lithography.

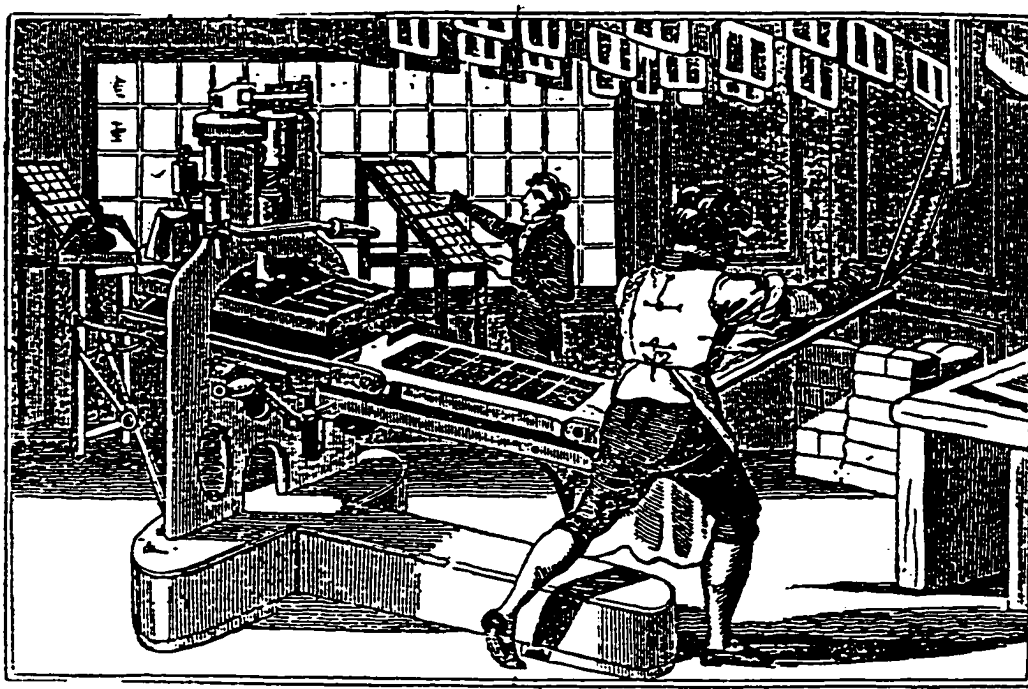


Figure. 1. An early Stanhope press, characterized by the massive T-shaped base and metal cheeks. In 1806 they were strengthened to avoid damage to the cheeks from the heavy pressure of the lever linkage. Note, too, the type form at the pressman's left, the tympan on which he is placing paper, and the open frisket, to be folded down over the tympan before printing [See pg. 27] (Moran: 48).

CHAPTER 3

MACHINERY TO PRINT WITH

The first application of power in printing was to run a printing press; it was not until well into the nineteenth century that other operations such as typesetting and binding were also mechanized; until then, with this single exception of presswork, the pace of production continued dependent on the nimble fingers or the conditioned responses of artisans. The power press dictated, within broad limits, the actual speed of that production operation. Until the first really effective folding machine (the Dexter) went into use in 1860, all folding of printed sheets was by hand; the first fully mechanical typesetter, the Linotype, powered by clockwork, was born in 1885, and mechanical feeders for press and bindery machines didn't come until 1895. Thus, in this chapter we will deal primarily with the developing printing process itself--putting ink on paper.

* * *

The new century's first major printing development was the steam-powered cylinder press installed in 1814 at *The Times* in London. *The Times* had been printed by hand on seventeen Stanhope presses; on that November twenty-ninth, when the pressmen came to work, they were told that the paper was already printed on the new steam-powered Koenig & Bauer cylinder press, installed next door with great secrecy, and that their jobs were gone (Moran: 107).

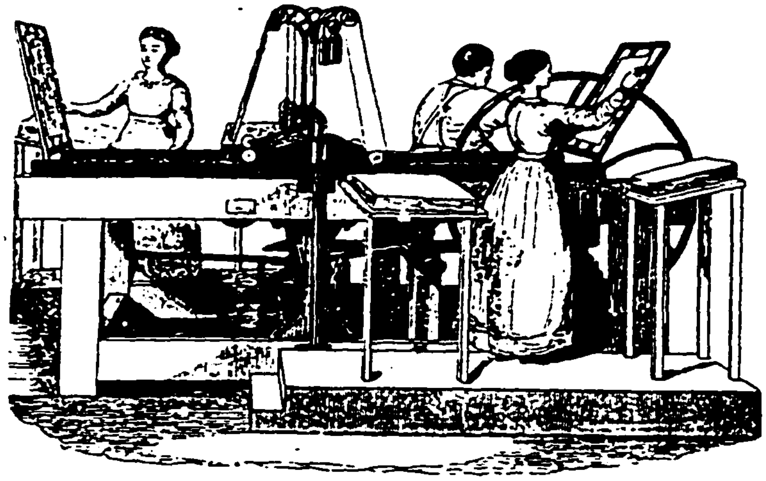


Figure 2. Adams bed and platen press using women as Feeders with a stalwart male to provide power at the flywheel [See pg. 8] (Moran: 114).

Friedrich Koenig and Andreas Bauer had to solve many problems in building this machine: inking, feeding, delivery, sheet transfer, applying power. Their success was monumental.

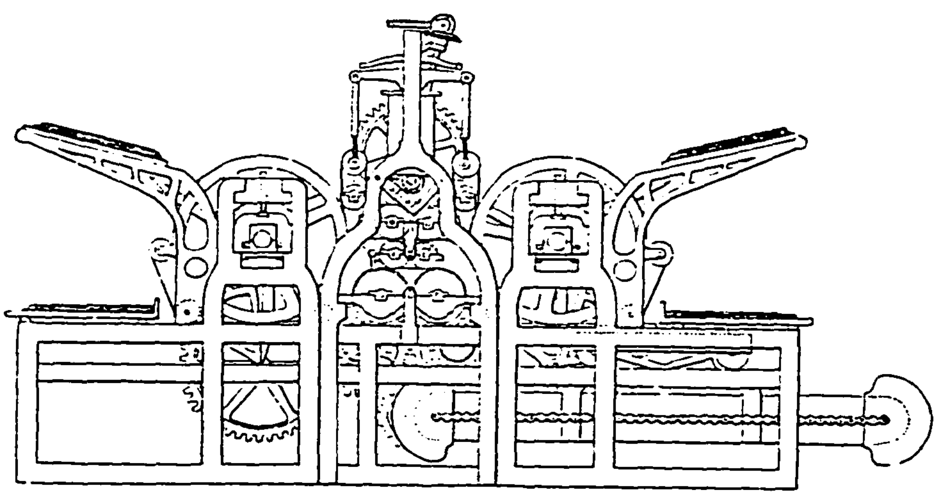


Figure 3. Diagram of Koenig & Bauer's double-ended machine for *The Times* in 1814. Note the ink tower at center of the press and the feeder boards at opposite ends of the press (Moran: 104).

The press installed at *The Times* in 1814 was already a derivative of an unsuccessful earlier design of 1811, being essentially a "double-ended" machine, printing a separate sheet at opposite ends of the press with each pass of the press bed (Moran: 106). *The Times* press' success was in a major degree due to Koenig's use of composition ink rollers of molasses and glue, a decision apparently made while building the press (Moran: 107). Most presses print only one side of the sheet, which then must be "backed-up" after turning the sheet over. Thus, a thousand impressions an hour generally translates to five hundred completed sheets an hour. *The Times* machine printed a 25 x 36 inch sheet at 900 to 1000 impressions an hour (Moran: 110). Press makers attacked this problem, and soon perfecting presses were available for single-color book and newspaper work, printing both sides of the sheet on the same pass, but with some loss in the quality of presswork (Dooley: 80).[1] The printer's operational decision to use a one-side or perfecting press would be based, of course, primarily on the relative cost and availability of the two machines at the time the book was locked up for press.

Once the new cylinder press became available, many machine shops plunged into the press market, many of them from the Wharfe valley in lower Yorkshire. Presses from these shops came to be known generically as Wharfedales, since differences between the product of different shops were minor. These minor, competitive differences continuously improved press technology; thus, improvement in the critical inking and gripper systems were but two of the "running changes" in press development. Various methods of inking the type form were tried, but the Koenig and Bauer system of releasing ink from a reservoir to a series of kneading rollers applying ink to the form, became commonplace. The empowering development in inking, however, was not the shift from hand brayers to a train of ink rollers, but rather the discovery of a compound of glue and molasses which could be cast to make perfectly cylindrical seamless rollers for even ink distribution, a

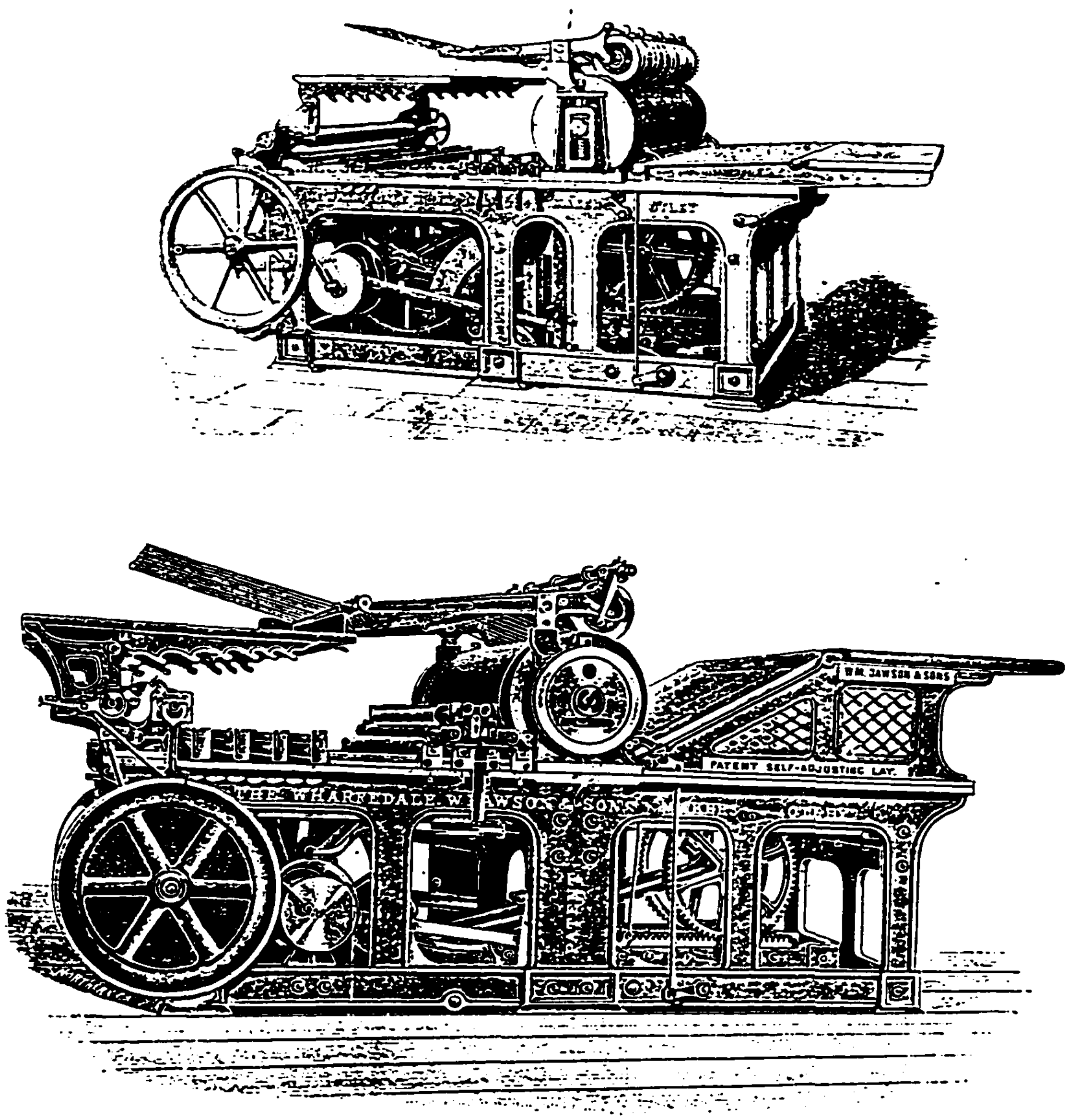


Figure 4. Two editions of Wharfedale presses, from 1830s and 1898. Note the sharply angled feed board and more complex inking mechanism nestled next to the impression cylinder on both machines (Moran: 136, 161).

compound still in some use for letterpress today. Most machines today use synthetic rubber rollers impervious to petrochemical washes and inks; such industrial rubber products were not available in 1814; thus the discovery of the compound roller was fundamental to press development.

Another major incremental development came from David Napier in 1824, when he devised a "gripper" system to control sheet transfer on a perfector press (Moran: 131), replacing imprecise tape transfer mechanisms. As the sheet was fed against the impression cylinder, it was seized by a set of clamping fingers, actuated by cams within the cylinder. As it proceeded from one location in the press to another, it was transferred by sets of meshing gripper fingers simultaneously releasing and grasping it, ensuring that one sheet after another would be positioned perfectly against the type form. Sheet-fed presses today have more complex, but essentially similar, gripper systems, which take the sheet from the mechanical feed board, transfer it from cylinder to cylinder and then to a final set of grippers on a chain delivery, stacking the sheets on a skid, thereby maintaining both control of the sheet and precise register through the full press cycle.

After 1815, press designs were modified quickly for specific applications; machines were accordingly configured for newspaper or book printing. And by mid-century, newspapers were already turning to rotary presses to satisfy the expanding demand for news by printing faster from curved, revolving stereotypes (Moran: 177).

Some plants were operated by horse-power. In 1833 a steam engine at Harper's finally replaced the faithful steed which had walked in a circle for many years, turning the shaft powering the plant. It was reported that in retirement he found a single tree in his pasture, and he lived out his days marching 'round and 'round the tree, continuing in retirement what he had done at work.

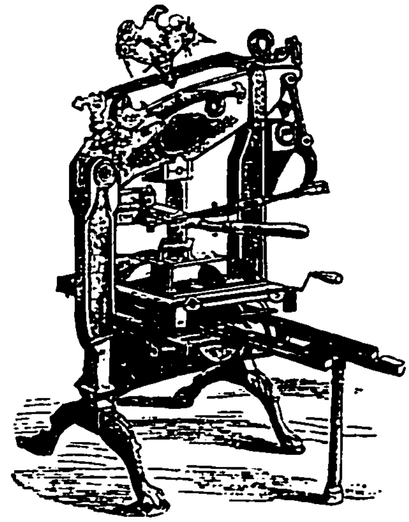
In 1800, the printing process began the night before printing, when an apprentice would stack dampened paper for the next day into a pile of moistened sheets, enabling the paper to take on a cleaner and sharper image when printed. This practice was the same for either the hand-operated Stanhope or the powered platen presses, and it continued until the third quarter of the century. By this time, paper was a much improved and more consistent material. Similarly, book printers' conservatism kept them from fully exploiting cylinder presses, saying that they were "type-smashers." This view changed around 1880, as the costs of using platen presses for longer runs rose and cylinder press print quality improved.

In time, the 250-impression-per-hour hand press gave way to the powered platen press, at about a thousand impressions an hour (IPH), and then to the cylinder press at perhaps fifteen hundred to two thousand IPH. Printers have known for centuries, however, that rated running speed of a press is essentially meaningless--what counts and makes profit for the printer is the net delivered sheets per hour or per shift.

Two factors were at work here in addition to the use of steam power: cylinder presses allowed the use of larger sheets so more pages could be printed at a time at nearly the same speed as smaller sheets; while the use of larger perfecting presses spread rapidly. The capacity of the London plant of Clowes and Company in the 1840s is frequently cited to illustrate the increasing mechanization of printing: nineteen perfectors, twenty-three hand presses, and five power platens (Dooley: 131). Even today, it would be a substantial plant; its equipment list is remarkable, for it had grown to this size in only twenty years (Moran: 123). Clowes was known not only as a book printer, but as the major printer for the Useful Knowledge Society (Altick: 277), a commercial connection which highlights the connection of books, religion, and Utilitarianism.

The growth of Harper and Bros. in America was equally remarkable. The brothers Harper started in 1817 as book printers with only two presses and some type; and when the plant burned out in December, 1853, it had nineteen power presses, 350 employees

Figure 5. Stock wood engraving of the Columbian Hand Press. The form has been rolled under the platen and all that remains is to pull the handle. The Columbian press was created by Adam Ramage of Philadelphia, and was widely distributed in the United States and abroad; British chauvinism mandated that an exact duplicate of the Columbian be sold in England under the name "Albion." The presses differed only in that one mounted a cast iron American eagle, the other the royal arms (Moran: 63).



occupying seven loft buildings, and producing two million books a year (Exman: 36). After a totally plant-destroying fire their new plant occupied two new six-story buildings, ran forty-one presses, and produced over 4,700,000 books a year (Exman: 40).

Another American publisher with its own plant was Philadelphia's J.B. Lippincott Co., which was into book manufacture from its earliest days, boasting a large, full-function manufacturing plant. In the 1880s, the composing room's cases for hand-set type occupied a block-long area on the fourth floor. The pressroom, too, was a block long on the third floor, with four cylinder presses, and "seven others" (Freeman: 31). This large plant at Seventh and Market Sts. burned out in 1899; the firm moved to a new plant and offices on Washington Square at Fifth St., where it still operates as a Dutch-owned medical publisher with its books produced in Singapore.

These substantial American publishing/printing plants covered typesetting, printing, and binding; British bookmaking practice separated binding from printing, perhaps because markets could not support the complete plant, except in specific cases of large best-sellers. Altick also points out the major market impact of numbers publishing in Britain, where a substantial number of each title was distributed as serial sections of folded press sheets (signatures) (Altick: 254).

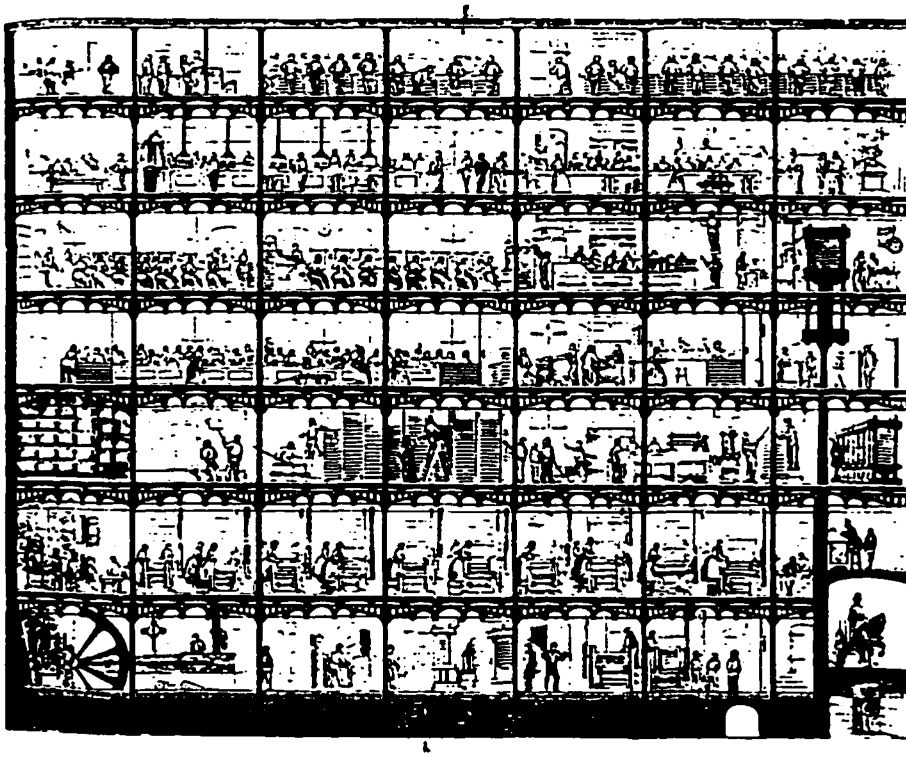


Figure 6. The new Harper plant, built in 1854 after their plant was burnt out in 1853. The plant layout was seen as extremely efficient: storage and paper dampening in the basement, press-room on the ground floor, paper drying on the second floor, folding and gathering on the third floor, sewing and case-making on the fourth floor, binding on the fifth floor, and composing room and foundry on the sixth floor. It employed 300 women: 150 to gather and fold, 100 to sew, thirty to feed presses, and twelve to gild edges and covers (Comparato: 105).

In 1800 bookmaking was centered on printing, for most books were issued in serial sheet form, with the lucky owner, who had bought and read the book in sheets, then commissioning his friendly local printer/bookbinder to encase his book between leather-covered boards. With the creation and mechanization of binderies later in the century, combining printing and bookbinding was a natural marriage, independent of publishing; these plants, offering composition, electrotyping, printing, binding, and warehousing, became a major factor in American industry well before World War II. The names of American Book-Stratford Press, Colonial Press, Quinn and Boden, Kingsport Press, Haddon Craftsmen, to mention only a few, have been lost into conglomerating corporations with larger mechanized manufacturing units struggling to keep ahead of exploding book markets.

At mid-twentieth century, American publishing production was highly sophisticated, planning books in size and number of pages to print most efficiently on elderly workhorse letterpress machines. Book printing practice across the twentieth century was structured on letterpress, raised letter printing--book press design and improvement were essentially stalled at the outbreak of World War I; offset lithography was still in the closet, used essentially set the stage for a press equipment race, which was won over the next two decades by offset litho equipment.

Proper choice of type face, type page size, front and back matter, location of illustrations, and chapter opening design are all tools used then and today to adjust the number of pages for most efficient and economical production. This practice has carried over to today with the shift to offset lithography, where most presses are similar in size to letter-press equipment, and binding considerations dominate planning.

In a cyclical reverse, however, smaller, high-speed sheet-fed and web offset presses today are replacing the larger cylinder letterpresses, and with their speed are delivering many more pages per hour than the big machines, and with a more consistent level of quality. Books planned to run on other available, specialized equipment such as web or belt press lines, go through the same planning process, but with slightly different size and page parameters dictated by the production machines. In short, new equipment and processes caused book production planning and design to become even more highly sophisticated joint ventures of publisher and printer.

In moving from muscle-powered to steam-powered cylinder machines the development and use of presses took three courses in the nineteenth century: the hand-operated, lever-actuated Stanhope press and its variants; cylinder presses driven by steam power and requiring both heavy capital investment and a high level of operator skill; and the Adams and Napier power platen presses, admirably suited to turn out a steady quantity of shorter-run sheets of high quality and at low cost.

The illustration in Fig. 2 not only shows one source of rotary power - the brawny fellow at the flywheel; it also pictures one of the jobs performed by women as too menial for men to descend to: feeding and removing sheets from the press. At that time few press runs were long enough to switch effectively to cylinder presses from the hand-fed platens.

Various types of these bed and platen presses are still in use today for small jobs. The hand press, once cast iron had replaced wood, changed quickly from a screw-operated piece of wooden furniture to using intricate lever linkages in a rigid steel frame, thereby applying a heavier, even pressure over the full form. The feeder would place a sheet of moistened paper on the tympan and fold over it the frisket, a sheet of paper in a hinged frame with windows cut in it to match the type pages and to prevent ink from transferring onto non-printing areas of the paper. This unit was rolled under the platen of the press, and the pressman pulled the lever to transfer the type image from the type to the paper. The heavier and stronger metal press enabled the pressman to cover the whole form with one stroke of the platen, an improvement over wooden framed presses, where he had to use two strokes (Moran: 53). The major advances here came from reduced operator fatigue, larger forms, and heavier impressions for sharper images. Hand press use never died: Washington hand presses were still in use for proving photo-engravings well into the 1960s, when the letterpress engraving industry finally collapsed; they can still be found enshrined in printers' reception rooms.

With cylinder letter-presses then and now the paper moves into grippers on a revolving cylinder, timed to meet the flat type form moving back and forth, transferring ink to the paper as the two meet. The moving press bed also handles the inking operation: a flat plate at one end of the bed takes ink from a bank of inked rollers on the press frame, the rollers also knead the ink on the plate for easy transfer; a set of form rollers then transfers the ink from the plate to the moving type form before it meets the paper on impression. Two-color presses have two sets of inking systems on the same press bed, shifting the sheet from one cylinder to another, and printing the two colors almost simultaneously. A perfector press is built similarly, but with a transfer cylinder to turn the sheet over between impressions.

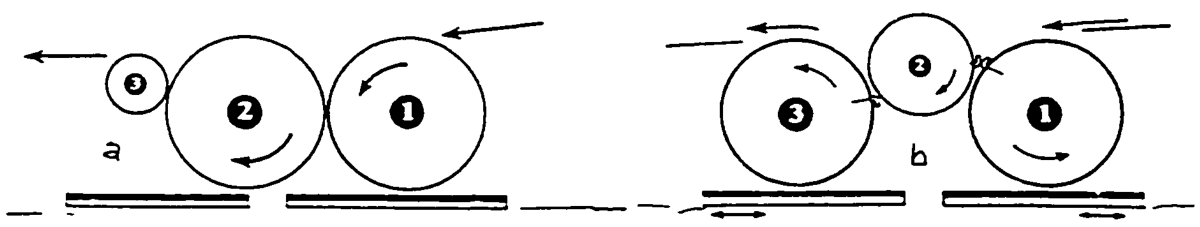


Figure 7. Diagrams of perfecting and two-color cylinder press operation. (a) Note that the transfer to cylinder (2) on the perfector positions the sheet printed on cylinder (1) facing up; (b) also note how the transfer cylinder (2) on the two-color press prevents the sheet from being turned over in the transfers between The location of the grippers is clearly shown on the two-color diagram (Strauss: 314)

As cylinder presses came into use, there were many problems to be solved by their builders: inking systems capable of transferring adequate amounts of ink from the ink fountain (a trough with a flexible spring steel bottom into which ink is loaded) to ink rollers to form rollers to type form. Early presses moved paper through the press on ribbons or tapes, making precise register and back-up impossible (Napier's gripper solved this problem); absent mechanical feeders, running speed was limited to the ability of a person to feed sheet after sheet into the press. The physical act of hurling a half-ton to a ton of metal along the press, stopping it, reversing direction, and then doing it all over again in a few seconds at the other end a few feet away, seriously limited effective press speeds.

Typically, as late as 1960, 25 x 38-inch one- and two-color presses only slightly larger than those sold by Robert Hoe circa 1835 (Moran: 79), printing sixteen 5-1/2 x 8-1/2-inch pages on a side, ran at fifteen hundred IPH, netting some twelve hundred sheets an hour, one side only on critical color work; at the same time large perfectors, printing sheets four times the size, and in one color only, netted about a thousand sheets hourly. The smaller press yielded, after backing up, 19,200 5-1/2 x 8-1/2 pages an hour; the larger perfectors yielded 128,000 similar pages an hour. Press speeds fell as sheet sizes climbed.

Robert Hoe, the American press salesman and distributor who gave his name to a whole generation of presses, saw the need for faster and faster presses, particularly for newspapers. He devised a roller inking system for hand platen presses; and at the other end of the equipment spectrum he pressed for and pioneered in developing rotary presses with the type form mounted on a cylinder revolving against a moving web of paper. Development of curved stereotype and electrotype plates, locking onto a press cylinder, enabled Hoe to design web presses which speedily made their way into newspaper and magazine press rooms. For example, the Curtis Publishing Company's plant at Sharon Hill, PA, where letterpress rotary technology was at its zenith in the 1950s and 1960s, was printing rolls nearly six feet wide, in five and six colors on huge Harris YY presses, delivering at high speed twelve-page folded signatures of the weekly *Saturday Evening Post*. These presses were so specialized that when the plant was closed, their only use was for scrap metal.

Another major advance did not come till 1895 when the Dexter pile feeder was developed. Today, in feeders of various designs, sheets are lifted off the pile by combing rollers, by suction cups, by air blast, or combinations of all three, and forwarded to the slanting feed board, where they are "shingled" onto moving tapes. These tapes carry the shingled sheets to the first set of grippers, the "swing grippers." As the sheet comes to a momentary halt before it moves into the gripper, a metal finger moves it laterally against a stop, the "side guide," giving precise three-point positioning into the swing gripper and thence throughout the press. The arrival of mechanical feeders finally automated completely the printing process, relegating hand feeding to a forgotten skill. Another type of feeder, which feeds fanned sheets into the press, was the Cross feeder, developed in 1900; these are used extensively in binderies today; pile feeders are more often found in pressrooms, where they are built into the press by the manufacturer. The advent of high-speed offset litho presses after World War II brought new feeder designs onto the market, capable of handling large sheets of paper at three to four times presses' former running speed.

The third course of nineteenth century press development was the bed and platen press (See pg. 15). Here the type form is positioned in a rigid frame, the paper was placed on a heavy plate pressing it against the type; when the jaw opens, the sheet is removed and a new one inserted. The sheet is fed into three clips on the moving platen, two the long way and one on the side thus ensuring three-point positioning. An alternate construction is for the form to be flat horizontally, the paper placed on it, and the vertical platen presses the paper against the type as in the Stanhope press (See pg. 2). The speed of the press controlled productivity, and speeds of 1000 IPH on small platen presses were not unusual in the nineteenth century, even with hand feeding. Pressmen and printers alike preferred bed and platen presses for fine work until late in the nineteenth century, with their ease of makeready and close quality control. Inking systems were simple, with ink rollers moving ink from a circular, rotating plate directly to the form. For the short press runs of most books of the time, this equipment was ideal, though sheet sizes used were limited, partly by the optimal size that could be handled by a human feeder.

Printing economics were long dominated by its being considered a labor-intensive craft, a carryover from the days of the bawny artisan pulling on a lever. As presses grew more complex, the pressman (or his British counterpart, the machine-minder) was forced to spend a long time setting up his press. This included positioning the form in the press (it was delivered to him locked-up by the compositor), setting the feeder and delivery to use the paper furnished to him, evening out the impression of type on the sheet of paper, making sure that ink and paper were feeding properly, bringing the impression to the proper shade or color, and then, only after the foreman had given his OK to the printed sheet, could he start running the press. It is obvious that strenuous efforts would be made both to shorten makeready time and to run the press smoothly at the highest optimum speed.

A major factor in setting up the press is its age and condition; presses with sprung journals, blemished impression cylinders, uneven beds, distorted inking systems were not uncommon and required endless hours of effort by the pressman adjusting mechanical conditions and pasting spots of tissue under the tympan sheet on the impression cylinder. Improperly set or maintained feeders and deliveries, with vacuum and compressed air systems to separate piled sheets and to transport them one by one into and out of the press can extend makeready, too. Drying and anti-offset systems spraying a protective layer of starch powder onto each sheet as a physical barrier to smudging and offsetting the pile requires precise adjustment before running. These all point to the complex and precision discipline needed to deliver first-class work from yesterday's presses.

Today's offset litho presses are even more complex, with water systems, ink systems, plate and blanket cylinders, common impression cylinders. And, as presses have grown more precise and sophisticated, so have controls, today largely electronic and monitored completely from offpress consoles, directed at control of quality and running speeds, and with shorter makeready time. These advances all increase capital investment in return for more productive output; one of the outcomes of the massive switch from letterpress to offset lithography after 1946 was the critical need to replace old, slow, badly maintained letterpress machines with new, high speed, mechanically up-to-date offset presses.

Printing, in all its ramifications of quantity, markets, reproduction materials, and subjective perceptions, defies a precise definition of print quality; printers often define quality more by what it is not than what it is, although there are several specific items to look for in examining a printed book. First, there should be precise backup register of type pages--the front and back of a page should align exactly, usually at the head, as type pages will differ in depth to avoid widowed and orphaned lines. Second, type and images should have even and consistent color throughout the book, with no light or dark pages or variations on a single page. If illustrated, images should be crisp and sharp, with halftones of photos in as full a range from solids to highlights as possible, with good separation of tones within the picture. Finally, if there is color in the book, it should be accurate and also consistent; if full color is involved, colors should be accurately reproduced, with good separation between tones and sections of the photo, and the subject should look real. The ultimate test in all cases is whether the sheet looks good to the customer and to the printer.

With the introduction of powered metal presses early in the nineteenth century, costs of printing equipment rose sharply, as might be expected with such increasingly complex machines. In 1815, a Stanhope press cost £95, a single-ended Koenig and Bauer machine cost £700, a double-ended one cost £1400, both plus a royalty of £250 to £500 a year over the life of their patent (Moran: 110); today a two-color offset press of about the same size can easily run over $500,000 in price. These escalations in cost quickly demanded substantial capital to operate a printing plant, forcing publishers to choose between using their capital for book inventory or for printing machinery. Over the century, the consequences of publishers being printers as well brought a heavy toll to the industry: virtually every American publisher committed to printing as well as publishing went through bankruptcy--Appleton, Harper, and Lippincott are only three of the large American firms whose printing operation was sold off in reorganization to use the proceeds of the plant's sale to pay clims of creditors.

Only one major publisher today owns its own printing facilities: the Bantam Doubleday Dell group, dominant in publishing, book clubs, paper backs, inexpensive reprints, book stores, a market mix which can keep plants in Dallas PA and Berryville VA continuously busy. The last two decades have also seen book manufacturers conglomerating into ever-larger units: R.R. Donnelly & Sons Co., Quebecor Graphics (formerly Arcata Graphics), Rand-McNally & Co. are typical of the major firms in this specialized area of print. The "Little Golden Books" series sold so successfully by Simon and Schuster are conceived, designed, and manufactured by Western Printing and Lithograph Co, a large, creative multi-plant lithographer.

Some of the available statistics demonstrate clearly the dramatic change in the printing trade brought about by the power press. Typically, Jane Austen's novels had first printings of only 700, and only one of her novels, *Pride and Prejudice*, was reprinted. Altick points out that Charles Knight, publisher of vast amounts of Sunday School material, found that published titles between 1816 and 1851 totaled 45,200, 3,500 of them fiction., 10,300 religious works, 3,400 on dress, and 2,450 on science (Altick: 108). Many of these non-fiction works were of major importance in forming England's intellectual climate; similarly, subscription non-fiction and other like works in America brought knowledge and thought to the frontier, helping to form the American dream.

George Palmer Putnam noted in 1855 that from 1830 to 1842 American publishers published 1,115 books, 623 being original works and 419 reprints of foreign titles; in 1853 723 titles were published, 278 were reprinted English books, 38 were translations and 420 were American in source (Davidson: 180). The high number of English reprints probably indicates the level of piracy by American publishers. In contrast, today's title production is in the order of forty-five thousand, with yearly book totals in hundreds of millions. The mass market here today is dominated by heavily promoted books, such as General Colin Powell's autobiography, John Grisham's legal novels, Tom Clancy's techno-thrillers, or Newt Gingrich's latest political manifesto.

Serious works of non-fiction such as David McCullough's biography of Harry Truman, Carlos Baker's biography of Ernest Hemingway, and Robert MacNamara's biographical memoir of the Viet Nam war, (all Book-of-the-Month selections) have had impacts on American society as great as many works of serious fiction.

Publishers' markets grew with the growth in literacy; and this drove printers to improve and enlarge their plants. Just as automobiles are "improved" from year to year with running changes, so too are presses. These running changes do make the whole machine more efficient, or faster, or better controlled, or more able to perform additional operations in line.

Until 1895 when the first Dexter feeder was installed, feeding presses was low-end, routine work, avoided, if possible, by the journeyman printer; thus, when the bed and platen press came into use, journeymen gladly turned feeding over to women, traditionally the lowest-paid workers. Davidson also points out that this change in press manning in the 1830s moved book printing from a craft to a manufacturing process, further accentuating the divorce of bookseller and publisher from printing (Davidson: 197).

The period between 1900 and the end of World War II, however, did not bring important breakthroughs. There were only two significant new press developments: Ira Rubel devised the first offset lithographic press in 1906, although the process did not reach its real potential until well after 1945; and in 1921 the Miehle firm popularized its Miehle Vertical, a small job cylinder press standing on end with both cylinder and type form moving synchronously; this was small (12" x 9" type form), and very fast (3,000 IPH) (Moran: 159).

But with only minor modifications being made by manufacturers to large cylinder letterpresses, the stage was set for the explosion of the lithographic industry in the 1960s. There are two other developments which hastened this separation. At the turn of the century it became clear that many publishers had become over-extended through publishing ever-cheaper products. This forced some of the largest houses such as Appleton, Harper, and Lippincott into receivership, and their plants were sold to satisfy creditors, a particularly savage way to tell publishers that their investment should be in books, not machines. This move had another, less heralded effect: there was no longer a need to publish books just to keep the plant busy, a rationalization that had brought to light of day many books better left unpublished.

It must be noted here, however, that although the composition function has moved back toward the author's computer, book manufacturing is no longer presswork alone--binding and its collateral operations make up the largest part of a book's manufacturing budget.

The pent-up demand for equipment at the end of World War II put enormous pressure on press manufacturers and other suppliers to the printing industry. Major corporations, sensing this demand for change and seeing that adoption of these new systems could create and hold new markets in the graphic arts for chemicals and electronics, responded with research and marketing. Scitex, Heidelberg AG, DuPont, 3M, W. R. Grace, Dai Nippon, Mitsubishi, as well as the Graphic Arts Technical Foundation, are only a few of the entrants in this intense technological race.

We have seen that in the 1940s magazines and books were printed largely by letterpress, books on large (46 x 69 inch) single-color and perfecting presses; while larger run magazines and newspapers ran on enormous specialized rotary, web-fed machines. Large sheet-fed offset presses, up to 54 x 78 inch size, single- and multi-color, led the race for new equipment in the 1940s and 1950s. A British productivity team, visiting American plants in 1948, noted wistfully in its report that one lithographer in New York City had more 76-inch multi-color presses on its floor than existed at the time in the entire British Isles (Productivity: 100). The first such four-color press in Philadelphia was installed in 1955 and cost in the neighborhood of $250,000.[2] Printers found that their most grievous problem with these large machines was dimensional stability of the paper, as well as lowered running speeds, yielding perhaps only 3,000 to 3,500 net IPH on a press that was manufacturer-rated at 6,500 IPH.[3] By the mid-1970s it was apparent that presses a quarter of the size of these big machines were faster, had shorter and easier makereadies, had far fewer paper dimensional problems, and utilized modernized electronic controls for better quality and productivity. Obviously a smaller four-color press at 10,000 net IPH, manned with a smaller crew, could outperform the large machine.[4] And, at the same time, many commercial, magazine, and book lithographers were finding the economics of web-offset presses. Shorter runs were becoming practical with faster makereadies, making new web markets available; web paper is inherently less expensive, since it does not have to be sheeted and cut to size and folding and finishing can be done as part of the press operation. New electronic control technology has rapidly come on stream for shorter makereadies and more precise running controls.

Book manufacturers have gone further yet. With long runs available for paper backs, school books, book clubs, and semi-magazine books, they have been investing in another direction, pioneered by newspapers: the polymer plate. Consideration of this process falls naturally into a discussion of improvements in chemical technology, as it essentially involves a light-weight plastic printing plate on an aluminum backing sheet, printing by letterpress on a high-speed web press, delivering sheets or pages into a binding machine. Plastic or rubber plates, printing in line with the binding operation, may well be the next wave in the book publisher's future.

It should be noted, too, that Donnelly and Quebecor both produce national magazines and commercial printing on a massive scale as well as books, enabling them to spread their marketing risk across several areas of printing. The variety of product in the book market today--size, binding, paper, quantity, mailing, all require intense specialization of facilities. The increasing use of computer word-processing similarly separates word production and author participation, low in capital cost, from the book manufacturers' massive investments in multi-million-dollar press and binding lines. The growing conglomeration of publishers, entertainment empires, and book manufacturers has created both new challenges and new fears for the future distribution of the written word.

NOTES

[1] Frederick Koenig patented a perfector in 1814, his last patent before moving back to Germany (Moran: 109). David Napier is said to have produced 87 perfectors between 1836 and 1862 (Moran: 133).

[2] I watched this machine being cut up for scrap in 1978, having been run three shifts, six days a week, for twenty-five years.
I also was involved in its original installation. (See also footnote 4)

[3] In one case, I observed a 76-inch two-color press, rated at 7,500 IPH, running flat-out at 6,500 IPH, and because of the speed, yielding perhaps only 5,500 net IPH.

[4] My employer bought two of these smaller American-made presses in 1974 for under $200,000. each, and in 1980 two more for about $500,000. each, and then in the 1980s several six-color machines at about $1,000,000. apiece; all were imported from Italy, East Germany, and Japan: a commentary on the inflation of the 1970s, the incredible complexity of today's machines, the demands made on them by the printer, and the global nature of the printing equipment markets. When I retired in 1982, there was no major piece of equipment in that plant that had been manufactured in America.

CHAPTER 4

PAPER TO PRINT ON

Paper is one of the world's oldest manufactured products. It is said to have been invented by one Ts'ai Lun in China, ca. 105 A.D. (Hunter: 466); its use spread around the world, arriving in Germany a half-century before Gutenberg in 1390 A.D.(Hunter 2: 478); and it reached England in 1495 (Columbia 5:2066). About 900 A.D., Egyptians learned of paper from Arabs; and their use of papyrus strips gave paper its name, derived from the papyrus reed (OED: 1436). But the fact is that paper itself, first made by hand using cellulose fibers from linen and cotton rags, remained a material of limited availability until the nineteenth century, when two seminal events occurred.

These two most important developments in paper-making occurred a half-century apart: in 1799, Louis Robert patented his paper-making machine, and in 1851, chemical wood pulp became a practical way to meet the need for a new, high-volume, material source. Robert brought his patent to England after a confrontation with his French sponsor, Francois Didot. Financed by Henry and Sealy Fourdrinier, the first Robert machine was started-up in 1803 by John Gamble, Didot's brother-in-law, at Frogmore, Herts. As the century began, a hand paper maker could produce sixty-five to a hundred pounds of paper a day; this first Fourdrinier machine at Frogmore produced a thousand pounds a day in a thirty-inch wide web. Today's machines, over twenty-five feet wide, running at a speed of thirty miles an hour, can produce about 250 tons a day.[1] The paper industry today is the fifth largest in America, a far cry from David Rittenhouse's first American paper mill, of 1690 on Wissahickon Creek in Philadelphia.

Figure 8. A seventeenth century paper-making team at work. The vatman maneuvered the mesh screen into and out of the vat of pulp; the coucher removed the sheet of paper from the screen; while the layman carefully piled the sheets, separating them with felt pads (Hunter: 174).

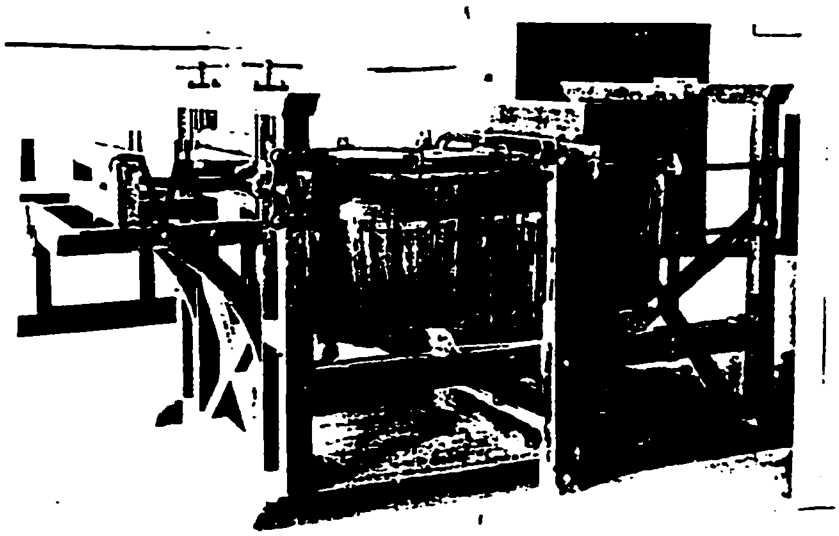


Figure 9. A model of the original paper machine built from Robert's patent drawings dated 1798. (Hunter: 346).

By 1810 there were 185 vats in America, all making hand-made paper (Fraser: 71); and in 1962 there were three times as many mills, each producing on average some 650 tons daily, all by machine. Chemical wood pulps and larger machines drove hand-made paper out of the market after the Civil War.

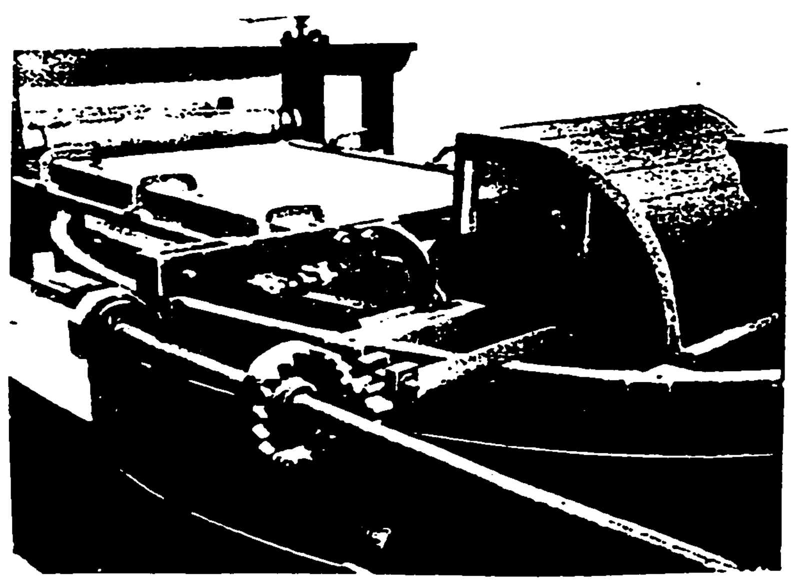
The paper industry today, despite its size and the investment involved, is astonishingly flexible. There are four major markets for printing paper, which in the large represent the major customer volumes for paper mills: newsprint, magazines (mostly light weight body stock), books, and commercial (job printing). The book paper segment of the industry has been noted for its great flexibility in furnishing special sizes, special thicknesses, and special weights through combining many publishers' needs into sections of a longer run of the same color, furnish, size, and caliper.

Paper is no longer a product for the printed and written word alone; the uses for various kinds of specialized papers are limitless: food board, trading cards, wrapping papers, corrugated cartons, envelopes, food and milk cartons are only a few of these other applications. In 1810, a hand paper mill with two vats (tanks in which the paper maker would put his wire screen) represented an investment of some $10,000, and could produce

2,000 to 3,000 reams of paper a year; the 185 such mills in the original thirteen states, of varying sizes, annually produced 10,000 reams of book paper, 111,000 reams of wrapping paper, 100,000 reams of writing paper (Hunter: 533). These output figures can be compared with one new greenfield mill started up some years ago which included a pulp mill, by-product chemical recovery, and two paper machines, both 220 inches wide, with finishing equipment, designed to produce 250 *tons* of paper daily. Its cost was around a quarter billion dollars.

Just as with printing presses, there were continuing paper making developments throughout the nineteenth century--and across the twentieth century as well, America's first paper machines were installed in 1827 and 1829, two of them using imported parts (Hunter: 544-5).

Figure 10. The traveling wire on the Robert machine model (Hunter: 348).



Paper machines seem to have perpetual life. For example, at the Curtis Paper Co. mill in Newark DE, two machines built in 1889, sixty-five and eighty-five inches wide, are running around the clock today producing high-grade specialty text paper for book covers and advertising material; careful maintenance and periodic upgrades have lengthened these machines' life span indefinitely (Snow: Heritage: 4).

*   *   *

By definition, paper is a felted web of fibers (usually cellulose) produced to specifications, precisely manufactured for a specific end use, generally related to printing or writing. And, for every part of that definition, there is an exception: for instance, envelopes used by air forwarders are made of paper using plastic, not cellulose, fibers; felted as is cellulose paper, perfect for this end use, as it is practically impossible to tear or puncture. Paper also can be defined by the pulp used: wood or rag pulp; mechanical, or groundwood pulp, chemical, or soda or sulfite pulp; virgin or recycled pulp, coated or uncoated. In early times paper was sold by the ream of five hundred sheets; today it is bought and sold not by the sheet or ream, but by weight; the Fourdrinier machine makes possible making paper to exact weight specification, or pounds per standard size ream, to a particular caliper, from a particular mix of pulp, using soft, or coniferous wood, or hard, or deciduous wood, to a specific kind of finish--a soft vellum or a hard, shiny calendered surface. And, if a glossy, clay-coated enamel sheet is needed, there are a further set of specifications--dull or gloss, a specific brightness, a particular shade of white, or to other characteristics related to end use.

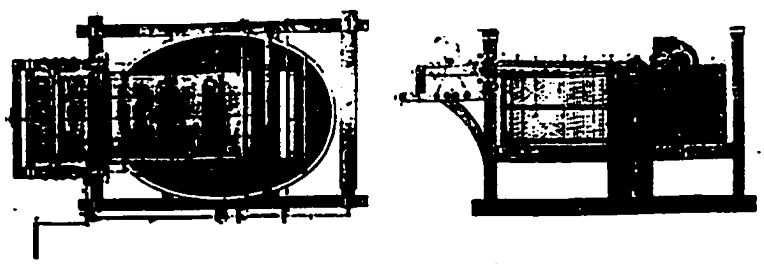


Figure 11. Detail of the Robert machine model, showing relation of parts: the wire, furnish distribution, and paper removal systems (Hunter: 347).

The paper options available to the book publisher today seem almost limitless; paper selection affects every part of a printed book: printability, folding, adhesive reception, finish, bulk, price, all qualities dependent solely on the paper.

The Robert/Fourdrinier machine flooded a suspension of cellulose pulp onto a moving, fine-mesh wire screen through which the water dripped, leaving felted paper on top of the screen. For several years, paper off the machines was hung out to dry in lofts; the first refinement of the paper machine involved adding heated dryer rolls, followed by suction units inserted under the wire to remove even more water efficiently from the web. Today's high-speed paper machines are little different in principle, varying only in details of size, speed, drying systems, and type of product.

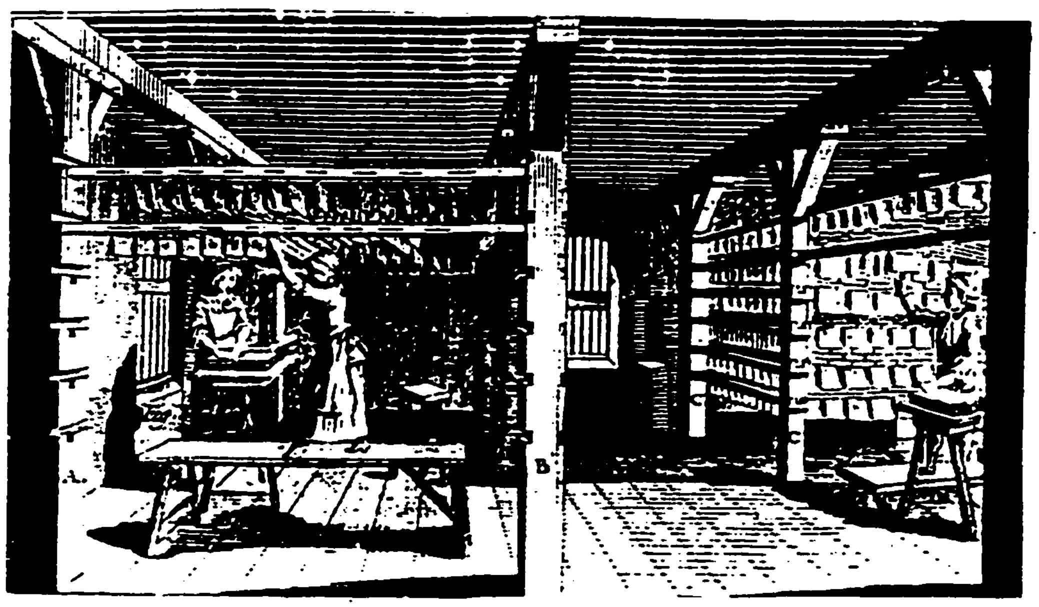
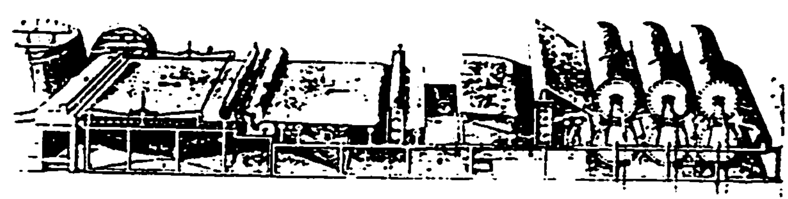


Figure 12. The drying loft of a hand-made paper mill, a system still in use for European hand-made papers. The original machine-made paper was dried thus (Hunter: 189).

The pulp/water suspension floods out of the head box (a tiled storage tank) onto the fast moving wire, and in perhaps thirty-five feet it goes from 99 per cent water to about 30 per cent water. The web is already strong enough to leap unsupported across a three to four-inch gap between the wire and the couch roll, which will transfer the web to a continuous felt blanket, carrying it around and over steam-heated drying drums.

Figure 13. English machine from period 1835-40, with three drying cylinders. The wire is at the right, dryers and master roll at left (Hunter: 364)

Figure 14. English machine from period 1850-60, with six drying cylinders at the right, the wire is at the left (Hunter 364).



When it reaches the end of the machine and is wound into a "log roll" it contains only some five percent water by volume. This massive reduction in water content is achieved by a combination of gravity and the suction boxes located inside the loop of wire mesh, literally sucking water out of the speeding web, and by the heated drums in the dryer section around which the paper winds.

With the startup of the new paper machines, a radically different technology from hand methods, it was almost immediately apparent that the rag market could not adequately meet pulp needs (Hunter: 341); and paper makers searched for other forms of cellulose fibers; but neither esparto grass, sugar cane, nor other fibers could match wood pulp for availability, cost, and ease of handling.[2] Paper makers have been seeking out alternate pulp sources since then, and the multitude of papers available testify to their success over these two centuries; yet, wood pulp is still the material of choice for most paper.[3]

The paper makers turned first to ground wood pulp, producing it first in Nova Scotia in 1841. This pulp starts with a debarked log pressed against an abrasive wheel which grinds off cellulose fibers. These are treated in a short chemical "cook" to break down lignins and resins bonding the cellulose fibers together in the log. This is essentially the way newsprint is made today. The microscopic groundwood fibers are significantly shorter than fibers from chemical wood pulp; mills add small amounts of groundwood pulp to the "furnish" for other printing papers to help the finished sheet lie flatter, and thus to move more smoothly through the press.

* * *

The first truly chemical wood pulp was made in England in 1851, half a century after Robert's first machine was put in service. Thumb-sized debarked wood chips were mixed with caustic soda and cooked to remove the binders; and after blending and mechanical treatment, the pulp was flowed out onto the Fourdrinier wire. And, only six years later in 1851, came the sulfite process, in which the pulp was cooked in a liquor containing both caustic soda and calcium sulfide, producing a basic pulp that is bright in color and easy to bleach.

In 1883 the sulfate process was developed in Germany, cooking wood chips with caustic soda and sodium sulfide at high temperatures and high pressures. This cook for both sulfite and sulfate pulps in what is essentially a gigantic pressure cooker, produces a deep coffee-brown liquor of chemicals and fiber which are then washed, bleached, and mechanically treated to make white pulp.

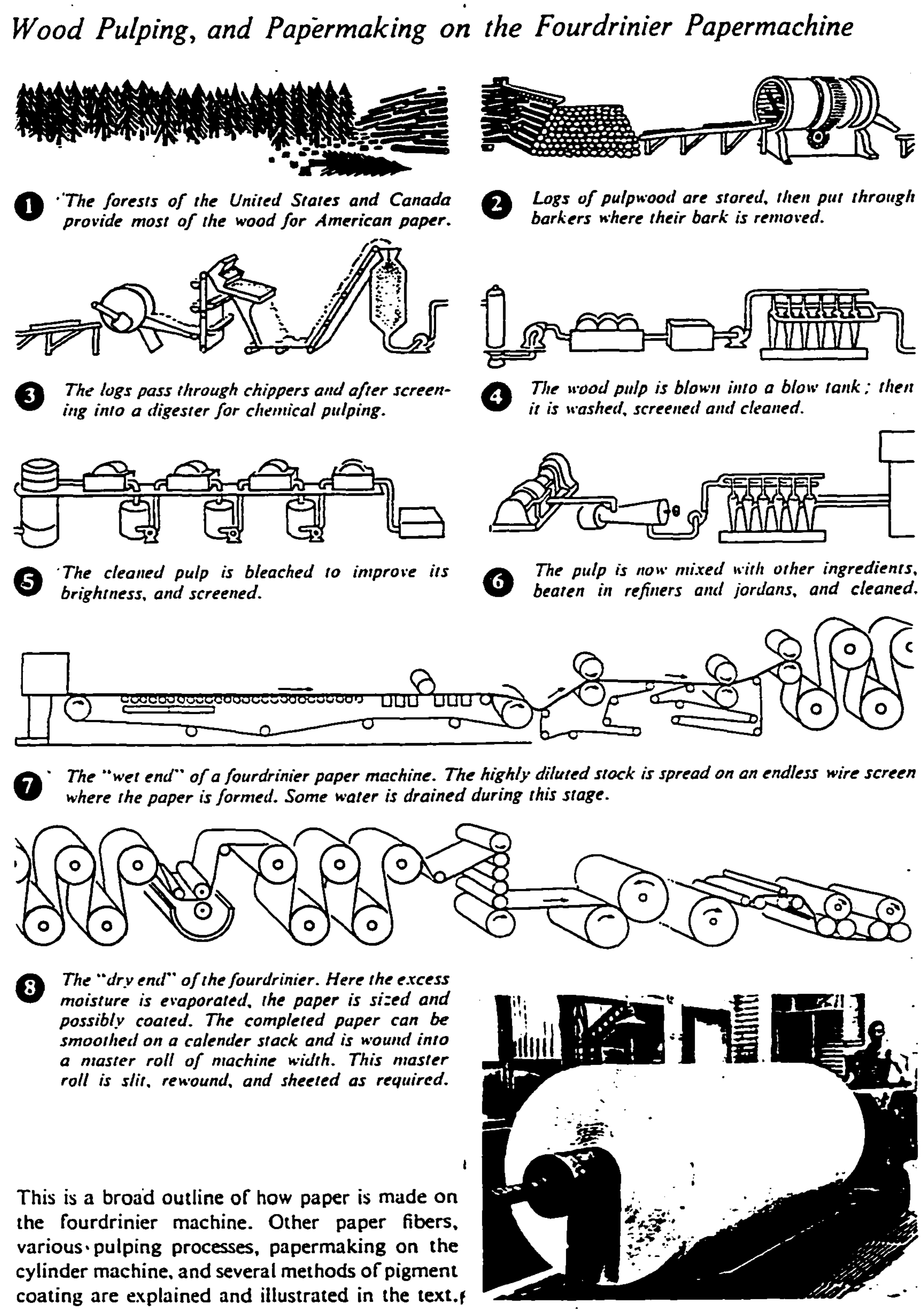


Figure 15. A simplified schematic rendering of modern paper-making from log too log roll. All the key operations are shown here (Struss: 527).

Unbleached brown sulfate pulp, used in making paper bags and boxes, was called "Kraft" by the Germans because of its strength, a generic name now used world-wide to identify this particular paper, its pulping process, and its product. Until after World War II, it was difficult to use kraft pulp in making printing paper, largely because it was difficult to bleach, thus limiting printing papers to the sulfite process and to coniferous soft woods. However, new bleaching techniques in the 1950s made it possible to use the less expensive hard-wood kraft pulp. Paper companies have invested hugely in managed tree farm to such an extent that it has been said that more trees now exist in North America than when the Pilgrims landed. In addition, mills have pursued forest genetics aggressively, reducing the time needed to grow harvestable trees by almost half.[4]

After hydrating, the pulp is processed to make it suitable for varied end uses. The fiber in the liquor from the digester is washed and bleached to remove the liguins and resins which had held the fibers together. The pulp, now white after bleaching, is beaten, or hydrated in a Jordan engine--a conical male plug with steel scraping bars on it revolving at high speed inside a female cone, similarly equipped with steel bars.[5] Scrubbing the pulp against the bars causes the microscopic cellulose fibers to fray and to interlock more tightly in the felted web. Better grades of paper have added brighteners, such as titanium dioxide and fluorescent dyes, as well as fillers and other additives to improve handling on press. This blending with other pulps, chemicals, and dyes is done in a hydropulper, similar to an enormous kitchen blender, which combines these components together and suspends them in water. The final solution goes to the paper machine's head box as ninety-nine per cent water and one per cent material.

Coated paper for illustrations was first made for publication use in 1881, when the S.D. Warren Co. of Westbrook ME produced the first coated two sides book paper, named "Century." It was shipped to the famous plant of Theodore DeVinne in New York City to be used by the Century magazine for printing a series of wood engravings of Spanish paintings by the celebrated engraver Thomas Cole.[6] At the time the Warren Company had four coaters making coated-one-side wallpaper.

When the halftone process came into use in 1888, publishers and printers soon found that fine-screen (that is, 110, 120 screen) halftones would not reproduce by letterpress on uncoated paper. The publisher's solution to this problem has always been to place halftones in separate coated paper sections, scattered throughout the book. This practice, involving some complicated planning gymnastics, continued until modern lithography enabled halftones to be run on uncoated offset paper next to the referenced text.[7]

Book users complain about the high gloss paper often used for illustrations, particularly in full color reproduction. Today's printing technique requiring the use of coated paper for full color will be discussed in Chapter VII. Inks used for flat, or match color printing, usually on uncoated paper, are opaque, and produce the image of color by reflecting the color back to the reader's eye. Full-color pictures, on the other hand, are made up of thousands of tiny halftone dots of varying size, smaller than can be differentiated by the naked eye, printed in special shades of transparent magenta, cyan (blue), and yellow, producing in combination an image of the particular colors in the picture reflected through the inks acting as colored filters in front of white light reflected by the coated paper.

As markets for full color printing have broadened, tightening specifications for presswork and for paper, these areas have had to keep up with growing knowledge of what color is--color theory and its printing fall naturally into a discussion of photo-mechanical techniques. In any case, full color printing requires that this smooth coated paper, either gloss or dull finish, be used for fine full-color printing.

To meet this demand for coated paper, mills have invested heavily in specialized paper making equipment. Forty years ago, most quality coated paper was coated in a separate operation off the paper machine; coating now is added right on the Fourdrinier by coating units installed in the dryer section; the paper is calendered (smoothed) at the end of the machine, passing between stone and steel rollers moving at different speeds, literally "ironing" the paper smooth.

The rapid growth of offset lithography after World War II, particularly in the use of color, forced paper makers to develop new technology to meet lithographers' needs. Offset lithography punishes paper severely on press: in considerable measure this is due to the quantity of water used to dampen the plate for sharp distinction between printing and non-printing characters. Paper is intensely hygroscopic, accepting moisture in almost uncontrollable fashion; paper fibers change size, causing the sheet of paper to change dimensions literally in moments.[8]

The microscopic cellulose fibers accept water readily, growing about the same absolute amount both in length and girth; thus, if one can get most of the fibers to lie in the same direction, then the percentage enlargement to the sheet will occur mostly from change in the fibers' circumference. The lithographer can make minor adjustments to his plate's circumference on press by packing under it; he cannot stretch the plate lengthwise on the press cylinder. Therefore, he requires that his paper be made with the fibers substantially aligned the long way on the press. Fortunately, the paper machine will definitely align fibers with the direction the wire is moving and careful cutting will generate paper that is grain long. In addition, for better folding it is desirable that the paper's grain run with the last fold on the folding machine, and the size and design modules used for most books now put this last fold in the signature with the grain, particularly when using smaller sheets.

As the demand from lithographers grew, mills took steps to minimize distortion from size change, surface sizing with alum for water resistance along with other water-resistant additives in the furnish, controlling relative humidity of grain long paper with moisture-barrier wrappings, and specifying the period that a skid of paper should be stored to reach the temperature and relative humidity of the air conditioned pressroom, and, in the 1950s it speedily became mandatory for printers to air condition pressrooms to a standard relative humidity.[9] What has been impressive for a century is also the mills' great flexibility in making paper to order as it rolls off the paper machine at better than thirty miles an hour, hour after hour, as well as the continuing efforts of mill research staffs to solve paper problems arising on press. Any paper buyer or pressroom supervisor can talk for hours about the problems he has seen in offset pressrooms; happily, by the 1970s, the worst of them had been solved and many of the problems of printing paper by offset lithography had subsided.

There are perhaps a dozen major mills whose competition sets the pace for the industry. Producing a broad line of papers: coated, uncoated, text, cover, wrapping, label papers, they are often engaged in joint ventures in mill ownership with each other and with customers. Although this suggests a picture of managed markets, it guarantees continuing output in hard times, just as it guarantees production and delivery, a vital necessity for both magazine and book publishers, in good times. Given parallel pricing, this puts a floor under printing costs, since ten to fifteen per cent of a book's cost today is paper. (In commercial work, this percentage is closer to a third.) The process also fosters stable relationships between printer and publisher. Thus, making paper and its delivery can have a significant effect on getting an author's work to market.

Just as publishers and book printers have combined into ever larger business units, the same trends appear in paper making. Paper is a commodity whose efficient manufacture calls for ever-tighter vertical integration and enormous investments to achieve that goal. Mills can, and do, achieve miracles in flexibly meeting impossible customer demands--it is astonishing to the average lay person to discover how nimbly a quarter-billion dollar mill can turn around. This adaptability is a great boon to publishers, who have traditionally supplied paper to their printers, enabling printers to concentrate on putting ink on paper.

In the past three decades, the book paper industry has been in flux; established uncoated mills expanded into coated paper (P.H. Gladfelter); some mills found other paper products more profitable (Kimberly-Clark--Kleenex, sanitary tissue), and sold off their book paper-making facilities; conglomerates seeking additional end uses beyond lumber from their managed forests, bought paper mills (Georgia-Pacific, Weyerhouser); others sought financial security by selling out to national corporations (S.D. Warren's purchase by Scott Paper);[10] some mills just sold out for tax reasons or for an attractive price (Curtis Paper, Hamilton Paper). The net result was increased conglomeration of the paper industry, as well as an influx of badly needed new capital for some mills. Plagued with low profit margins and a feast and famine market, paper corporations rush to install expensive new, higher speed equipment as soon as markets firm up. Today's paper markets tend to rigidity and move slowly because of the long lead-time for complex new paper making equipment. The trouble here is that several firms expand at the same time, markets destabilize, and another round begins.

With the exception of only two companies, book paper is sold through distributors, whose function is to consolidate orders, to warehouse stock, and to carry the credit risk of many undercapitalized printers and publishers. Most book paper is made to order--size, weight, branded specifications, in quantities of 5,000, 10,000 pounds and carloads (36,000 pounds), with an elaborate set of tightly enforced trade customs. Prices for similar grades show remarkable parallel movement; mills compete more on delivery, quality, and specifications than on price.

Today two particular problems have surfaced, presenting serious marketing, manufacturing, and environmental problems: acid-free paper and recycling. Residual acids in paper after pulping can combine with air moisture and cause the paper in a book to deteriorate quickly; books made from the hand-made paper of the early nineteenth century have a considerably longer physical life span than most books published in recent decades, since their rag furnish lacked chemical processing. More and more publishers and authors have come to see that these acids are a hindrance to long-term preservation of the published work, and are demanding "acid-free" paper.

Similarly, recycled paper is a new entrant in the field. Spurred by Federal and State requirements, mills are increasingly offering recycled sheets, particularly for office use. On the one hand, most recycled printing or office paper uses printing and office waste, computer waste and segregated trash, a material source with finite limits. On the other hand this is a significant part of the waste paper market, and does replace an equal amount of virgin pulp. Recycled paper is a major factor in writing papers used in computers and copiers; it is a somewhat less significant factor in book making. In any case, it is here to stay, and cutting down the waste stream is a valid exercise at any time.

Paper is a commodity taken for granted in the book industry--it has always been thus, and probably always will be. An author views paper mainly as a vehicle for his text, and generally has no real concern or knowledge of the printer's problems with paper; the publisher sees it as a raw material essential to his product, to be ecured at as favorable a cost as possible including availability; the printer sees paper in terms of availability and printability--slippage here can mushroom into a disaster for him; and the reader wants a sheet that is easy reading, neutral in color, and which comfortably represents the author's work. Paper is a ubiquitous material, taken for granted, always on hand, and with no easy, less expensive alternative.

NOTES

[1] Conversation with S.D. Warren Co. marketing department.

[2] In 1856 one ingenious paper maker imported Egyptian mummies whose papyrus "wrappings" were removed and converted to paper. There seems to be no record of what happened to the mummified Egyptians within.

[3] A further value of this broadening of pulpwood sources comes through enabling farmers to harvest miscellaneous deciduous trees from their woodlots in the off season, thereby gaining a second cash crop and relieving some of the pressure on other pulpwood sources.

[4] A close friend of the author, whose career has been in forest genetics, describes himself as a "marriage counselor to pine trees."

[5] Until recent years pulp was hydrated in vats called "beaters," (hence, the name for this step in the process) where steel bars mounted on a large drum both circulated the fibers and hydrated them. Beaters have been replaced almost completely by Jordans in today's paper-making.

[6] This bit of historical data represents the efforts of major mills to respond to inquiries. It comes from Geoffrey Howe of the S.D. Warren Co.

[7] Today offset lithographers routinely use 150-line and 175-line screens, regardless of whether the paper is coated or uncoated; good letterpress printing calls 133-line screen a very fine ruling.

[8] For many years the most vexing printing problem for both lithographer and paper maker alike was this hygroscopic characteristic. Typically, the author has observed sheets six feet long growing an eighth of an inch in the single second it took to travel from feeder to delivery on a large four-color offset press.

[9] The fact that pressrooms were air conditioned, but printers' offices were not, prompted some employees too grumble rather proudly that their employer air conditioned its paper, but not its people.

[10] In a downswing program toward liquidation, Scott Paper Co. sold the S.D. Warren Co. to South African investors for something over $1,250,000,000 enabling Scott to concentrate more firmly on dismembering its paper business to make it more attractive to sell to its major competitor, Kimberly-Clark.

CHAPTER 5

TYPE AND PLATES TO PRINT FROM

A half century before Gutenberg Chaucer complained about the quality of the work his scrivener, Adam, who copied texts in a fair hand on vellum, in his ...*Wordes unto Adam, His Owne Scriveyn*:

> But after my makyng thou wryte more trewe,
> So ofte a daye I mot thy werke renewe,
> It to correcte and eek to rubbe and scrape
> Andd all is thorough thy negligence and rape.

Authors today still complain about the quality of composition when they read proof. Regardless of the medium--hand engrossing, typewriting, metal composition or word processing--the same possibility of transcription error exists today as in the fourteenth and fifteenth centuries. It is a provocative issue for author and publisher alike.

There are probably at least a million places in a normal-sized book where an error is possible, mostly, of course, in the composition stage. Hand composition of moveable type is a lengthy and laborious process, requiring intelligence, great skill, and manual dexterity. No other part of the book-making process had so much inventive attention lavished on it throughout the nineteenth century, and with so modest a success, until the first Linotype went into use at the New York *Tribune* in 1886. It was followed in 1890 by the improved Model 1 Linotype, which was rightly hailed throughout the world as printing's most important development since Gutenberg (Huss: 137).

In 1800, typesetting was entirely by hand: an artisan picked up each single piece of type and placed it properly in his composing stick, and, then reaching the end of a line, he inserted tiny pieces of brass, copper, or paper between words in order to space out the line to fill his stick; and then he did the same for the next line, and so on. A skilled compositor could set about 600 letters and spaces an hour[1] or using another measure, a page of 10-point type in an hour. Type was in chronically short supply, expensive, and until a job was killed and redistributed, it was unavailable for another use. Although the earliest printers had to make their own type, specialist type founders made type by hand until late in the nineteenth century. A skilled die cutter would make a steel punch of the type character, using hand cutting tools, files, and abrasives to create a perfect punch of the letter. This was then driven into a piece of soft metal, usually copper, and the copper matrix would be annealed to harden it before use. This matrix was put in a mold with adjustable sides, and a hot type metal alloy of lead, tin, and antimony would be poured into the box, creating a single piece of type. Both the punch and the matrix could be used many times to make further pieces of type until they were worn out. It was not until 1878, when the Wicke caster became available in England that type was made efficiently by machine (Seybold: 7). Given the high level of craftsmanship required, it is no wonder that type was costly and difficult to get.

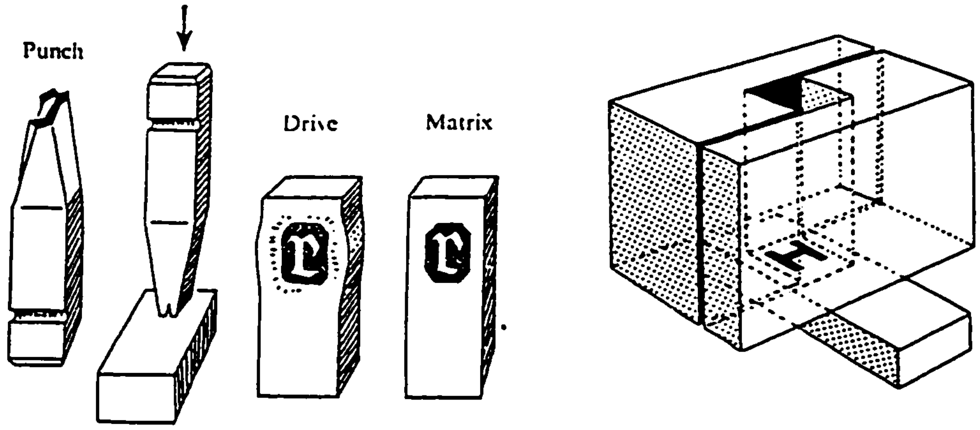


Figure 16. Schematics of steps in type-casting by hand. At the left is the steel punch, driven into the copper matrix bar and the unfinished and the finished matrixes. On the right is an adjustable type mold which can be positioned for varying horizontal dimensions without affecting either point size and type-high of the pieces of type (Strauss: 67).

Other problems were involved in using hand-made foundry type. First, there was no standard dimensioning. An inch is 72 points; a pica is 1/6 of an inch, or 12 points; all sizing of type and letterpress material in America and Britain is now based on these numbers. In addition, "type high," or the height of a piece of type, was not standard; leading American type founders in 1885 made type in five separate heights: .917," .918," .919," .920," and .922"; similar variations existed in Britain (Huss: 16-17). These sizing patterns made it impossible to mix type from different type founders; it was not until 1892, when fourteen American foundries merged into the American Type Founders Company, that the industry's standard of today's dimension of .918" as type high was accepted generally. France's standard is 23.567 mm., or .919" (Seybold: 30).

Dimensioning for today's computers is a mix of type measures (pica, 10 pt. or 12 pt. character width), typewriter standards (6 lines per inch vertically), and inches (margins, folio positions). And in a tip of the hat to the electronic age, programmers' nomenclature includes "headers" and "footers" for what the printer has called "running heads" and "foot folios"; a footnote is still a footnote; an extract is still an extract; and bold face and italic are still bold face and italic. A font to a compositor is a full complement of a type face in one size, comprising all letters, numbers, and punctuation; to a computer worker, font is merely a generic name for a type face.

William Ged's plaster-molded stereotypes of 1725 drew so much opposition that they were never widely used; but by 1802, Lord Richard Stanhope had developed not only a new approach to presses, he had also researched improvements in the stereotyping process, making plaster molds easier to use, less likely to stick to the type being duplicated, and sturdier in standing up to the strains of handling (Dooley: 56). Although compositors still grumbled, duplicate plates did then come onto the market, thus enabling standing type to be redistributed after plates were made. In 1825, a process using wet paper mache, or "flong," instead of plaster to make stereotype molds brought about better molds for easier and faster platemaking; in 1893, came another step, using dry molding, making possible the continuous casting of curved, rotary press plates, further improving quality and processing speeds, particularly for rotary newspaper use.

Allen Dooley, in his *Author and Printer in Victorian England*, uses textual analysis to consider carefully the movements of proof by printer, publisher, and author in the early part of the nineteenth century. His study highlights a dramatic rush to get books into print, with poorly-made proofs sent to authors without manuscript after a casual reading in the plant, and with authors revising their work almost *ad nauseam*, right up to press time. Although timing a century later was somewhat less frantic, there was much the same pressure on proof handling as in 1825 (Dooley: 38).

Serial publication intensified pressure to read proofs to stay ahead of press demands. Dickens vividly describes writing and reading proof almost simultaneously at the plant of his printer, Wm. Clowes and Co. (Dooley: 40). Dooley develops some astonishing information--in most cases early in the nineteenth century: original manuscript was not returned with proof, for no reason apparent today; compositors undertook to correct and standardize punctuation and spelling on their own; and in the spirit of the day, proofs were badly made and often extremely difficult to read.

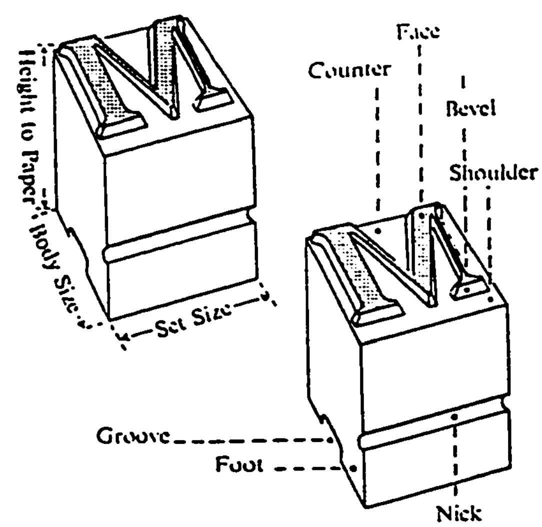


Figure 17. The parts of a type character. Note that the face of the character is in relief above the body of the type and is smaller than the type body--thus, a nominal 12-point type face is less than 12 points in size (Strauss: 59).

Books were set by each compositor in a series of short "takes" of a page or two, and in the early 1800's, proofs were made on actual hand production presses, in printing position. Thus, an author might receive one copy of two proof sheets of eight pages each, covering both sides of a press sheet, forcing him to move from one place to another in the form as he read. Time was of the essence, and publishers kept steady pressure on authors to return proofs. Until the middle of the nineteenth century, books were set directly in pages, with no galley proof stage; and since proofs were made on the actual press used in printing, corrections altering pagination increased the problems of handling proofs, requiring major type moves, reproving, and rereading all along the line. The author would probably get page proof after the printer had eliminated the most egregious errors, he might see early pages after his revision and he might get another look at them in page form, and he might demand to see revised pages right up to press time. Authors might make corrections requiring the printer to set several pages ahead, involving major makeup changes.

The Linotype simplified the proof process by enabling galley proof several pages long to be submitted to authors at first stage; he would see corrections on page proof (pulled on a proof press) in sequence. When galley proofs were introduced, they added another stage in the review process, but at least early corrections would not require complete repagination. Gradually, as power presses came into wider use, older hand presses were demoted to service as proof presses under the composing room's control, a step which would ease proof handling (Dooley: 24).

Until the advent of computerized composition whereby a simple keyboarded command can change measure, leading, and size of type, it was the practice to break a manuscript down so that all text was set at one time, extract matter at another--perhaps on a different machine with a different operator--quotations at another time, footnotes on yet another machine, and only then would they be assembled by a hand compositor, or stone-hand, into galley form. When ready to paginate, the stone-hand would count lines of type or slugs, and assemble pages as necessary. Handling metal type in this fashion was the norm for all book work.

Dooley examines the proof-handling of four Victorian authors: Matthew Arnold, Robert Browning, Tennyson, and George Eliot. Eliot comes out looking somewhat better than her peers, perhaps because of both her professional background as an editor and the careful work and representation of George Henry Lewes. But all of these authors hacked their proofs unmercifully; this was the period of author and publisher sharing costs, so it may be that both parties saw a considerable amount of cost shifting in their relationships. Dooley also points out that Eliot was the first major British author to go to payment on a royalty per copy sold basis (Dooley: 119)--perhaps another commentary on her professionalism and experience with publishing practices.

This author spent several years of his business career on the production interface between publisher and author and can testify to the complexities of proof handling. In this century publishers' contracts generally specify that all authors alterations over ten percent of the cost of composition be charged back to the author, an allowance set to free the author from paying for publishers' makeup changes. He can affirm that in this period authors were as undisciplined as a century earlier, despite being advised repeatedly that every time a pencil was put on the proof, it would cost the author a quarter, all too many authors would routinely waste all their royalties on corrections to proofs; and unfortunately, many of these corrections were extremely minor, on a book where a copy-edited manuscript had been approved.

Today's optimal practice in handling manuscript and proof is light-years ahead of the 1950s. Empowered by word processors and computers, manuscripts are submitted on disk, which, of course, enables changes to be made easily to the text and ensures their accuracy and position.[2] Publishers can convert the text to ASCII code, which can then be converted to the particular word processing program the publisher is most comfortable with. The text is then printed to hard copy for editing for style, accuracy, and general copy review; already publishers are working to copy edit on the computer monitor. These changes, once approved by the author, can be easily typed into the converted text, and, after review, readied completely for press, either onto paper for use in camera-ready mechanicals or into strippable negatives. In either case, the final film is used to prepare lithographic plates for press. When a manuscript arrives in hard copy form, it can either be keyboarded (typed) or, with the increasing use of character recognition scanners, it can be scanned into the appropriate form needed.

This seemingly complex procedure has several advantages to both author and publisher. First, the publisher's cost of composition is reduced to a minimum, with that cost being shifted almost entirely onto the author, who has delivered his book on disk, prepared completely by him. Internal editing costs are probably the same, no matter how they are handled, but corrections and pagination are done more simply electronically. Second, the amount of time the book is actually in work can be reduced significantly. Third, corrections and updates to the disks for a later revision are easy and swift to make, and can be easily stored for future use, for corrections, or for revisions. Fourth, one whole step and set of proofs is eliminated, since computers find it just as easy to deliver paginated material as unpaginated, and repagination is automatic. Fifth, makeup for illustrations, charts, insert material is arranged by keyboarding at the correction stage; and, combined with lithography's ability to print fine detail on uncoated text paper, the author now can locate illustrative material next to text references, using fine-screen halftones, producing higher quality pictures, and saving cost at the same time by eliminating a separate form for illustrations. Sixth, and finally, the author has an ultimate control over the text which authors never have had before, since he is the one who finally reviews and corrects the disk's output.

* * *

The flexibilities and opportunities which we have today in dealing with copy came in a rush in the 1970s, when authors and publishers discovered how much the personal computer could lighten their work. To the layman who saw only linotype slugs in a galley, the machine that made the slugs was an ultimate event. Actually, the Linotype, and later, the Monotype, were end points in a steady development of typesetting machines.

Mechanical typesetting posed several fundamental problems of system, much as with power printing presses: sharp, clean type, line justification, type redistribution, line justification, and flexibility in handling a wide range of sizes (perhaps from 5-1/2 point Agate to 12 point Pica) were all requirements of machine typesetting.

Readers generally, think uncritically that the Linotype sprang full-blown from its developer's mind as the first truly mechanical typesetter. In fact, several more or less successful typesetters were developed in the nineteenth century prior to Mergenthaler's Linotype; Richard Huss identifies two hundred nascent typesetting machines between 1822 and 1900, most of them dying a-borning, although a surprising number were built and put in service (Huss: 214).

The first machine to be patented was designed by Dr. William Church in 1822. An eccentric American physician and inventor who emigrated to England, Church devised a composing machine linked to a typecaster to produce new type which, after use, could be melted down; its main fault, as with most others, was that each line had to be justified by hand. Only models of this system were built.

In 1838 the Bruce Typecaster was put on the market, and went into use successfully. This machine assembled existing type and spaces, which had to be further justified by hand; only after high-speed casters came into use forty years later did this machine begin to realize its potential.

The Hattersley typesetter immediately proved itself in 1857 and was in effective use for three decades until the Linotype made it obsolete. It set existing type by machine and then distributed it in another unit by reverse keyboarding.

Hans Barth devised a type caster in 1888, the first machine since Church to generate type directly for the printer. It produced type for use in a typesetting machine and for other uses as well.

In 1862 the Fraser typesetter came into use; it was one of the most successful such machines and one of the simplest; 10,000 pages of the *Encyclopedia Britannia* were reported to have been set on Fraser machines; one machine was still in active use in 1902 in Edinburgh.

One machine successfully installed by the London *Times* in 1889 was the Kastenbein. It was a mechanical typesetter, assembling fresh type from a high-speed Wickes caster. The Wickes rotary caster had come on stream in 1878; a high-speed caster, it could easily cast enough type to stay well ahead of a linked typesetter. Compositors resisted installation of Wickes casters because of their speed--60,000 pieces of type in two hours, and this type did not need to be redistributed. The next year, the Wickes firm put a simple composing machine on the market; it was one of the very few composers that had any success; Wickes-cast type could be either distributed by a separate unit, or it could be melted down.

The story of Mark Twain's investment in the Paige typesetter is a familiar one--over several years he invested heavily in developing this machine, which became available just as the Linotype was coming onto the market. It weighed two tons, had 18,000 moving parts, and could set only one size of type, 10 point. The machine was a failure; and Twain had to earn his way out of its collapse through writing and lecturing.

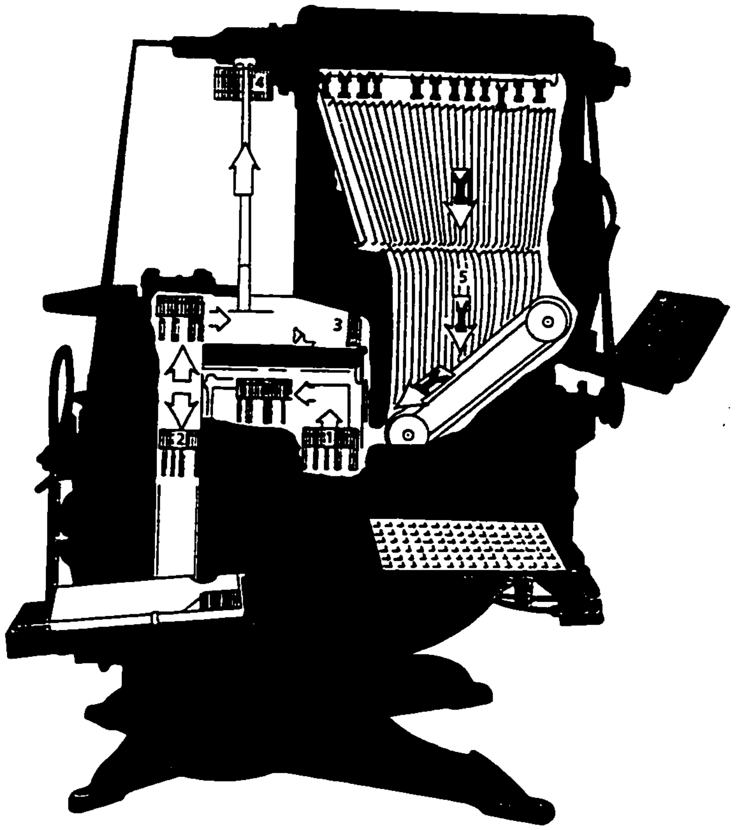


Figure 18. A simplified view of a Linotype machine. Follow the arrows to trace the path of Linotype mats from the magazine, through the machine to the elevating arm carrying a line of mats to be returned to the magazine (Seybold: 44).

Two serious objections to all of the systems except the Wickes machine and the Linotype were that every one of them required that assembled type be redistributed after use. Casting new type which could be melted down eased one of the most serious objections to machine composition. Another problem arose when word spacing had to be hand justified to fill the line tightly after setting.

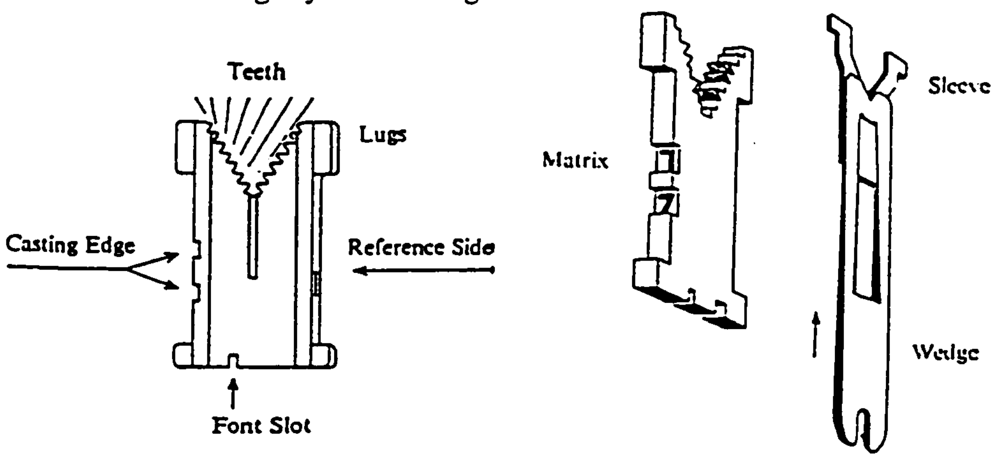


Figure 19. Drawings of Linotype mat and spacebands. Note lugs at top which engage the distributing rollers, the linked sliding wedges on the spaceband, and the relief characters on the mat edge for casting (Strauss: 76, 77).

Ottmar Mergenthaler was a German watch maker who persisted in developing his typesetter. His first really successful machine, actually his third model, was installed at the New York *Herald* in 1886 and soon proved its worth. The Linotype was a successful system which solved the four major problems all at the same time.

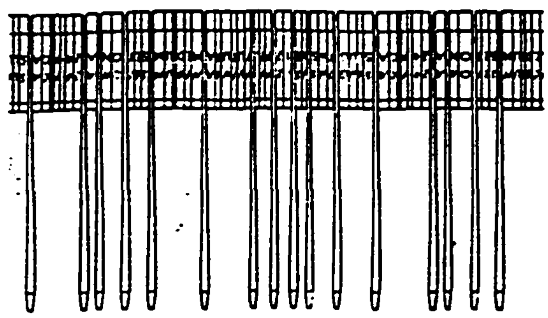


Figure 20. Line of mats and spacebands. When the spacebands are pushed together from both above and below, the wedges slide together and thicken, justifying the line of mats before it reaches the mold (Strauss: 75).

To solve the problem of controlling word spacing, Mergenthaler used a set of double sliding wedges to adjust word spacing. These spacebands, each one a linked pair of sliding wedges, dropped into place between words in the line of matrices when the operator used his space key. When he reached the end of the line and could not complete another word, he pressed a lever causing the paired wedges in the space bands to slide together and to fill solidly the space between words.

Mergenthaler's second major move was using the new Benton engraving machine in 1885 to create clean and sharp dies for making matrices; he was not alone, Tolbert Lanston also used the Benton diemaking system. The hardened brass Linotype mats did not wear out quickly, so the type on the Linotype slugs was always sharp, fresh, and clear, without the wear of successive press runs.

With these two developments, Mergenthaler was well on the road to the Linotype system. Finessing the whole type redistribution problem by melting down Linotype slugs after use, casting new type for each job was a third major solution, harking back to Dr. William Church sixty-three years before; and, fourth, Mergenthaler's simplest and his most elegant contribution was his system for delivering mats back into the magazine channels, the fourth and last step to complete his typesetter. The line of mats was grasped and elevated so that the ears on each mat engaged two threaded rollers moving the line of matrices along the top of the magazine. Each mat had a particular pattern of notches which released it into the proper magazine channel.

Unlike the development of presses, where many machine shops jumped into the press market with differences between each shop's product, both Linotype and Monotype systems dominated the market, effectively freezing the basic machines. Over the lifetime of hot-metal typesetting between 1886 and 1968 a continuous series of running modifications came from these companies as they set about improving their systems.

Though Mergenthaler devised a set of elegant solutions to mechanize typesetting, the Linotype was also the product of many skilled mechanics and inventors, who continuously made changes and upgrades available, a fluid development keeping the machine line up-to-date (Huss: 137).

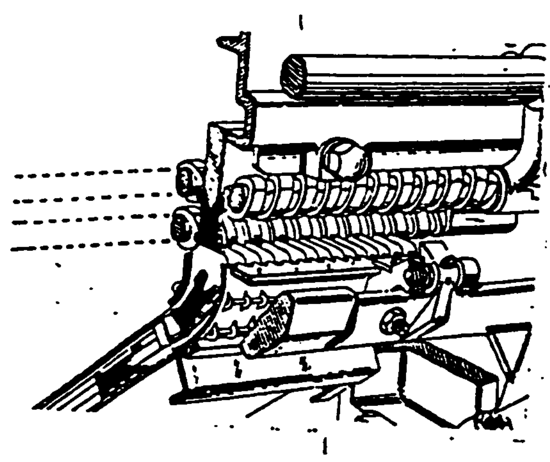


Figure 21. Mergenthaler's elegant mat distribution system. The paired helical slotted rollers forward the line of matrices along the combination bar where they drop off into the correct magazine slot (Strauss: 75).

It is noteworthy that all four of the basic steps in mechanical typesetting were all made by Americans: the first practical foundry typesetter (Bruce, 1838); the first mechanical slug caster with justification and mat redistribution system (Mergenthaler's Linotype, 1885); the first single type casting and composing machine (Lanston's

Monotype, 1898); and the first commercially successful "cold type" caster, the Intertype Fotosetter, tested thoroughly at the Government Printing Office in 1946.

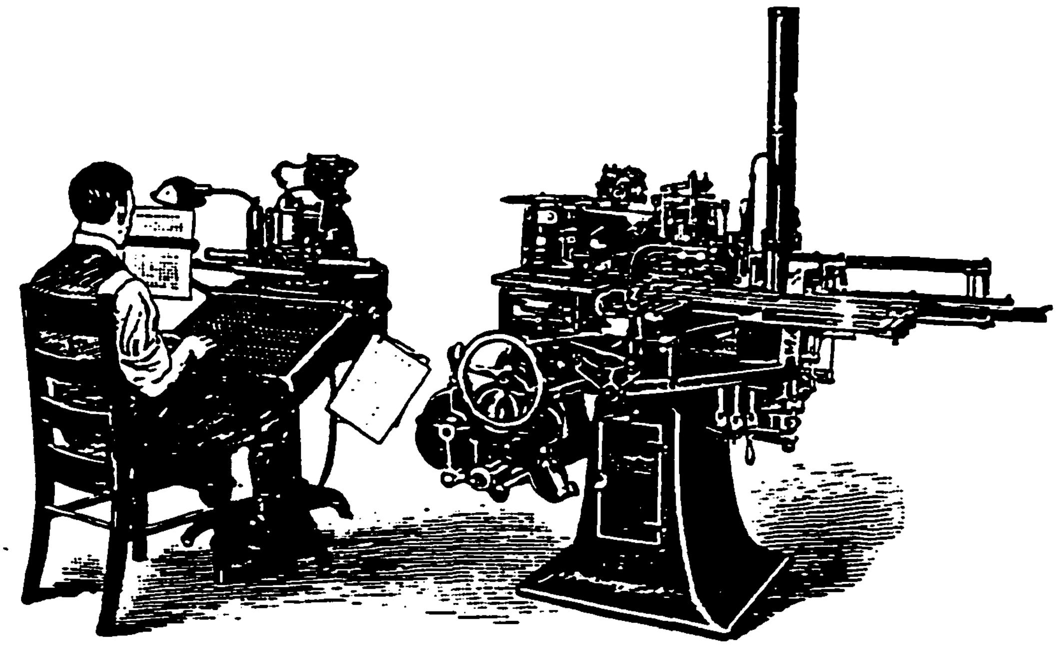


Figure 22. A full view of the Monotype system, with the keyboard unit on the left and the caster on the right. The paper tape is at the top of the keyboard unit; the keyboard itself reflects all 225 characters in the matrix case. The tape is also seen at the top of the caster (Seybold: 52).

The second system to be widely accepted by the trade was Tolbert Lanston's Monotype, which used separate complex keyboard and casting units. Matrices in the caster were placed in a designated position in a matrix case, which was moved into casting position by compressed air instruct-ions created on a wide perforated paper tape from the key-board unit. The caster cast individual type characters In justified lines which could be handled in the composing room exactly as was hand-set type. The machine cast from the end of the work, instead of from the beginning, as all justifying and spacing instructions to the caster were at the end of each line, and it had to respond to them before casting the line.

A good operator on the Monotype could set as fast as a Linotype operator, with considerably more elegance and spacing. It was also the only effective machine system for highly complex text such as chemical and mathematical equations. In fact, Monotype is still used by some publishers for setting mathematical and chemical equations, as it may be simpler than creating the equations in a computer; some publishers do use specialty computer programs for this work. Corrections on the Monotype are significantly more flexible than on the Linotype, particularly for complex work. It was also the first system to rationalize mathematical standards for wide and narrow letters and spacing, enabling precise control by the operator for even setting.

Huss tells of a group of British investors who examined the Monotype while on a voyage home to Britain, and were so impressed that they speedily formed a firm to develop the Monotype, even before landing in Europe.

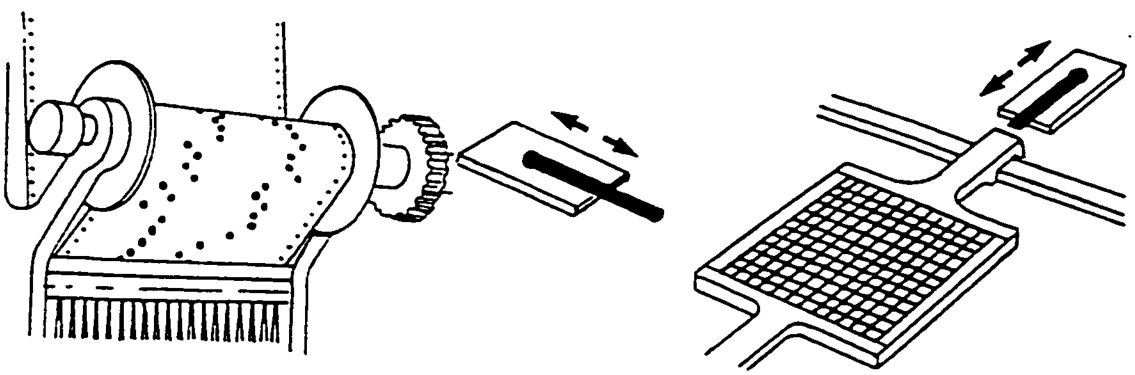


Figure 23. Schematic views of the perforated Monotype tape which actuates the caster, and of the matrix case which moves horizontally in two directions to position the mat in casting position. The mat case contains fifteen by fifteen mats, or a total of 225, including fixed spaces (Seybold: 58).

British and European practice has been generally to use Monotype for setting books, in contrast to America's dependence on the Linotype; the broader use of Monotype to set non-newspaper material in Britain was probably a major consequence of this local marketing. British Monotype made great inroads into European markets, eclipsing the success of Philadelphia's plant; in later years, the American Lanston Monotype Machine Co. expanded to manufacture a dependable line of step-and-repeat platemaking machines and process cameras for lithographers

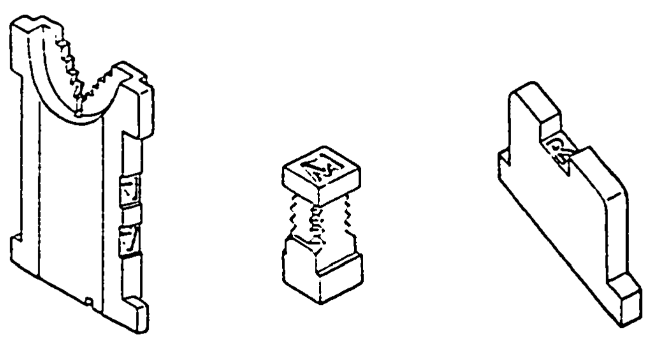


Figure 24. Comparison of mats used in the three leading casting systems. (a) The Linotype mat is collected with others to make a one-line slug; (b) the Monotype mat is included in the 225-mat case which moves to and fro at the casting pot; (c)the Ludlow mat is set by hand in a special "stick" which is fed into the Ludlow caster (Huss: 8).

In many composing rooms there was another system for casting display type, the Ludlow Typograph (Huss: 8). Originally conceived as an inexpensive system for creating newspaper headlines, it evolved into a real production tool for casting display type and new headlines, using the same principle as the Linotype's melting down type after use, instead of re-distributing it. Essentially, special brass matrices were clamped in a special "stick," which was inserted into a casting unit producing single lines of type. It earned its way in job and newspaper shops and was used only incidentally in book plants.

American and British book publishing practices have differed. Not only did Americans use Linotype as their basic typesetting system while British publishers used Monotype, but they also preferred longer-wearing copper-faced electrotypes and, when they became available after World War II, plastic printing plates for economy, while British practice was to use stereotypes of solid type-metal. This may well be a consequence of larger markets in America, requiring longer press runs and heavier wear on plates. In general, publishers preferred to run from plates, which they owned; keeping type standing cost regular surcharges for rental of both the type and the space it occupied, as well as heavier lockup and makeready charges; it has been a rare book that was run from type. Foundry type in the twentieth century was still expensive; when needed, printers would make blocked electrotypes of the foundry type for inclusion in the form and would distribute the costly type for prompt reuse, and could put wear on plates instead of on costly original engravings.

Figure 25. "In the Days that Wuz." A retrospective comment on the introduction of the Linotype, as seen from the Inland Printer of August, 1942 (Huss: 21).

A major development here was the use of Teletypesetters to control Linotype machines. This practice, as with the Monotype, made casting capability a function secondary to control by a perforated tape. Originally conceived in 1932 as a device to transmit breaking spot news and sports stories from a single news room to several newspapers, the Teletypesetter was used by book manufacturers to generate eight-channel tapes in the office (created by re-trained non-union secretaries) for straight, simple type matter, without extracts, quotations, or footnotes. In general, a battery of teletypes would service two shifts of Linotypes, with a single Linotype machinist tending to four casters. Casting from teletypesetter tapes was significantly faster than that by operator-controlled machines; in fact, machine speed was limited more by the number of mats which could be loaded into the channels of the Linotype magazine, rather than by the operator's speed.

By the 1960s, the Associated Press and United Press did use these machines to transmit copy, but difficulties of type size, column width, and editorial text changes between papers raised significant problems (Seybold: 31); and it wasn't long before air delivery of papier-mache stereotype mats, copper electrotype shells, and litho negatives eliminated the Teletypesetter from magazine and newspaper use. Today magazine or newspaper copy is transmitted in digital form by wire or satellite from publisher to plant, generating plate-ready film for plating; book publishers more often merely ship mechanicals to the printer for conversion into negative form for lithography.

The end of World War II opened the floodgates on changes in the Graphic Arts; this revolution started in the composing room. The first generation of typesetters to provide material for photo-mechanical use was paced by the Intertype Fotosetter. The Intertype Corp., founded in 1913 as a direct competitor of the Linotype, built machines with the capability to use interchangeably the same matrices as did the Linotype. Early in the 1940s their engineers devised what was essentially a modified Intertype machine, but with an elaborate photo unit in place of the metal casting section. An image of the letter was embedded in a clear window in the mat's center, instead of on the edge of the mat as it was for metal casting. Spacing was electronic, and a zoom lens controlled letter sizing in the photo turret.

The Fotosetter was tested in the Government Printing Office in 1946 and was an instant success; it came on line just as lithography was beginning to explode with new films and plates. Shrewd forward-looking typesetters went into the business of furnishing reproduction prints to publishers from batteries of Fotosetters, profoundly changing the climate for "cold-type" composition. Like the Linotype itself, this was a direct-input machine from keyboard to turret, without a tape from a separate keyboard unit.

The British Monotype Company developed a photographic analogue to its hot-metal casting machine, producing reproduction proofs or negatives from a light projected through letters in tiny windows in a matrix case. This Monophoto gave a perfect image of the type, but there was no speed or cost advantage over the regular Monotype, and it did not gain wide acceptance.

Hardly had the Fotosetter and the Monophoto systems demonstrated the values of photo-composition than the second generation of machines was on the market. These were still rooted in conventional keyboards, several of them using modified IBM typewriter inputs. They speedily evolved into mainframe computer typesetting, using tape drives, with text on one tape merging with a pagination/makeup program into a combined tape which would then drive the reproduction. Today these mainframe type processors are obsolete and have been replaced by one form or another of "desk-top processing," enabling designers and production people to merge design, text, and illustration on small personal computers into a harmonious whole, empowered by increasing sophistication of photomechanics and offset lithography.

Reviewing the process of book production by raised type letterpress may be redundant, but although computers replaced Linotypes, sheet aluminum replaced electrotypes and rotary litho presses replaced flat-bed cylinder presses, this improved technology-- which has shortened the production cycle, lengthened press runs, and enhanced quality of product--is rooted deeply in letterpress origins for application and management.

Although there were few, if any, major break-throughs in press development up to the end of World War II, incremental changes in type design and mechanics did occur. The Monotype Company led in these fields both in the United States and in Europe; but the Linotype and Intertype companies upgraded their machines with available mechanical options. For example, standard Linotypes set a line up to 30 picas long, or five inches; 42 pica (seven inch) machines came into use, eliminating in many cases the need to butt slugs for long line captions and display material. Mixer Linotypes, with more than one type magazine, made it possible quickly to mix varied sizes and typefaces in straightforward composition. Book manufacturers invested heavily in Teletypesetters both to reduce labor costs and to increase production of straight matter. Platemakers developed vinyl molding for electrotypes and in 1942 introduced light-weight vinyl printing plates, replacing electrotypes for non-critical work.

There are really only two kinds of letterpress printing surfaces: locked-up type forms or plates. Pages of type are locked in steel frames (chaises) with standard-sized pieces of wood or metal (furniture); pairs of wedges (quoins) jam the type and furniture tightly into the chaise. Precise positioning in the chaise is critical to lockup for precise register between forms in printing the second side of the sheet (denoted as inside and outside forms, depending on which form contains page one) and between colors, where a shift of a thousandth of an inch can cause misregister. Union rules typically have always required that final adjustment of position be made on press by compositors, not by pressmen, during the makeready phase.

With the end of World War II, book manufacturing costs rose sharply, and this inflation continued over the next two decades. Essentially similar wage rates and manning schedules tended to standardize costs throughout the industry, although aggressive marketing, costing, and management strengthened some manufacturers in this highly competitive market. Thus, manufacturers tended to stress the quality of their service, particularly in composition and proofreading.[3] This was in sharp contrast to the picture that Dooley paints of careless typesetting, sloppy proofing and proofreading, and unresponsive printers a century before.[4]

The availability of new, freshly cast type at the end of the nineteenth century brought a new dimension to typesetting--a new aesthetic. Energized by William Morris' Kelmscott Press in the eighteen-nineties, at which he sought to create a revitalized crafts movement, many small, creative print shops sprang up both in Britain and in America. The Kelmscott Press was more than a machine with a talented operator--Morris designed three new, important type faces (Golden, Troy, and Chaucer); he created designs and typographic formats unique to each book produced, printing them carefully on special paper made only for Kelmscott; and in doing so, he unlocked the gates of a new visual dimension of print production (See figure 26)

Type founders were prodded into new type designs; books were seen as visually more than just ink and paper, and in the 1930s there arose a new profession of book designing. Expatriate designers from Europe, such as Ernst Reichl and Andor Braun, American artists such as Warren Chappell and Robert Josephy, were typical of these new professionals. Led by publisher Alfred Knopf, far-sighted publishers drew on such designers as Chapell and W. A. Dwiggins to establish a new direction for book and typographic excellence. Chappell's Lydian and Dwiggins' Caledonia type faces became a standard in many works in these decades, bringing these two designers into prominence in the book world. In the 1920s, the American Institute of Graphic Arts was founded and

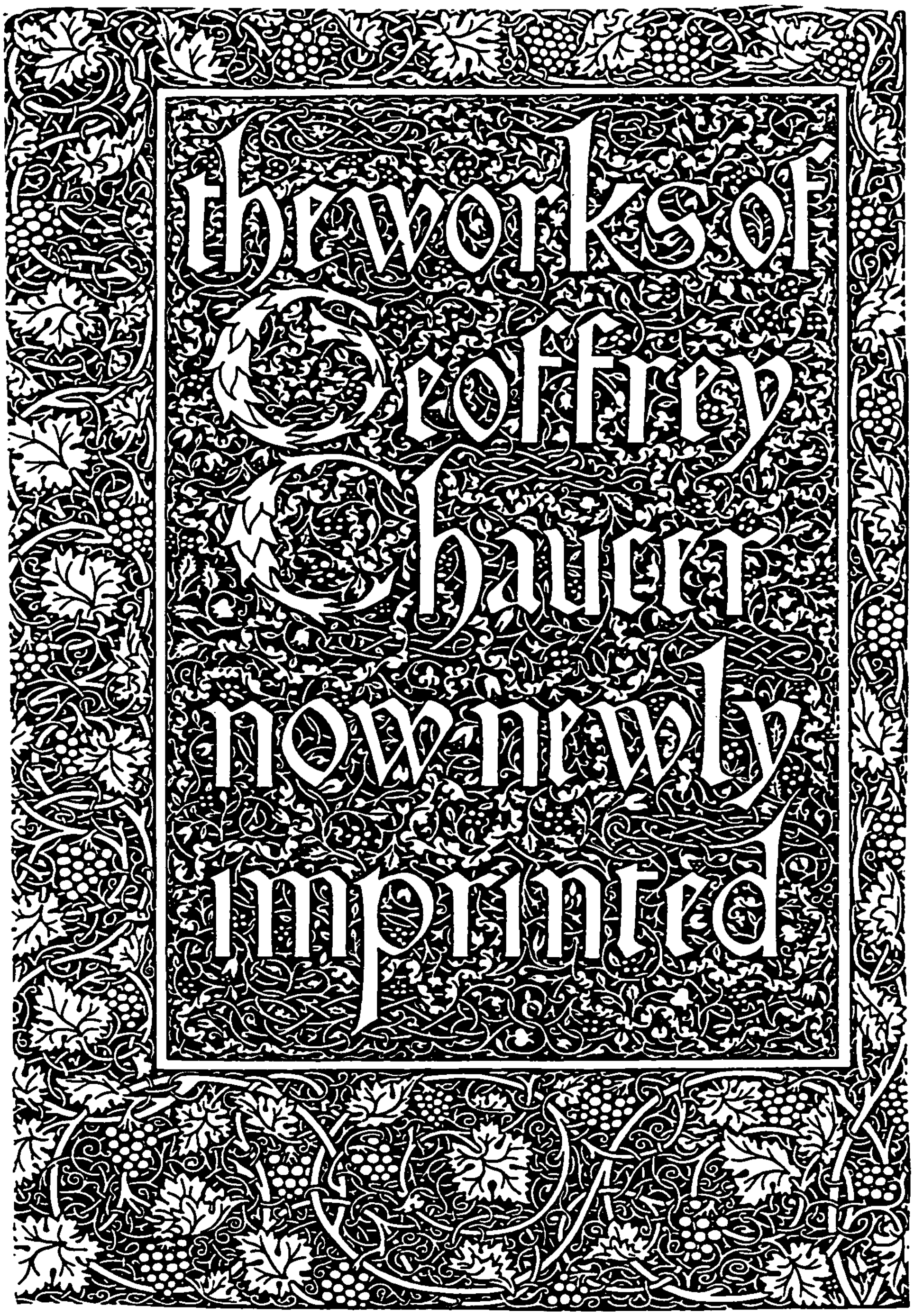


Figure 26 Title page and text page from William Morris' Kelmscott Chaucer printed at the Kelmscott Press in 1895. There are 87 wood-engraved illustrations by Sir Edmund Bourne-Jones, with decorations and initial letters by Morris himself. He designed three type faces for his own use at Kelmscott Press, as well as using special paper made for him in his effort to create a new climate for the Graphic Arts (Johnson: xiii) Reduced.

But thus they mette, of aventure or grace;
And he saleweth hire with glad entente,
And asked of hire whiderward she wente.
And she answerde, half as she were mad,
Unto the gardyn, as myn housbonde bad,
My trouthe for to holde, allas! allas!

AURELIUS gan wondren on this cas,
And in his herte hadde greet compassioun
Of hire and of hire lamentacioun,
And of Arveragus, the worthy knyght,
That bad hire holden al that she had hight,
So looth hym was his wyf sholde breke hir trouthe;
And in his herte he caughte of this greet routhe,
Considerynge the beste on every syde,
That fro his lust yet were hym levere abyde,
Than doon so heigh a cherlyssh wrecchednesse
Agayns franchise and alle gentillesse;
For which in fewe wordes seyde he thus:

MADAME, seyeth to youre lord, Arveragus,
That sith I se his grete gentillesse
To yow, and eek I se wel youre distresse,
That him were levere han shame, and that were routhe,
Than ye to me sholde breke thus youre trouthe,
I have wel levere evere to suffre wo,
Than I departe the love bitwix yow two.
I yow relesse, madame, into youre hond
Quyt every surement and every bond,
That ye han maad to me as heer biforn,
Sith thilke tyme which that ye were born.
My trouthe I plighte, I shal yow never repreve
Of no biheste, and heere I take my leve,
As of the treweste and the beste wyf
That evere yet I knew in al my lyf.
But every wyf be war of hire biheeste,
On Dorigene remembreth atte leeste.
Thus kan a squier doon a gentil dede,
As wel as kan a knyght, withouten drede.

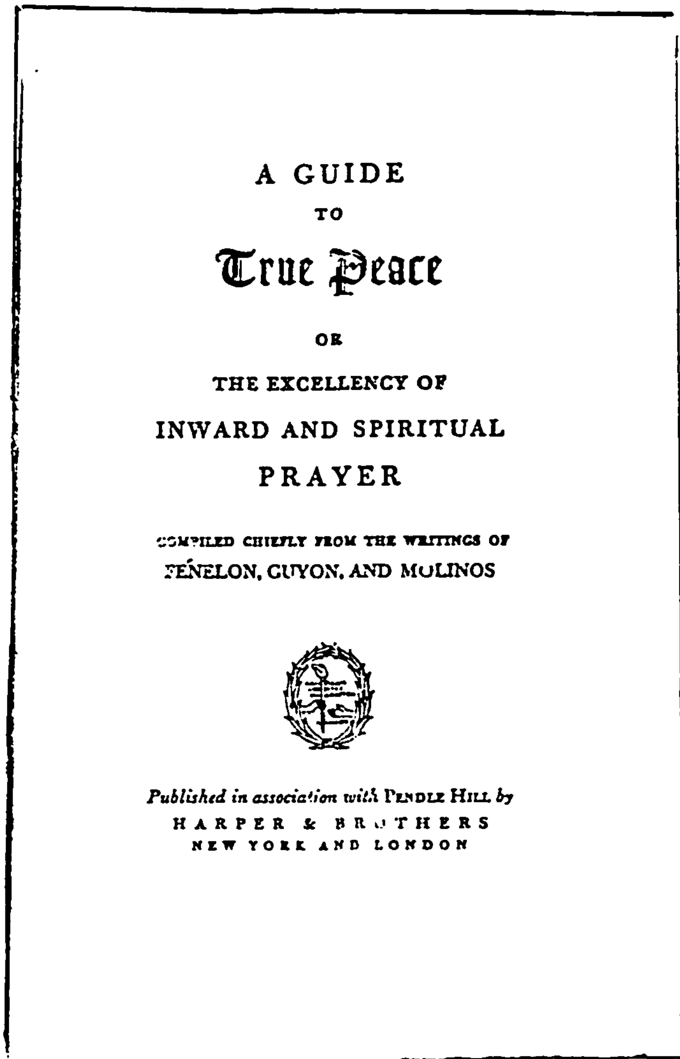
SHE thonketh hym upon hir knees al bare,
And hoom unto hir housbonde is she fare,
And tolde hym al as ye han herd me sayd;
And be ye siker, he was so weel apayd
That it were inpossible me to wryte.
What sholde I lenger of this cas endyte?

through its annual Fifty Books Show and its continuing thrust for good design and typography, created a climate for publishing better looking and more readable books.

The twentieth century also brought a new generation of printers who stressed both high quality production and fine typography and design. Theodore DeVinne, who owned a large variegated printing plant in New York City, wrote and preached a sense of quality product; Joseph Blumenthal's Spiral Press won awards nationally for its excellent typography and beautiful presswork; Peter and Edna Beilenson ran the Peter Pauper Press as both hard-boiled printers and avant-garde designers. Daniel Berkley Updike and Carl Purington Rollins were two more leaders from this period.

Some leaders in other areas of publishing or printing became more deeply involved in the mechanics of type and printing, setting up print shops in their homes and discovering the hands-on beauty of setting type and printing themselves. Two such ventures were Arthur Rushmore's Golden Hind Press in Madison, NJ, and Walter Kehoe's Press of the Wooly Whale in Swarthmore, PA. Rushmore was general production manager at Harper's and actually hand-set some appropriate books for the firm (See Figs. 27 & 28). Kehoe was head of the Medical Book Department at Lippincott's, rising from production work to senior management.

The outstanding example of moving from hand work in typesetting and production to full-scale publishing is, of course, Virginia and Leonard Woolf's Hogarth Press, which managed to embrace each stage of nineteenth-century publishing development. Starting in 1917 with some type and a platen press in their dining room, the Woolfs were successful in transmuting their interest in text to type, eventually moving to London, where the Press went on to become a leading influence on publishing itself, publishing not only Nobel laureates such as T.S. Eliot, and also Christopher Isherwood, Sigmund Freud, Rainer Maria Rilke and Virginia Woolf herself, and, at the same time carving out niche specialties



A GUIDE

TO

True Peace

OR

THE EXCELLENCY OF

INWARD AND SPIRITUAL

PRAYER

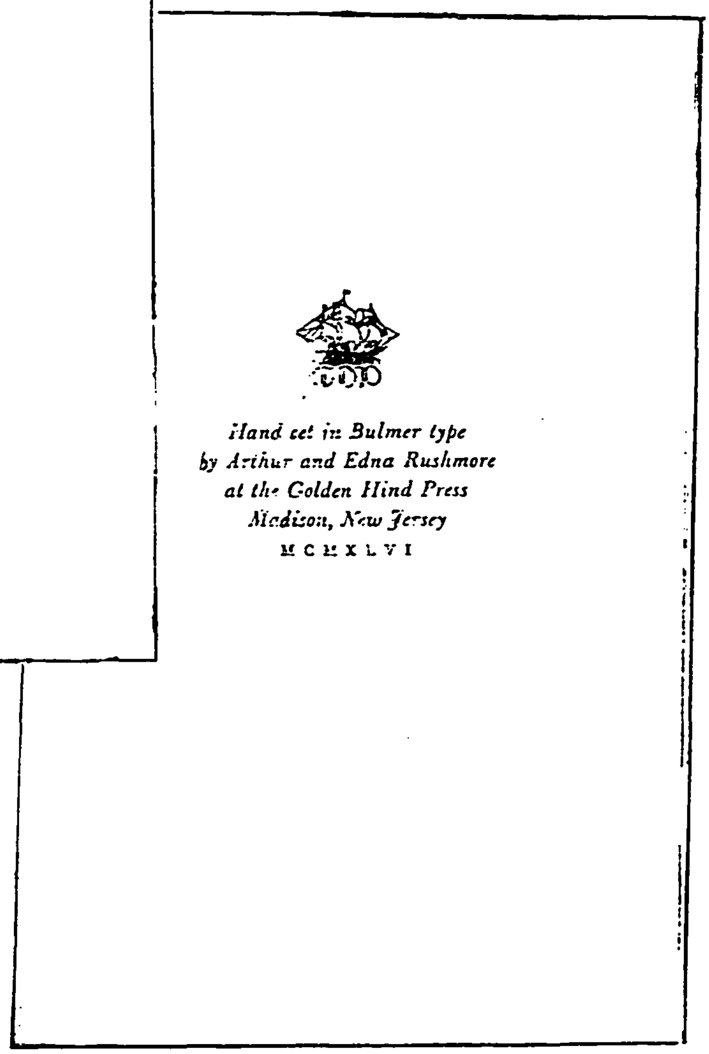
COMPILED CHIEFLY FROM THE WRITINGS OF

FÉNELON, GUYON, AND MOLINOS

Published in association with PENDLE HILL *by*

HARPER & BROTHERS

NEW YORK AND LONDON



Hand set in Bulmer type

by Arthur and Edna Rushmore

at the Golden Hind Press

Madison, New Jersey

MCMXLVI

Figure 27. Title page and colophon book of meditations published in 1946 by Harper's religions book department. It is noteworthy that this book was hand-set at the Golden Hind Press, the basement hobby shop of Arthur Rushmore, Harper's then Production Manager. Rushmore obviously set the type, took it to the office, where he had it electrotyped and turned over to the printer. (Same size)

THERE IS A SPIRIT

The Nayler Sonnets

BY

KENNETH BOULDING

FELLOWSHIP PUBLICATIONS

NYACK, NEW YORK

Figure 28. Title page, copyright page, colophon, and text spread of a book of religious sonnets by Kenneth Boulding, originally published by Harper, following the same production pattern at the Golden Hind Press as with Figure 27. It demonstrates both a sense of fine typography growing from the exercise in hand composition and the dedication of the typesetter to his craft and to the subject.(Same size)

FOURTH PRINTING, 1959

Set by hand at
The Golden Hind Press
Madison, New Jersey

XXIV. *I found it alone, being forsaken*

THERE is no death but this, to be alone,
Outside the friendly room of time and space,
Forsaken by the comfortable face
Of things familiar, human, measured, known.
Not in raw fires, nor in the imagined groan
Of tortured body-spirits, do we trace
The shape of Hell; but in that dreadful place
Where in the vision nought but self is shown.
And yet—he found it there, as on the cross
When even God had fled, Love did not die:
So from the last despair, the extremest cry,
Flows the great gain that swallows all our loss.
And from the towers of Heaven calls the bell
That summons us across the gulf of Hell.

XXV. *I had fellowship therein with them who lived in dens and desolate places in the earth*

CAN I have fellowship with them that fed
On desert locusts, or the husks of swine,
Slept without tent, went naked as a sign,
And made the unforgiving earth their bed?
When I in gentle raiment have been led
Through pastures green, and have sat down to dine
At banquets, and have let my limbs recline
On easy couches, and slept comforted?
How can we pray for daily bread, with lip
Still smacking from a comfortable meal,
Or how, from Dives lofty table feel
With Lazarus the glow of fellowship,
Unless, with spirits destitute, we find
Fellowship in the deserts of the mind.

in Russian translations and psycho-analysis. The combination of Virginia Woolf's critical and writing sensibilities and her husband's commercial acumen and editorial judgment lifted the Hogarth Press into leadership in the trade (Willis: 396).

American authors whose concern for printing and typographic excellence affected American publishing included the poets Robert Lowell, Robert Frost, and e.e. cummings and the photographer Samuel Chamberlain. Lowell demanded of his publisher that his books be produced by one of the best printers available; Joseph Blumenthal's Spiral Press created both distinguished typography and outstanding presswork.

Similarly, cummings worked closely with his own typographer to ensure that he could create poetry that spoke as aesthetically to his theme as did the text itself. Chamberlain was well known for his series of small photographic books of New England scenes, printed by sheet-fed gravure for Hastings House. At the time (the late 1940s and early 1950s), quality offset lithography was not available to produce the smooth continuous tones of Chamberlain's photos; Hastings House produced an outstanding series of books, with stunning photos, beautifully printed, and well published.

One of America's most professional authors was James Michener, whose forty books gave him a keen sense of what matters in today's publishing world. Michener points out that, although he had not made concessions in subject in order to enhance marketability, he took great pains to make his books physically comfortable; revering fine bookmaking, with careful, readable typography, good paper and binding. He also said that while in the past he had been most concerned with type and paper, he came to understand the importance of colorful, illustrative jackets and paper covers on paper-back editions (Memoir: 396). An examination of the original hard-back copies of his works bears out

(will you teach a
wretch to live
straighter than a needle)

ask
    her
        ask
            when
                (ask and
                ask
                and ask
again and)ask a
brittle little
person fiddling
in
the
rain

(did you kiss
a girl with nipples
like pink thimbles)

ask
    him
        ask
            who
                (ask and
                ask
                and ask
ago and)ask a
simple
crazy
thing
singing
in the snow

Figure 29. A poem from the *Collected Poems of e.e. cummings*, where he arranges the lines of his poem to illustrate the subject's body in describing their snow play. This author vividly remembers his excitement on discovering the poem's visual code when he was working on the book's publication.

this standard. One exception to this occurred in reprints of his first book, *Tales of the South Pacific*, which was published at the height of the post-World War II paper shortage, and, although typographically pleasing: the grey, coarse paper used to keep the title in stock spoiled the book's image.

Although publishers cherish their ultimate responsibility for packaging a book, authors do have concerns for the appearance of their work. Five trends have made this interface easier: sharp, fresh, newly cast type; typographic freshness from new type faces brought to market by Lanston Monotype and Mergenthaler Linotype; offset lithography, enabling close location of text and illustration; the increasing use of professional typographers to harmonize text and type aesthetically; and, finally, the new flexibility available from the computer to generate visually attractive books.

NOTES

[1] The standard measure for type is the "em," or a square type of the point size; an "en" is half an em. Typesetting has been traditionally measured in ems, either in a time reference, as "ems per hour," or as an area reference, as "ems per page." Thus, a 5" x 8" book, with a type page 20 x 40 picas, set in 10 pt. type on 11, would have some 980 ems, taking about an hour and a half to set, for which a Philadelphia compositor in 1800 would have been paid thirty-nine cents (Gesensway: 20e).

[2] William Zinsser, distinguished scholar, writer, and editor, in his book Writing with a Word Processor, describes his battle to tame his new Personal Computer, and closes with a prescient paragraph describing how he will walk from his office to his publisher's, reach into his pocket and deliver the manuscript of the book--on two disks. (Zinsser: 116). This practice is more and more the norm, with the additional use of fax machines and modems to transmit copy telephonically.

[3] My first independent responsibility in my first publishing job was to handle production of a new line of mystery books.

We were dumbfounded one day to find a query on a galley proof: "Address correct? New York City Directory places address between Broadway and Columbus, context locates address between Broadway and Amsterdam. Which is correct?" No one in the office knew the answer, so the editor rode the subway to 116th St. and reported that the query was not only legitimate, but was also correct and important to the story line. The astonishing fact was that the proofreader was in Clinton, MA, with no direct experience with New York City. Since then, I have always thought highly of the Colonial Press.

[4] On a routine sales call on the Princeton University Press, I was introduced to another visitor - "...our consultant, Carl Rollins." It was a rare opportunity to meet one of the giants of our profession, a man whose typography had been part of putting the Yale University Press at the top of its field.

CHAPTER 6

BINDING TO BRING THE BOOK TOGETHER

Bookbinding is the process of putting and holding a book together; it is also the last set of operations in physically making a book. Thus, it is one of the five major mechanical areas in bookmaking: typesetting, printing, paper, photo-mechanics, and binding. Binding is of particular concern to the publisher for two reasons: it represents about a third of the raw manufacturing cost of a book, and it is also the obvious starting point for planning any printed piece, drawing together, as it does, material from all the other areas of the Graphic Arts.

Binding today comprises the final complex series of steps in this process of taking blank paper, putting words and pictures on it, and then manipulating the printed sheet into a finished book. It is also the most mechanically complicated area; this is not surprising, for until nearly 1970 the mechanical operations in a bookbindery closely replicated the hand bookmaking operations of 1800. In other areas of bookmaking new technology came from significant breakthroughs. In this one, three factors tended to delay changes which might have drawn the industry closer together: this emphasis on mechanical replication of hand work, the fragmented state of binding service, and the sharp divisions among typesetting, printing, and binding. In 1800 book-binding was generally an adjunct to the local printer/book- seller's service. Many of the developments in binding operations came from inspired tinkerers trying to make their work easier by mechanizing each hand-done task.[1] So, it was not until late in the nineteenth century that major breakthroughs occurred. As binderies became more mechanized in the late nineteenth century, complete book manufacturers were born, providing for publishers complete production service from manuscript to bound book and erasing the corporate boundaries between trades. Plants owned by publishers were the exception: Harper's, Appleton's, Lippincott's, for example.

The practice early in the nineteenth century was for local patrons to bring to the local printer number sheets of books, folded sheets, or gathered sheets "in boards" for completion as a bound book. The printer would sew the folded sections (or signatures) onto fabric strips or cords, which were attached to boards in the cover. Leather could then be wrapped around the boards, completing the cover, on which the author's name and the title would be branded with heated brass letters. Before the cover was covered in, the backbones of the signatures would have been hammered to form a round back, with the first and last signatures making a stable edge for the hinged cover; attractive end papers might be attached to the text and inside cover; edges might be marbled or gilded, all work was done slowly by hand. Comparato points out that, despite some minor changes, binding in the 1830s was essentially at the rudimentary stage of printing itself at 1800 (Comparato: 24). Over the early nineteenth century, as printing processes became industrialized, specialist bookbinderies sprang up using the skills of artisan specialists to produce finished books.

The binding industry developed in essentially two directions. On the one hand, there was, and is, the trade, or commercial bindery, which functions largely as the anonymous binding and finishing department of many printers, simultaneously cutting, folding, stitching, finishing printed sheets of many printed jobs. The other direction is the edition bindery, manufacturing hard-bound books from printed sheets. Although there are specialty binderies in this trade too, most book manufacturers include their own binderies, using highly specialized equipment to produce books. In one sense, edition binders can be compared to sausage makers, turning out a stream of books, differing only in details of size, thickness, and materials, but all similar in structure.

Figure 30. A wood engraving ca. 1859 of Walker's New York Bindery. This identical illustration had been used, ca. 1843, to picture a large London bindery, too. Each artisan did all operations on each book he handled. Note the man at center front using a plow to cut sheets (Walker: 3).

Bookbinding involves feeding manufactured book components and sub-assemblies into the production stream, creating more and more of the final book with each step. There are at least seven separate groups of operations which must be merged: cutting, folding, gathering, sewing, forwarding, casemaking and casing-in, each one representing an operation that was done originally by hand.

Binding also differs from other parts of the bookmaking process in the number of operations needed to accomplish the goal of a good book in lining-up and covering-in. Printing, paper, and typesetting alike involve essentially a single product, run through the same machines: Linotype, press, Fourdrinier have been common to all printing--binding can vary spectacularly from job to job. advances in binding were incremental and slow in coming. There were two probable reasons: the product was varied, and runs were short, as markets for bound books had not grown large enough to justify mechanical power; production runs were largely to meet library needs.

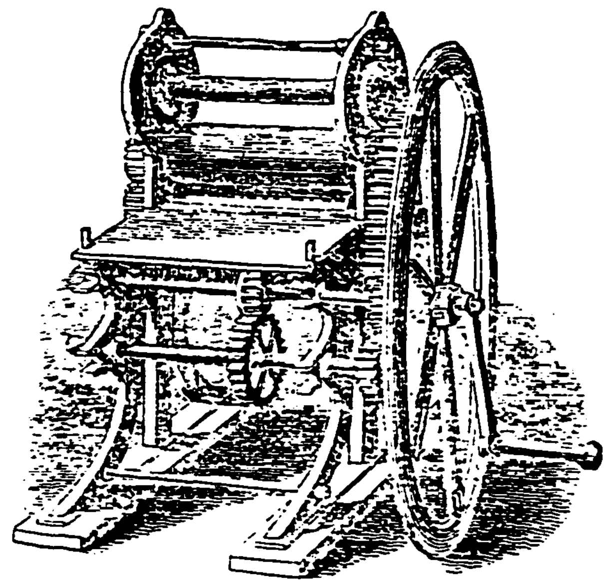


Figure 31. An early rolling press. Note the power source: a flywheel to be turned by a husky male, while the feeder would put sheets between the mangle-like pressure rollers (Darley: 32).

In 1825 the first operation in binding a book was to smooth out the wrinkles from printing on dampened paper and to reduce the thickness of the sheets by beating a lift of sheets with a fourteen-pound hammer. This was the first function to be mechanized in 1827:a boy would lay a lift of dried sheets between metal plates and feed that "sandwich" between two rollers to press out the sheets, evenly reducing the caliper of the paper by perhaps a fifth or sixth, and shortening this particular operation from twenty minutes in beating to two minutes in rolling (Darley: 30).

Cutting and trimming of paper and boards was done by an artisan running a "plow" (a type of captive blade held in a rigid channel by a carpenter's plane-like device) back and forth by hand until the full thickness of material was cut; guillotine paper cutters as we know them today did not appear until 1861.

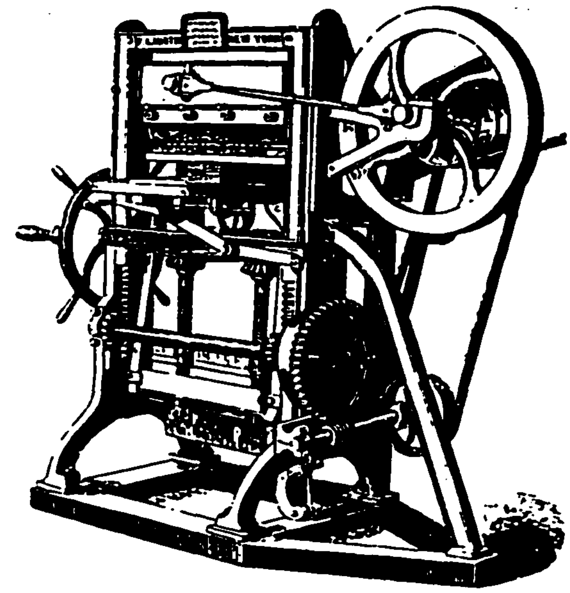


Figure 32. An early guillotine cutter, ca. 1861. Note the long crank from the wheel to top of the cutter, which moved the knife down; operating control handle is located right below the table (Comparato: 31).

Press sheets were folded by hand (usually nimble, inexpensive female hands) until mid-century. Books were hand-sewn by other female hands, until the Smyth sewing machine came into use in 1871 (Comparato: 167). The impact of industrial work by women is noted in Chapter 2 in connection with women press feeders; their use in binderies is another case of female exploitation in industrialization of repetitive work, eschewed by journeymen as beneath them (Davidson: 188).

Another major development, making a separate case, or cover, to be attached to the sewed book after rounding and backing, arrived with the introduction of the arming press in England in 1832. This press liberated decoration from limiting hand work on a finished book combining production and decoration of covers in quantity as a separate operation. The early arming presses were essentially hand-powered Colombian or Albion printing presses modified to stamp a pre-made case, permitting the substitution of tipped and glued endpapers for the cloth tapes or cords holding the book in its cover. Later, hydraulic presses applying heavier pressure and using gas heaters to heat the die were able to handle increasingly complex designs.

At first, cloth bindings, instead of leather, received only a lukewarm acceptance in the 1820s, but as materials improved and heat and pressure on arming presses gave binders flexibility in stamping blind images, inks, or metallics on covers, while book cloth replaced leather.

Book cases today have available a broad spectrum of covering materials: specialty papers, starch or pyroxylin-filled fabrics, synthetic leatherette materials. Binding materials in cases can be ink or foil stamped, lithographed, embossed, screen printed, coated or laminated, to name only a few of the techniques actively in use today.

Every piece of paper coming into the bindery must be cut at one time or another--into smaller sizes, to trimmed end-use specification, or trimmed into a final form. And, every sheet from the pressroom will probably be folded into a signature of four to thirty-two pages. Every signature must be gathered with other signatures into book form, with endpapers attached (tipped) to the first and last signatures of the book. Every gathered book must be sewed to ensure that signatures are aligned and held tightly together. Every sewed book must be rounded, glued, and backed to provide mechanical stability and correct size. And, finally, every book must have a cover (case) attached, and a paper jacket wrapped around the book for protection and for marketing.

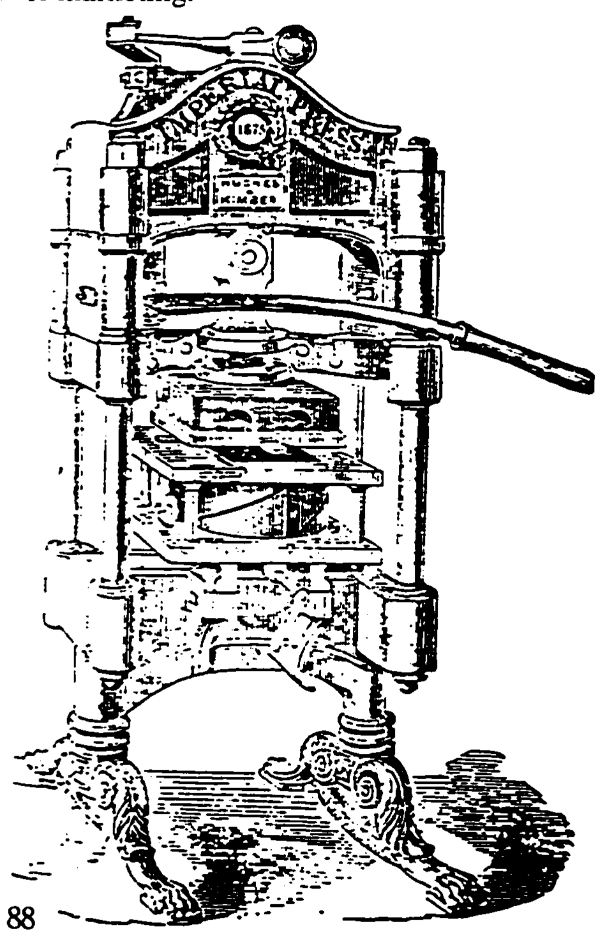


Figure 33. An Imperial Arming Press for stamping and embossing cases, ca. 1875. An off-shoot of the hand press developed into a hydraulic-powered ram with a gas-fueled heater for stamping and embossing (Comparato).

Bookbinding has always been a labor-intensive industry: flat sheets had to be cut and held till they could be folded; after folding, the signatures were again held for sewing. After sewing, the backbone was given a coat of glue and put through a rounding and backing machine, which rolled a steel roller back and forth across the backbone of the sewed book (replacing the hammering operation to the backbone), to create a round backbone and to ensure that the text will remain in the cover; in backing, signatures were bent to create a fulcrum for the cover's hinge.

In backing, heavy glue was forced between the signatures, and one or two layers of coarse muslin (crash) and a strip of wrinkled paper were laid down on the backbone; and, if called for, decorative head and foot bands applied. The glued book was trundled across the floor to a casing-in machine which applied a coat of glue to the endpapers and then married the decorated case to the prepared text. The finished books were carefully stacked by hand on small dollies and the whole pile was compressed for several hours by a hydraulic ram to dry under pressure.

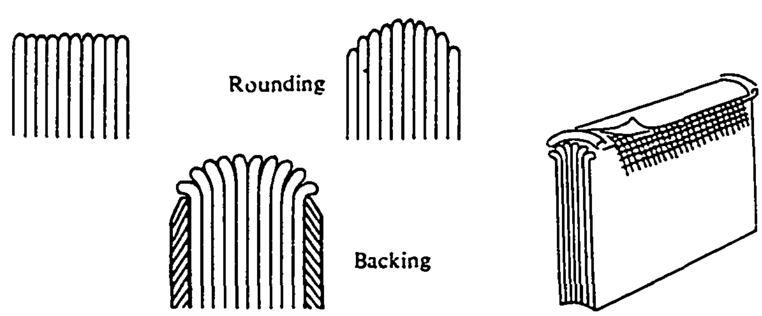


Figure 3-4. The forwarding operations include gluing and rounding and backing. (a) After trimming and before rounding the book to give it structure in the case, a coat of glue is spread on the backbone; the signatures are bent so that the end signatures are bent at right angles to form the hinge. (b) The rounded and backed book has another coat of glue applied and strips of crash and paper are attached; note that these strips run over the hinge, strengthening the book at that point of heavy wear.

In the 1960s, binders still equated automation with conveyorization (Comparato: 295); and, even in the 1970s, binderies had skids and skids of books in various stages of processing, waiting for the next operation. Yet at the same time integrated, linear, complete book manufacturing lines were being planned, combining all these functions into one continuous sequence of mechanical operations starting with printing on blank paper and ending with finished books.

Book manufacturers furnished another important service to publishers in warehousing. As books were completed, the binderies would store them, pending the publisher's calling in stock to his shipping department. This put the binders into warehousing as well as book manufacturing, the cost of this service being buried in binders' overhead. In the 1950s and 1960s, publishers began to realize how high this cost really was, and many moved to operate their own warehouses, to which all books were delivered as soon as completed. Such moves both created efficiency in publishing operations and better controlled costs to publisher and book manufacturer alike.

Over the nineteenth century, binders attacked each step in the bookmaking process itself, trying to devise machines that would function as well as did human hands and muscles. Thus, there were folding machines patented in 1841, 1849, 1850, and 1853; but the first to gain significant acceptance was the Chambers folder in 1855, whose development started as a powered blade to fold gathered newspapers--a vertically moving blade would push gathered, unfolded sheets between two rollers to make and tighten the fold.

Two kinds of folding machines are in use: buckle folders and blade folders. Both types steer the sheet to be folded between rollers which actually make the fold--buckle folders bring the sheet to a stop and it buckles precisely at the pair of rollers while blade folders use a vertically moving blade to drive the sheet between the rollers. In both cases,

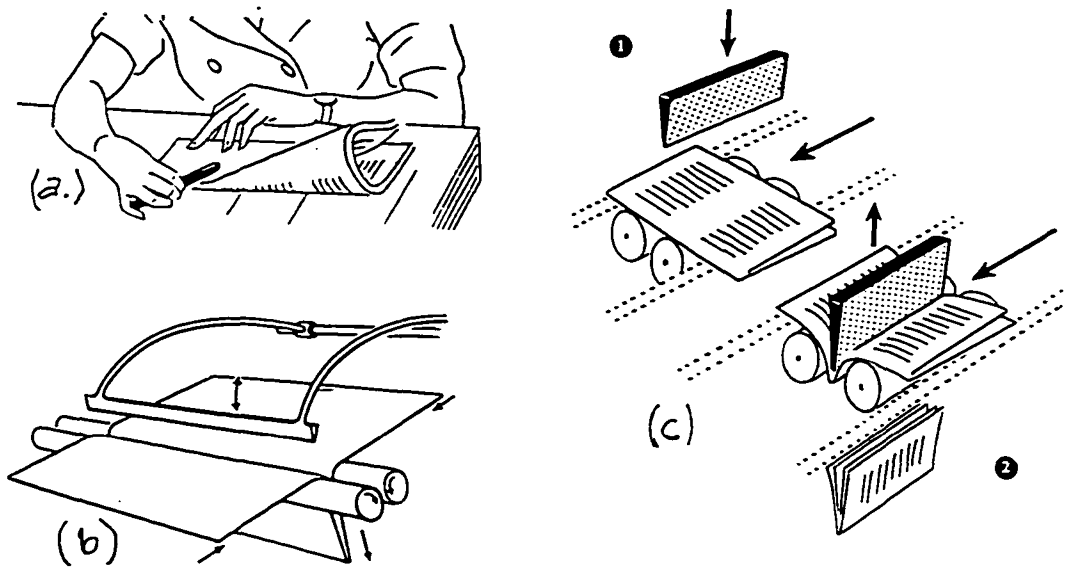


Figure 35. Folding was originally done by hand, it is now mechanized. (a) Hand folding with a bone folder. (b) Schematic drawing of a blade folder: the sheet is pushed between rollers by the blade - the first Chambers folder in 1855 used the blade to push flat, gathered newspaper sheets between rollers to make the single-folded newspaper. (c) Buckle folder in which the sheet is pushed against a stop by the drive roller on top and then buckles between the two fold rollers below. Successive folds can be made in both kinds of folders by arranging the path of the sheets through fold plates (Strauss: 636-7).

fold units can be combined to fold many combinations of right angle folds, parallel folds, accordion-type folds. These combinations can range from a single fold unit to make four pages to the large quad machines which will deliver four 32-page signatures from a 128-page press sheet. As a general rule, edition binders are unlikely to have much buckle folding capability, and similarly, trade binders lack blade folding capability; we are dealing here only with edition binding which is completely focused on bookmaking.

In recent years, the spreading use of web lithography, delivering folded signatures off the press, has changed the balance of work in the bindery; most of these presses are equipped with former folders which fold the fast-moving web of paper over V-shaped formers leading into right-angle folders and rotary sheeters, cutting off finished signatures at high speed.

From its earliest days, bookmaking has been structured around combining folded units, or signatures into books. It has been only with the development of complete bookmaking machines, tying together gathered pages and adhesive binding, that the process has turned its back on a signature system.

Gathering machines involve many feeding stations (pockets) which are kept filled with individual signatures or other units. Signatures are removed from the pockets by finger-like clips or by rotary units; both deposit each signature in sequence into a box on a moving belt or chain.

If the gathered book is to be smyth sewed, it will be set aside on a skid or truck to be fed into a Smyth sewer. If it is to be hot-melt adhesive (perfect) bound, the gathered units are clamped tightly in another station of the gatherer and travel under a milling head, where a high-speed cutter removes an eighth of an inch from the folded backbones. The cut sheets pass over a glue roller to apply hot glue to the cut backbone; the still-damp glued edge is tucked into a paper cover or a hard case, smoothed into position, and then dried in a heated building-in unit. Once good adhesives were developed, increased use of perfect binding has been dramatic; today fewer and fewer books are sewn, since they can be assembled and adhesive bound at high speed. Conspicuous examples of this process are trade paper-backs and pocket sized mass market paper-backs. Some books are printed and bound in pairs (two-up) and trimmed apart as a final step.

Smyth sewing came into the industry about 1870. Instead of sewing signatures onto fabric strips or cords, Smyth sewing ran thread from one signature to another, locking the thread in a knot after sewing each signature. It was an instant success, making hand sewing virtually obsolete overnight and significantly speeding up the production process. Endpapers are tipped onto the first and last signatures before sewing and move with the sewed book to the next operation.

Another, parallel series of production operations makes the cover, or case, so that it will be available to receive the forwarded sheets. The back of a piece of book cloth is coated with glue and two pieces of binders' board are positioned on it. This unit moves under former rollers which fold the edges of the cloth over the boards and smooth o the glue between board and fabric. The assembled cover can then be decorated with a brass die stamping title, author, and decoration; here the book designer has many creative opportunities for decorating the cover.

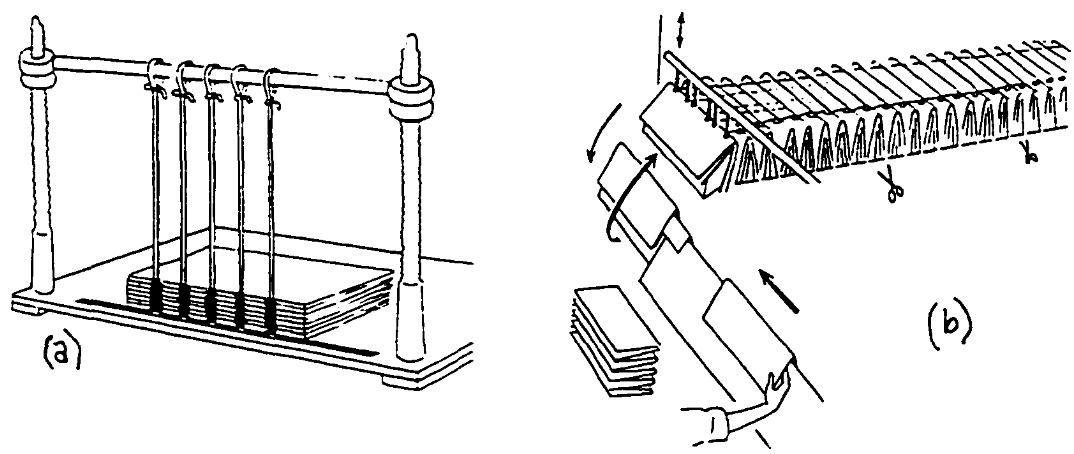


Figure 36. Until the development of complete book-making machines folded signatures were sewed together. (a) A hand sewing frame. Each signature was sewed to the cords or tapes held vertically between crossbar and base; after sewing the cords or tapes were attached to the boards in the cover to hold the text in the case (Darley: 17). (b) A Smyth sewing machine. The operator lays the open signature on the saddle, positioning the signature for sewing to the previous one. The endpapers have been tipped on the appropriate signatures, and the operator cuts the sewn threads between books (Strauss: 655).

Some of the material options are paper, book cloth, leatherette, leather, plastic; they can be blind stamped, foil stamped in colors or metallic, or covers can be pre-printed by lithography.[2] This last option is popular with school books, while trade books are more often covered with special paper instead of cloth, a difference dictated largely by relative cost. Case-making machines may also use cloth or paper from rolls, enabling three-piece bindings with different materials on the front cover, back cover and the spine.

In any case, the final operation in bookbinding is to marry case and text, building-in the cover and text, and putting it in a paper jacket to protect (and to promote) it.

With careful examination, one can easily determine how well the book is printed, checking evenness of color, sharpness of print, and ease of reading. Similarly there are points to test for binding quality, remembering that virtually every operation today is mechanical; in-plant quality control now is largely a matter of holding machine-adjusted tolerances. The case should be tightly glued to the binders' board, and corners should be well-made, with even folded edges all around. The quality and workmanship of decoration should be high, and of even impression and color.

The folded signatures should have the same margins throughout the book, and with minimum push-out at the head and backbone and even alignment at the head of the pages. Folded books, particularly those on bulky stock, should not vary in head alignment by more than one line, books off belt press lines should align precisely; books on thinner paper should vary little since there is less folding push-out.

The endpapers, which hold the book in its case, should be evenly positioned in the case. The hinge on either side of the backbone should be clean and sharp and should open and close on the edge of the backbone, which acts as the fulcrum of a lever for the cover motion. In many cases of hard-back, perfect bound books, the backbone may also be glued to the case--this should not interfere with the hinge action. Paper-back books, usually perfect bound today, should have, pages thoroughly glued, precisely trimmed, and tightly bound, as well as being positioned properly and with good workmanship.

Recent years have brought major technical changes to bookbinding, however. The spread of lithography has driven most relief printing letterpresses out of the market, delivering sheets about four times faster than letterpress, with shorter makereadies and better print quality. The further development of web offset equipment, printing both sides at once on roll stock, and delivering folded signatures has affected cost allocations between printing and binding, and has substantially reduced waiting time between presswork and assembly.

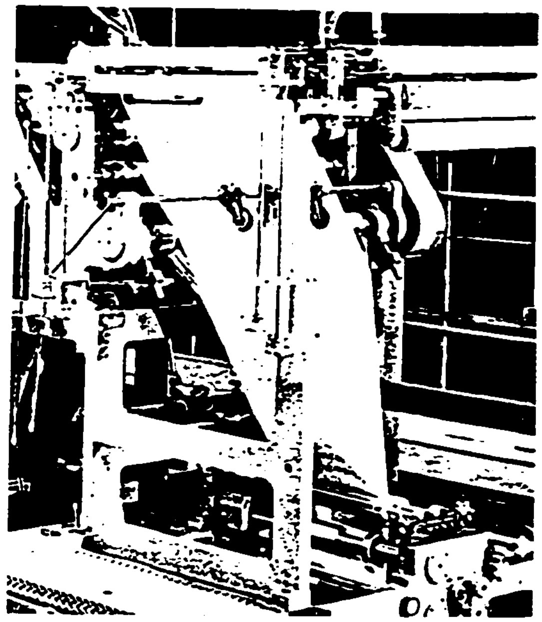


Figure 37. Former, or plow folder on a large web offset press. Note how the moving web is channeled by the former from full- width into rollers which fold the web to half-width. (Strauss: 509)

To printer and customer alike, web offset printing equipment made it possible to combine steps for economy and speed of delivery: using less expensive roll stock, printing both sides of the web at the same time, and incorporating folders into the press to deliver folded signatures. The high press speeds forced folder redesign, with combination units of both plow-shaped "V" formers to fold the moving web upon itself and "chopper" folders, high-speed versions of blade folders, folding across the web.

It has become possible, with this modern binding and printing equipment, to take those web-offset printed signatures, to run them through gathering and perfect binding equipment next to the press and to make them immediately into finished books. The first such integrated book-making installation was at the Doubleday plant at Hanover, PA, in 1948 (now closed as a printing establishment), where it produced books for all the Doubleday book clubs.

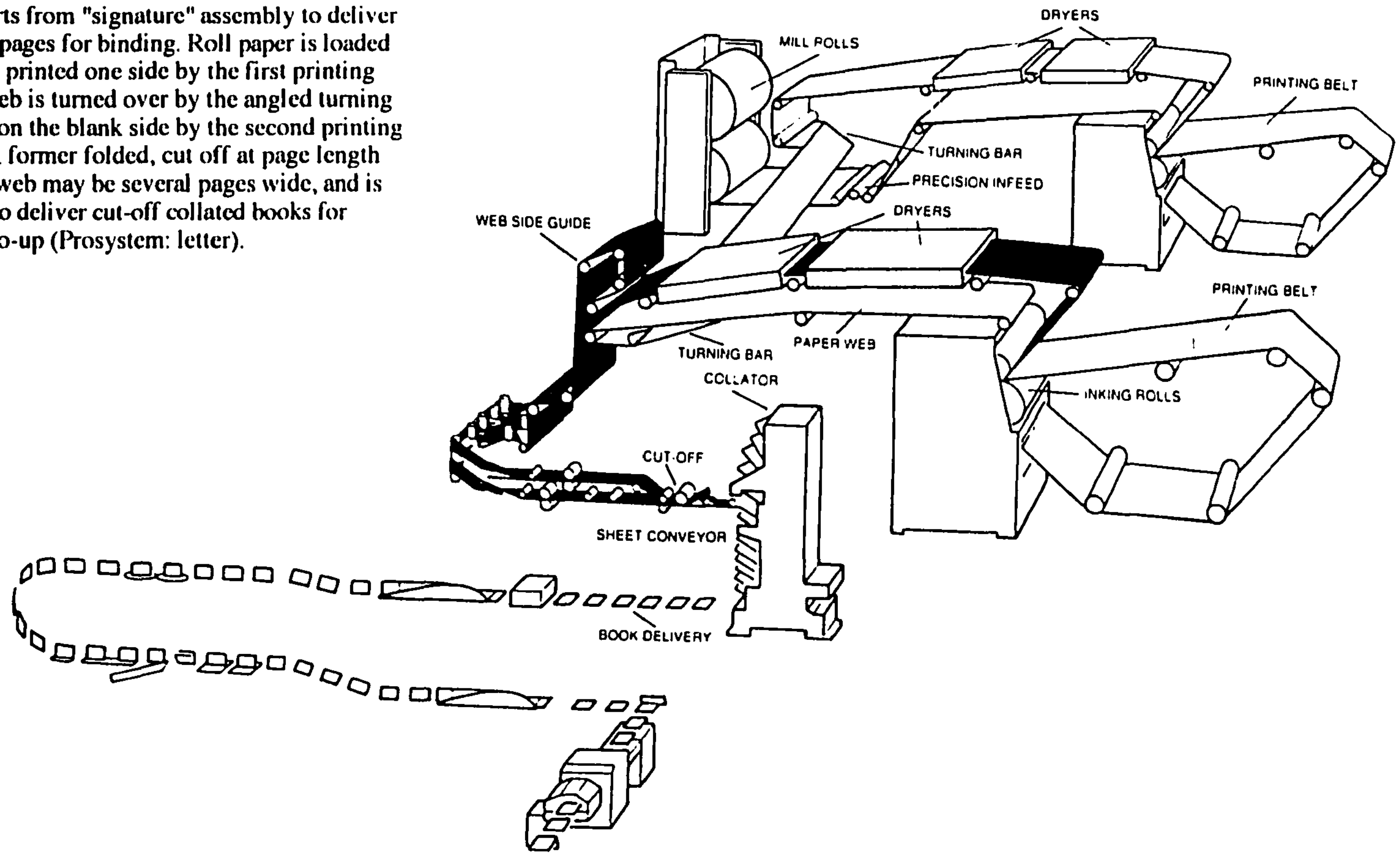
A second step toward integrated production came in 1968 when the first Cameron Belt Press line was unveiled at Kingsport Press in 1968. If there was a single event which has driven technological change in bookmaking, it would probably be this Cameron Press, the developmental equivalent of Koenig & Bauer's cylinder press of 1814, Mergenthaler's Linotype of 1886, stable base litho film of 1958, and today's ubiquitous Personal Computer taken all together.

Careful examination of the schematic of the Cameron press shows how it applies new concepts to both printing and binding. First, the belt of plates is essentially a variable diameter plate cylinder, printing one page after another and then starting all over. Once dried in the dryer, the printed-one-side web is steered to the second unit which prints the other side of the web. The perfected web then goes through another dryer and then is slit into appropriate widths to go over former folders and be sheeted into two-page (two-sides of a single page) or four-page units which are gathered in sequence in a collator. The collator feeds the gathered books into a conventional adhesive binder which completes the book. The press manufacturer claims output of two million books weekly from one machine.

In the first Cameron machine, a relief press, rubber plates were attached to a mylar belt (later machines have used linked polymer plates) which printed each page on top of the previous one. With ingenious combinations of turning bars to steer the printing of the second side of the paper web, former folders, and high-speed sheeters and gatherers, the press delivered stacks of gathered single sheets for perfect binding. Today, more and more books are produced on Cameron machines, and, when the economics work, publishers can enjoy efficient and less costly production. Though these machines cost in the neighborhood of $8,000,000, to $10,000,000. they are manned with only three men on the press and three more on the connected binder. Plates are pre-positioned in belt form off the press, enabling belt changes in less than an hour, making the belt the equivalent of a variable circumference printing cylinder which can be loaded off press for another job while one is running. Running speeds can approach 20,000 books an hour.

We have seen how book printing, 1800-style, changed in 1814--after applying power to run fast, increasingly sophisticated printing presses. And, at the end of the nineteenth century, typesetting was mechanized, Ira Rubel's offset lithographic press was on the horizon for 1906; photomechanics had changed illustration totally by 1890.

Figure 38. Manufacturer's schematic of Cameron belt press, which departs from "signature" assembly to deliver trimmed, collated pages for binding. Roll paper is loaded at the top left, and printed one side by the first printing belt. The paper web is turned over by the angled turning bar and is printed on the blank side by the second printing belt; it then is slit, former folded, cut off at page length and collated. The web may be several pages wide, and is slit and/or folded to deliver cut-off collated books for binding one-or two-up (Prosystem: letter).



But bookbinding then was still only tinkering its way to integrated mechanization. By 1900, mechanization had progressed enough for book printers and binders to become complete book manufacturers, with improved guillotine cutters, folding equipment with automatic feeders, smyth sewers, casemaking and casing-in machines as well as using well-equipped composing- and press-rooms to feed the bindery.

Publishers' cost pressure on their manufacturers was unrelenting and, along with the continuing ebb and flow of publishing enterprises, their manufacturers began to conglomerate as well.

Other manufacturers tried different approaches, such as standard specifications, contract prices, enhanced service. but with no real impact until the advent of integrated printing and binding lines released manufacturers from the "signature system."

Another approach was that of Leonard Shatzkin, head of book manufacturing at McGraw-Hill Corp. at the time. It involved contracting for the full capacity of a given number of presses for a fixed period, giving him full scheduling control of that equipment. This enabled McGraw-Hill to control its deliveries precisely, giving the firm a major competitive edge.

Three printing associations greatly affected book manufacturing, each working in a different discipline. The impact of the American Institute of Graphic Arts on book design and appearance was profound; the Book Manufacturers' Institute established objective standards for materials, particularly relative to school textbook adoptions; and the Lithographic Technical Foundation (later the Graphic Arts Technical Foundation) provided basic research into the chemistry and physics of lithography and printing to empower the modernization of the industry in the latter half of the twentieth century.

Publisher mergers into seven giant firms have been matched in book manufacturing. Parallel with the growth of such book industry giants as American Book-Stratford Press, Kingsport Press, and Colonial Press, was the expansion of major corporate printers like R.R. Donnelly Sons & Co. and Arcata Graphics (now Quebecor), both of which bought out other printers and established new plants. Most recently, Donnelly has bought Haddon Craftsmen of Scranton PA; its sales in 1994 were nearly five billion dollars. Quebecor Graphics, formerly Arcata Graphics, has bought and opened book plants all over the United States, starting with the purchase of Kingsport Press in 1960. Both of these giants enjoy major positions in edition book manufacture, paper-back production, long-run consumer magazines, and commercial and catalog printing.

To Donnelly and Quebecor must be added three other firms whose expansion in recent years has also paced the industry: Rand McNally Co., known for both book production and map-making, Western Printing and Lithographing Co., producer of packaged book series such as Simon and Schuster's Little Golden Book series, and the Banta Co., with four Cameron Book presses in as many scattered plants, specializing in square-back, adhesive-bound books.

Other book manufacturers were also merging. Typically, Maple Press of York, PA, the largest producer in America of technical Monotype composition for books, purchased New York's J.C. Valentine bindery in the 1950s, and, more recently, has merged with complete manufacturer Vail-Ballou Press of Binghamton NY to form Maple/Vail. The esteemed J.C. Tapley bindery in New York City merged with Russell-Rutter Co. to provide edition binding service to the trade.

The commercial gulf between publisher and manufacturer has widened, with publishers being concerned today primarily with high-figure investment in promotable manuscripts and printers being primarily concerned with costs, equipment and credit. Publishers who started as printers have shed their plants, often in forced restructurings.□ Harper Collins, founded by the Harper Brothers in 1817 as a book printer, was forced to sell its plant in 1917, when J.P. Morgan wrung out the firm's finances. Similarly, D.

Appleton Co.'s modern plant was sold in 1900 to Trow Printing Co. to raise cash to pay creditors.

Thus, a century after bookbinding became a separate industry, we see binderies as a focal point for manufacturing change in publishing--the tinkerer has given way to the engineer, who, in turn, has created a wholly new technology and climate for packaging the printed word. Book manufacturing mergers have kept pace with publishing conglomeration, driven by the spur of new technology to produce books at ever-increasing speed.

NOTES

[1] This series of operations is vividly reported in Darley's *Bookbinding Then and Now*, the story of the founding of a large British trade bindery in the mid-nineteenth century, and its growth to today's size.

[2] The nation's largest source of pre-printed covers, principally used in school textbooks, is the Lehigh Press, located just across the Delaware River in Pennsauken. It has made such a specialty of lithographed covers that it dominates this market nationally.

Having worked as a purchasing officer in several publishers, the author can testify personally to the intense competition and price pressures in the period after World War II. Doubleday & Co., now a part of the German Bertelsmann combine, which is merging with Random House to dominate consumer book sales, is the one exception, with active plants at Berryville VA and Dallas PA for pocket-book production.

CHAPTER 7

ILLUSTRATION, PHOTOMECHANICS, LITHOGRAPHY

Thus far we have examined mechanical changes to the Graphic Arts as essentially growing out of the use of power to run various printing and binding machines. Late in the nineteenth century, changes began to occur through applying other scientific tools to printing: photography, chemicals, theoretical analysis. As the century ended, developments had occurred making easier the complex workings of the printing craft; at the same time, printing was already an industry, shifting away from being either a craft process or a series of one-man shops. Here, again, we find Lord Richard Stanhope's footprints in the early years of the century as he developed better means to make stereotypes for printing.

William Ged's plaster-molded plates of 1725 did not come into effective use, for printers refused to use them, since duplicates replaced their resetting type for reprints. By the start of the nineteenth century, however, compositors *did* work duplicate plates; Stan hope's contribution was to improve the plaster molding part of the process so that molds were not contaminated by dirt and plaster chips and were sturdy enough not to break in handling. The increasing use of rotary presses for newspapers later in the century--requiring a curved printing surface cast from a flexible *papier-mache* mold--speeded acceptance of duplicate plates.

Firmly builded with rafters of oak, the house of the farmer.

That the birch canoe stood endwise.

Figure 39. Two illustrations from a Collected Works of Longfellow, published in 1882 by Houghton Mifflin Co. These are obviously wood engravings, full of detail with delicate shadings to indicate tones and colors. It has been said that Longfellow supervised all editing and printing himself, allowing his publisher only a modest sales commission and at the same time maximizing his own reward for his work.

"THE WIDE AND WINDING RHINE."

Figure 40. Two wood engravings, frontispiece and a text illustration from a routine romance of 1887, showing the quality of wood engravings possible then, even on a somewhat pedestrian work.

IN THE PUBLIC GARDENS AT BONN.

The value of this plate-making refinement came not only from the printer's ability to obtain a dependable printing plate; he could duplicate the increasingly complex wood engravings which were coming into use. In 1800 wood-cuts, cut with the grain of a wood block, were both simple and sturdy, and in many cases, clumsy; later, sophisticated engravers working on the end grain of a block of wood, could create illustrations simulating the tonal shifts of light, shade, and color of the original picture. These engravers, working from *camera lucida* tracings, sketches, drawings, or original subjects, produced wood engravings rivaling the aesthetics of the original work. Translating the artistic copy into engraved lines in a wood block inevitably interposed the engraver's judgement in creating the engraved block. Even though photoengraving mostly replaced wood engravings, artists such as Timothy Cole and Fritz Eichenberg were creating these engravings as a separate art form well into the twentieth century.

We have already noted that the first application of coated two-sides printing paper in 1882 was to reproduce Timothy Cole's wood engravings of Spanish paintings for *Century Magazine*, printed at the then legendary plant of Theo. de Vinne in New York City.

It is especially significant that illustrative methods were under study in several directions at the time; tracking them is like braiding four strands of hair. These developing changes dealt with wood and intaglio engraving, photography and its application to illustration, using chromolithography for color illustration, and, early in the twentieth century, offset lithography, which applied many of the mechanical developments of the earlier century.

Engravers became increasingly skillful at replicating tonal changes by using different textures of tooled lines. The rapidly improving field of duplicate plates, paced by Lord Stanhope's stereotypes, permitted publishers to duplicate expensive and complex hand-cut engravings, avoiding damage to them on press. Similarly, artists were working in other media to provide illustrations for books--intaglio engravings on copper and steel, and stone centered lithography broadened the spectrum of illustrative methods. But both engraved images and lithographed material shared two serious problems: although the accuracy of their reproduction was high, production was slow and limited. And these illustrations could not be printed with the text, requiring a separate press run, thus increasing both cost and manufacturing complexity. And, although engraved as accurately as possible, the ultimate print was the engraver's perception of the subject, rather than an exact reproduction of the subject, even if practically there might be little difference between them.

* * *

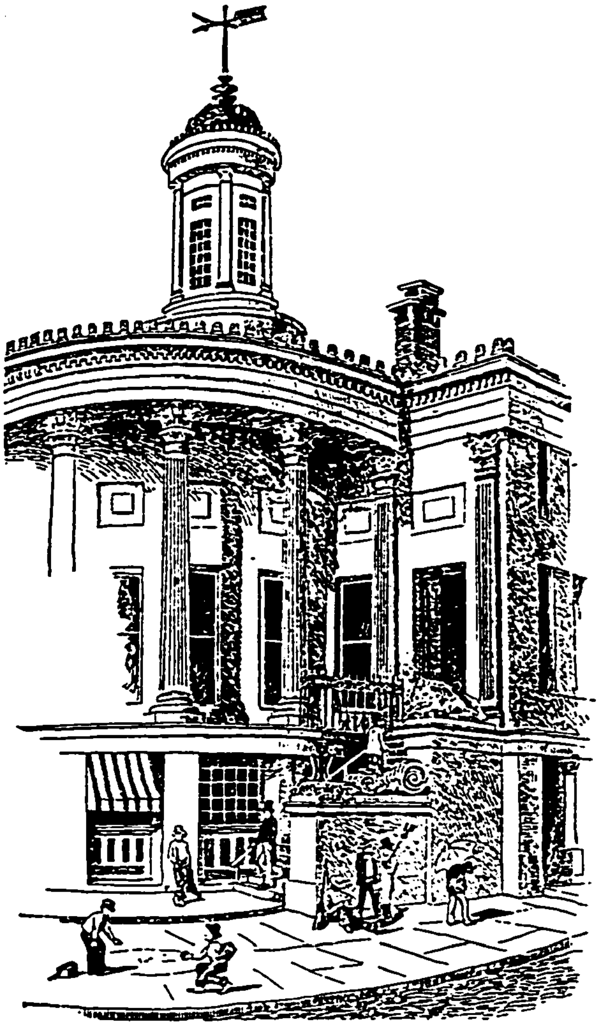
Photographic research and development can be said to have started with Joseph Nicephore Niepce, who teamed with Louis Daguerre in 1829 to use the camera lucida resulting, after Niepce's death, in photographic images on metal which came to be known as "daguerreotypes." Emulsions were very slow, requiring exposures of several minutes to produce a single positive image; Daguerre's success in developing this process was announced in 1839.

Jussim[1] quotes William Ivins stating that the invention of photography (an "exactly, repeatable pictorial ztate-ment") was probably the most important invention since writing (Jussim: 10). When viewed along with other developments in the nineteenth century, the enormous impact of photographic tools and methods leaps to attention. Typically, in the 1870s, they replaced the hand engraver's product. At the same time, William Fox Talbot in England was studying and developing the application and use of paper negatives, which he patented in 1844. His Calotypes and Talbotypes involved making paper negatives of the subject and then using them to produce positive prints on paper. This step broadened greatly the application of photo techniques, demonstrating that each useful image did not require re-exposure of the subject. At the time, the major applications of both Daguerre's and Talbot's processes revolved around studio portraiture and art photography as aesthetic artifacts.

Nearly a decade later, in 1851, F. Scott Archer pioneered wet collodion emulsion negatives on glass plates, thereby opening up both reportorial photos and applications in the Graphic Arts. Photography-on-the-block arrived just before the Civil War using pictorial images printed on wood blocks to guide engravers in accurately reproducing the subject (Jussim: 56)

Matthew Brady's association with President Lincoln and the Union Army in photographing the Union's role in the Civil War provided a well-known, broadened use of photography in reportage. The mental image of a Brady photographer frantically coating a wet plate in his little wagon studio, rushing the plate out to his camera, exposing it, and then developing it out in the wagon, somehow brings an element of comedy into his serious work, particularly when compared with today's small cameras and automated photo-graphic techniques and equipment. It was one of Brady's photographers, Alexander Gardner, who planned an elaborate two-volume set of Civil War photographs taken by Brady and his men. The two books presented a hundred photos and, since photo-mechanics had not yet developed in reproducing photos, these were actual photoprints. The project was apparently a resounding failure, both because the cost of the prints caused the book to be priced too high, and because at those prices at least, veterans were unwilling to revisit their combat memories. Dover Publications reprinted them by offset lithography in 1959; the collection is a vital record today of the Civil War for scholars use.

Photoengravers, applying the basic photographic tools of exposure, development, and photo-printing, combined with the chemistry of emulsions and etching materials, were effectively producing zinc line engraving; and by 1872, using zinc line engravings in production was commonplace, although photomechanical reproduction of photos awaited the work of Frederick Ives and the Levy brothers ten years later.



THE MERCHANTS' EXCHANGE AS A POST-OFFICE.

Figure 41. A probable zinc engraving, circa 1883, of an historic building in Philadelphia. This illustration. taken from Quaintto a Quaker Meeting for WorshipCorners of Philadelphia, with illustrations by Joseph Pennell, was published by John Wanamaker in 1883, just as zinc engravings were coming into use.

Figure 42. Contemporary wood engraving, "Fierce Feathers," by Fritz Eichenberg (1948), commemorating a non-violent response to a visit on a Quaker Meeting for Worship by an Indian war party. Eichenberg's skillful tonal differentiation using varying combinations of engraved lines is particularly evident here.

By the Centennial Exposition in 1876, photo-engraving had become a valued craft for meeting graphic arts needs. Zinc line engravings were well established and were in wide use--in fact, techniques for making them changed only in detail by the mid-twentieth century.

The result of wide-spread technologic growth and change has been that the photo-engraving industry, so busy at the end of World War II, is virtually non-existent today photo-engravers have joined lithographers, either producing film negatives for the trade or they have closed their doors.

To make zinc line cuts, the line copy was mounted on a copyboard and photographed in size onto a glass plate; after developing, the emulsion carrying the photographic image was stripped from the glass, flopped to give a "wrong reading" image for printing,[2] and assembled with other negatives into a "flat" on glass. The stripped flat was printed on a sheet of zinc coated with a light-sensitive emulsion. The exposure process hardened the spots where the light struck the coated metal; the non-printing areas were masked from the light by the black areas of the negatives, so that, upon development, the printing areas were covered with hardened emulsion, and the non-printing areas were bare. The metal flat was then placed in an acid bath, which etched away the bare metal, leaving the printing areas intact. After the larger non-printing areas were routed away, the engravings were cut apart, tacked onto wooden blocks to bring the surface to "type-high," ready to include in a type form, either to be run from type and engravings or to be molded for making duplicate plates, such as stereotypes or electrotypes.

Reproducing photos or other continuous tone copy presented a totally different challenge. Zinc engravings , although ideal for producing line work, they worked with solids only, and speedily replaced similar wood-engravings. Progress was being made in making tonal negatives through screens--Fox Talbot successfully used gauze fabric as a screen in 1852 (Bruno: 16); but this approach presented insoluble manufacturing problems.

Two Philadelphia brothers, Max and Louis Levy, at last developed a successful method for making a cross-line or halftone screen in 1883 by facing rulings on two pieces of ruled glass at right angles (Bruno: 16). It was speedily put to commercial use by Frederick Ives in 1885 and almost immediately replaced hand cut tonal wood engraving.

Although other kinds of screens have been developed in recent years, (such as grey screens and magenta screens) as well as using different screen patterns for special uses (such as straight line and chain-dot screens), the glass cross-lined screen has continued to be basic to production of tonal copy right up to the recent introduction of electronic scanners. Screen values are identified by the number of lines per linear inch, as 133-screen, or 175-screen.

The basic theory of the halftone screen seems simple enough: the right angle crossing of ruled lines functions as a grid of pinhole lenses, each one subtending in dot size the tone of grey in the copy in front of that pinhole lens, the screen having been placed directly in front of the negative in the process camera. The negative is treated initially like a line engraving, flopped to make the engraving print correctly, and printed on a sensitized sheet of copper. This copper plate is developed and heated to fix the lacquer resist, etched, retouched, routed if need be, proofed, blocked, and sent to the printer or publisher to be locked into the form. One major advantage of copper as an engraving material is its softness and ease of tooling and retouching, either by acid to reduce dot size or by hand tooling to modify the plate.

As the use of illustration in magazines and books grew, many artists and engravers devised imaginative methods to bring color to the printed work. An explanation of color theory and practice can introduce the major developments of the twentieth century, both in photo-engraving and in offset lithography.

Understanding that there are two kinds of color reproduction: flat color and process color, which work differently, is fundamental to understanding color printing.

Flat color, or match color, as it is often called, came first. It depends on the reflected color on the page activating the red and green receptors in the eye (the eye combines the red and green reception to form a yellow perception). Thus, a particular match color is made up of reflected light rays from the illustration, with the eye perceiving that reflection. Early color illustrations, such as those by Howard Pyle, were made up of these match colors, mixed for the particular work, perhaps with a change in tone from a hand-applied screen (called Ben Day tint-laying); the base color might also be altered by using a tint or screen of black. Pyle and other major illustrators of his day worked closely with magazine production people to broaden the use of color and to ease its production. If the subject calls for a soldier in green uniform planting an American flag at a wooden blockhouse, it requires separate press runs of red, blue, green, brown and black to produce the picture.

On the other hand, four-color, or process illustration, depends on white light being reflected off the sheet of coated paper through transparent dots of yellow, magenta, and cyan (blue) which act as miniature filters to filter out all other colors at each dot; a black negative is included in the set of four colors to provide some modeling to the reproduction. The halftone dots are closer than the eye can distinguish between them; it sees the colors as blends of the filtered colors.

The process of creating this matched set of negatives or plates for either letterpress or lithography is both fascinating and complex. Until the broad-scale use of electronic scanners, the color copy, reflected or transparent, was photographed in a process camera mounted in a darkroom wall. Successive exposures were made through a halftone screen using red, green, and yellow filters, and rotating the screen 45 degrees between color exposures to prevent dots in the different colors from printing on top of each other. These yielded, respectively, yellow, cyan, magenta, and skeleton black printing negatives. Using these negatives, the photo-engraver would make a set of copper engravings, correcting them through local etching, tooling, or burnishing. Once completed to his satisfaction, the plates were proved and the proof submitted, along with the copy, for OK by the customer. The high level of skill involved here created extraordinary expense to the customer, ruling out full-color for all but the most expensive books.

The photoengraver's method of working directly on the metal plate continued until well into the 1960s, abetted by the very restrictive work rules of the photoengravers' union. But once offset lithography became firmly established, using litho plates which could not be retouched, lithographic color shops worked on color material only indirectly on the film. They corrected continuous tone separations from the process camera by manipulating dot structures, by switching positive and negative prints on film, and by special photographic masking techniques to lighten or darken the tones on the negatives. Making press plates from screened negatives was the last step in creating color proof for customer approval. Final corrections made by the customer are made in a similar manner, plated, and the job released to press.

Digital scanners now generate continuous tone film which is closer to the copy than that from the process camera. They came into use in the 1960s and 1970s, with obvious results in shortened lead times, better quality, and reduced cost. These digital data also enable manipulation of the copy to combine, to add, and to subtract parts of the image. Throughout these two centuries, continuing technical breakthroughs brought about both efficiency and lower cost, but no development provided such dramatic results as did the color scanner, which brought color and accuracy to an ever broadening market, forcing printers to seek faster, more productive press and binding equipment and, at the same time, to install the most modern process and quality control equipment available.

One complexity of this electronic revolution has to do with the ease of altering pictures and text to adjust the message on the page. A recent two-page magazine advertisement illustrates the point--a man in his shirt sleeves is shown sitting in a garden lounge chair in the middle of an ice-covered lake, obviously at below freezing temperature. The likelihood of a camera crew, model, and equipment being transported to a frozen lake in the North country is small; in all probability a photo of the model in his chair was inserted at the litho plant into the process film from a stock photo, allowing more effective composition, and saving the cost and time of shooting it on site. Such film manipulation enabled by scanners and electronic assembly machines represents a flexibility which can have good results, or it can create literal falsehoods altering the Truth of a work. Electronic machines grow more and more powerful, and we should come to understand that their reporting of events or texts is not always accurate, and may be reflecting a different visual perception than really existed.

Since Aloys Senefelder's discovery of lithography in 1796, this process has had a steadily increasing impact on printing and the Graphic Arts. Throughout the nineteenth century, lithography was used both to reproduce fine lines accurately, to create soft tones and shadings, and as an art form in itself. The process depends on the chemical repellancy of a greasy ink and a thin film of water, successively applied to a piece of grained limestone.

The artist would draw a wrong-reading picture on the level face of the limestone block, using a greasy pencil, a greasy ink would be applied to the image. One still remembers Jose Ferrer as Toulouse-Lautrec in the movie *Moulin Rouge* slashing great gouts of color across litho stones to create his overwhelming posters.

The stone would then be moistened with a mixture of gum arabic and water, which would be repelled in the image areas by the greasy ink. The sheet of paper would be smoothed against the stone and the inked image transferred to it.

The process's limitations at mid-nineteenth century are obvious: larger sheets would require a larger, heavier stone; production was limited by the life of the image on the stone;

and, despite the introduction of steam power in 1868 by R. Hoe to drive presses, the operation was clumsy and relatively slow.

In 1907, Ira Rubel, a lithographer in Nutley, NJ, realized that an image inadvertently picked up on the tympan paper of his litho press could be transferred to the next sheet of paper being printed. From this came using a rubber blanket onto which was "offset" the image, which was then transferred to the paper.

Offset lithography brought new approaches to printing, with the result that, once established, printers no longer wanted to return to relief printing. First, the thin grained metal plate could be wrapped around a cylinder, and the revolving press could produce impressions at far higher speed than when slamming a ton of metal back and forth. Second, the "softer" impression of the rubber blanket on the paper enabled printers to use finer halftone screens to catch the finest gradations of tone on uncoated paper, again at high speed. Third, since the basic material used today in the litho plant is lightweight film and paper, razor blades, scissors, clear film bases, and litho tape take the place of moving heavy type on galleys into forms, locking up with quoins, and hauling heavy forms from one department to another. The stripper replaced the stone hand, just as the word processor replaced the Linotype and Monotype. Thus, once the move to offset lithography began after World War II, it accelerated though the 1960s and 1970s until the industry had shifted virtually completely to litho production.

It was not just the obvious advantages of speed and quality that spurred offset lithography to expand and move into traditional letterpress markets. Broader social forces were at work: typically, both engraving and electro-typing unions were unwilling to move forward into new technology--very little new was introduced at the middle of the twentieth century; although plastic printing plates did replace some electrotypes for book work, and plastic molding for electrotypes was put to use. Work rules such as ending day shifts at four o'clock, and second shifts not starting until six o'clock, guaranteed heavy overtime cost. Photo-engravers selling their service to this author in 1955 were only beginning to promote the use of "indirect" separations in 1960, fifteen years at least after lithographers were routinely using continuous tone separations.

At the end of World War II, printing plants were burdened with masses of slow, worn-out letterpress equipment, badly in need of replacement. The higher speeds of offset presses, the shorter makereadies and improved quality drove printers to buy expensive offset equipment promising greater efficiency, increased output, and improved product quality. Letterpress printers resisted the change to offset lithography, thus, at an American Institute of Graphic Arts meeting in 1961, the president of a large book manufacturer stated flatly that offset presses would go into his plant over his dead body; six months later his firm installed its first offset press--and he is still alive. The most significant move made by lithographers came in the early 1920s when they recognized the need for substantive research into their process, and the Lithographic Technical Foundation in Pittsburgh (now the Graphic Arts Technical Foundation) was founded. Its work in finding answers to problems facing lithographers, and in developing solutions to those problems, in technical training for personnel, in standardizing materials, standards, and control techniques demonstrated the importance of basic research and development in the printing industry.

Similarly, DuPont, W. R. Grace, Eastman Kodak, as well as Alcoa, 3M, the Harris Corporation, Miehle Printing Press, Heidelberg A.G. and a host of other corporations here and abroad applied massive research efforts to the new processes relating to offset lithography.

Two events are seminal to the development of offset lithography, one in 1907, and the other in the late 1950s. First, there was Ira Rubel's, discovery of the offset press principle. A rubber blanket cylinder suggested itself as an intermediate image carrier, and offset lithography was born, appropriately named after the offset image on the blanket.

General acceptance of this principle was quick, and stone lithography, except for artists's use, quickly went out of use, replaced with the new offset process.

At the end of World War II, lithography's biggest technical problem was dimensional instability of copy, of film, of paper, of all materials. This inability to procure a dimensionally stable film base for photography and stripping forced lithographers to use glass plates and to assemble on glass flats, after separating the photo emulsion from its acetate carrier. Thus, when DuPont introduced Cronar film in 1958, using a stable, polyester film base, the industry took one look, switched to polyester films, and opened a new decade of development. Probably no single development in lithography had the impact of Cronar film; it released lithographers to deal speedily with film assembly; it enabled better housekeeping; it cleared the way for daylight working materials; and it opened the door on literally hundreds of related developments in the field.

The importance of this product application cannot be overemphasized: it enabled the photo-typesetter to deliver a stable proof or negative to the printer; it enabled the use of lightweight materials instead of glass, allowed the use of simple cutting tools such as razor blades, and scissors, with adhesive litho tape to hold film images in place; film manufacturers developed many new kinds of litho film, such as daylight-handling film, auto-negative and auto-positive film, it enabled film-processing and platemaking machines to use magazines of assembled film, moving under computer control to locate pages precisely on film or on the litho plate; and most important of all, it speeded operations immeasurably, resulting in substantially reduced costs to the printer's publisher customer.

The last quarter century has brought great changes to the printing industry. To summarize we need only to point to the shift from letterpress printing to offset. In 1955 it was estimated that 90 percent of all printing was by letterpress, and ten percent was by offset lithography. In twenty years these percentages were essentially reversed! This change in direction can be seen as the direct outcome of two streams of research: one at the

Graphic Arts Technical Foundation, into the physics and chemistry of image transfer, photography, and materials, and the other into market-oriented research by major industrial companies who developed specific applications of this basic research. Much of this work was directed at the preparation stages of the litho process: camera work, assembly, color theory and application, litho and polymer plate making, specialty halftone screens to meet specific problems, improved correction methods, using both photo masking techniques and digital means to deliver film to print ever closer to the copy furnished.

What is important is that lithographers have built on the legacy of the photoengraver and have found ways to improve on their techniques. the shift from simple wood cuts to wood engravings to photoengravings to litho work is a continuum of photomechanical change, wherever it has occurred. Lithography had not developed far enough in 1883 to use Max and Louis Levy's halftone screen, but once the offset blanket came into play, lithographers speedily applied earlier technologies.

In the 1950s and 1960s, publishers found that many of their color needs could be met only in Italy or Switzerland, where high quality hand work could be bought at bargain prices. Today, printers in Singapore, Hong Kong, and Taiwan, using high-tech scanners and controls, produce fine work at prices which are impossible for American printers to meet. Other factors do work to produce these books in the United States, but the global nature of the book printing market cannot be overlooked. It is the universality of photomechanics that drive, printers to compete across the oceans, as well as across the city.

NOTES

[1] Probably the most thorough discussion of photographic application through the nineteenth century is in *Visual Communication and the Graphic Arts*, by Estelle Jussim, who reports in detail the complicated history of photography in illustration.

[2] All engravings for relief printing must be made wrong-reading for inclusion in type forms (from right to left) by reversing the negative's emulsion; offset negatives do not need to be flopped, as the transfer from the offset blanket reverses the image before it prints on the paper.

CHAPTER 8
CONCLUSION

This Tapestry of Change is continually growing, with some periods of rapid or basic change, and then slack periods. Two centuries ago, at a point of essentially parallel development came Louis Robert's paper-making machine; Koenig and Bauer's power cylinder press to use Robert's machine's product; and the fundamental discovery of lithography by Strasburger Aloys Senefelder. The search for a typesetting machine led off with Dr. William Church's machine's patent in 1826, and, culminated in the Linotype in 1886--coincidental with Frederick Ives' line engraving process and the Levy brothers' process halftone screen enabling the printing of tonal subjects. Studded throughout the nineteenth century were modifications and improvements to these basic machines, bringing more production, faster and cheaper.

Replacing hand work with these machines was the Industrial Revolution at its best, both increasing production of books and broadening readership in their use. Though change in the Graphic Arts did not come until early in the nineteenth century, it came with a rush as more and more inventors attacked problems of this complex industry to turn ideas written on paper into printed books.

As readership grew through greater literacy and better availability, the process of publishing itself changed radically to provide a service of producing and marketing books. With the Chapman case in 1852, when John Chapman successfully challenged the pricing cartel of publisher and bookseller pricing cartel, publishers shifted their efforts to securing manuscripts and marketing the resulting books, enlarging authors' opportunities to have their works published.

The three central changes in the book world relating to the Industrial Revolution were the shift from craft shops to printing factories, the use of machines to replace human hands, and the use of outside power sources to run machines. Along with this came employment of women in the more menial factory jobs.

A fourth trend was also occurring in this century--publishing was changing from a convenient service by printers to a highly structured manufacturing industry. Instead of functioning as a printer who bound part sheets or serialized fiction between board covers, publishers changed to function as risk-takers, financing and distributing books to he widening readership of the growing middle class. Gradually publishers have closed their printing works, shifting this investment from machines to inventory.

Mechanically, the twentieth century started with some new mechanical modifications, but there was only one real development occurring in the first half--Ira Rubel's discovery of offset lithography, which inspired research and change starting in the 1920s. In the first half of the twentieth century, coincident with concerns for Graphic Arts fundamentals, book manufacturers continued to wear out existing machines and, in some cases, found ways to replicate hand operations by machine. This meant that the end of World War II brought increased demand for new equipment to replace what had been worn out. Printers turned to offset lithography, finding it inexpensive to use, a fully rotary process to run at high speeds, and with new chemical processes, cheaper to prepare for press.

Hardly had offset lithography settled in at mid-century as a major contributor to publishing than the computer, main frame or desk top, revolutionized typesetting and image assembly, bringing us to the end of the twentieth century with processes which more and more enable publishers to stress marketing as their primary role.

Authors, too, have come a long way since 1800. The usual quantity of an edition printed at that time was some 750 books, printed by a strong-backed lever-puller at a platen press, using hand-set type, which was both expensive and in short supply; today an initial press run is usually in the low five-figures, and with some popular titles, may be as high as a half-million books.

The refusal of her publisher to publish Jane Austen's *Susan* was apparently not an occasional event; literary quality was not a standard for publication--the author's connections and sponsor were. It is significant that events in the publishing field today are getting national attention in news media as news worthy events in themselves.

Allen Dooley vividly describes the condition of authors' proofs in the Victorian era: carelessly pulled on a production press, sent out poorly printed, sloppily proof-read, frequently lacking the manuscript copy, pages not in order. Compositors followed their own rules for grammar, hyphenation, and punctuation, and often did not make ordered corrections.

By the time of Dickens, printers were more able to assign lightly-used presses to proofing, bringing a more professional standard to this part of the process, making life somewhat easier for authors.

Jane Austen also complained that her writing had produced less than £700 profit for her in her lifetime. Compare that with the reputed $6,000,000. in advances earned by General Colin Powell for his autobiography. Without the mechanical capability to produce millions of goods, his book could never have done so well.

Another major change occurring over the century was a shift in payment method for manuscripts--from an outright purchase of an author's copyright in a book to a percentage royalty per copy sold. With this also came written contracts, binding both author and publisher in a firm relationship. Some publishers insisted that contracts were unnecessary between gentlemen; but an incident between Henry Holt, who followed this practice, and his close friend and author, William James, highlights the misunderstandings inherent in not having a written contract. Some 400 copies of one of James' books were accidentally charged out of New York stock as a sale, instead of as a transfer to Chicago stock. When James reviewed his royalty statement he demanded payment for the 400 books. It was obviously a clerical error, but James was so incensed that he took his next book to another publisher, and his personal relations with Henry Holt were never quite the same, although he did return to the Holt list.

With contracts came literary agents, regarded then by many publishers as parasites. Over the years, agents have become indispensable in bringing manuscripts to publishers, in screening and in polishing manuscripts for publication, and in contract negotiation. Today, most Trade Book publishers will not even consider a manuscript that does not come through an agent. And the agent can truly represent an author in securing better payment terms from publishers, whose attention to small percentage shifts in cost is legendary.

Many similar changes in publishing and in author relations occurred on both sides of the Atlantic Ocean through increasing literacy, a growing middle-class with disposable income to buy books, and a growing readership of all kinds.

It has been pointed out that today there are only seven major book publishers: Simon and Schuster, Harcourt General, Random House, Doubleday, Harper Collins, Time-Warner, and McGraw-Hill, all particularly able to command millions of dollars from other parts of their conglomerate parents to secure promotable manuscripts.

In another glimpse of the under-side of the conglomerateur's coin, an incident at Harper Collins made headlines in major media at the end of February, 1998, Harper Collins reneged on a publishing contract with the former governor of Hong Kong because Rupert Murdock, of News Publishing Corp., the owner of Harper Collins, feared that critical comments in the book might affect Murdock's business interests in China. The issue was settled out of court with a personal apology by Murdock and reinstatement of the contract and the editorial personnel involved. Such high-handed exercises seem to revert back to the early nineteenth century (*Philadelphia Inquirer*, Feb. 27, 1998) and to Jane Austen's *Susan*.

A contemporary commentary on today's books business as a part of the entertainment industry was the use of family stock in Harcourt General, the marriage of publisher Harcourt Brace Jovanovich and movie theater owner General Cinema Corp. as collateral for the bank loan used in $190 million purchase of the Philadelphia Eagles football team by Jeff Lurie in 1994 (*Inquirer*, May 4, 1994). In like fashion, Paramount Pictures' purchase of Prentice-Hall, merged into Simon and Schuster, made the largest book publisher in the nation a central player in one corporation's continuing drive to dominate the entertainment world. It will be interesting to see if the next step in the Viacom/Paramount mating game is to shed either or both Simon and Schuster and Prentice-Hall, particularly now that Viacom C.E.O. Sumner Redstone in a palace coup fired the dynamic chief of the publishing unity, Richard Snyder.[1]

In similar fashion, there are probably only a half-dozen major book manufacturers in the United States today: R.R. Donnelly and Sons Co., Quebecor Graphic Rand-McNally, Maple-Vail, Doubleday, and Banta dominate this part of the publishing industry. The great names in American publishing: Appleton, Holt, Putnam, Harcourt, Ettinger, Rinehart, were all primarily merchandisers, astute businessmen whose literary sensibility was focused behind their sense of the market.

The chemistry between author and editor is tangible, and is a vital part of the publishing equation. What John Tebbell calls the "Golden Age of Publishing"--the period between World Wars I and II--was noted for these special relationships. Maxwell Perkins at Scribner's handled Hemingway, Fitzgerald, and Thomas Wolfe at the same time; Ken McCormack at Doubleday put a stamp on their list which still exists. Editors Saxe Comyns and Michael Bessie were as responsible for Random House's greatness as Bennett Cerf and Donald Klopfer. The existence of this kind of relationships existed at many great publishers of the period. Cass Canfield led Harper's to the very top of the industry, and after combining with Row, Peterson & Co., Harper's held the same position in textbooks. The point to be made here is that successful book publishing is the result of teamwork of author, agent, editor, printer, and marketer, and that literary excellence is a part of successful marketing.

A second major development which has derived from the production end has been the use of the ubiquitous computer. Mechanical computer applications are not limited to bookkeeping, accounting, and typesetting at publisher and printer. Computers have become indispensable in factory and office for control of the work, for quality control, for management control of the process itself. Besides bookkeeping and quality control, the first major use of computers in this industry was for typesetting, as massive main frames, tape drives, and printers were combined to set type. As the personal computer became more and more useful, publishers have included in their contracts provisions for authors to furnish floppy disks using approved computer language with a hard copy of the text, saving thereby the high cost of typographic union workers; this has become a basic requirement in authors' contracts. In one sense, though, this practice is regressive, for it puts responsibility for the typographic text on the quality of the author's more amateur typing than on the work of a professional typesetter.

Ranking with the Linotype and offset lithography in importance has been the use of adhesive binding to establish linear production of books. In use for over half a century to bind telephone directories and pocket paper backed books, new adhesives came in use in the nineteen-sixties, enabling binders to gather signatures printed on either offset or enamel pages, to apply adhesive to the backbone, and to attach a cover (either hard or soft) to make a finished book. Inexpensive books, using rotary web presses and adhesive binders, enabled a truly mass market for pocket-size books, putting them for sale in every kind of retail establishment, as well as in bookstores.

The use of offset lithographic equipment has made possible locating fine-screen halftones of illustrations next to text references, yielding greater textual accuracy, easier reading, and simpler assembly of material.

It is significant that all the major changes in printing technology in recent years have come from outside the industry--from manufacturers and vendors of materials for lithographers--not from printers as the nineteenth century, litho plates, chemicals, process film, photopolymer plates, color proving systems, specialty inks, and special machine designs such as web offset presses, the Cameron bookmaking machine, and specialty computer control equipment for all stages of the process. The computer applications which revolutionized typesetting and process control came out of the computer industry, not from printers; even the programs which achieve these dramatic results come from outside the industry, with computer makers writing programs to achieve results specified by printer and publisher.

Where will these marvelous developments take us? The industry is totally different today from what it was in the mid-twentieth century, with the results of basic research in the printing process, applied to new materials and controls by the Graphic Arts Technical Foundation and by corporate sponsors. Perhaps two developments since 1950 may give some insight into the future. In the nineteen-forties and fifties, publishers were terrified of what television boded for them--competition from information on the TV was only one facet of the concern; it could become new means of packaging information to be absorbed subliminally, eliminating books (and magazines) completely. The reality has been that TV is creating new entertainment media of personality programs, situation films, programs designed around books (another form of pocket books, perhaps), and has provided a new medium for promotion and advertising of books and authors; in the process TV has brought a new area of author and book marketing to publishing.

Nineteenth century publishers tried many marketing channels to move books--subscriptions, door-to-door sales, direct mail, special editions, books as advertising premiums were some of them. Applying sophisticated direct mail methods, publishers between the wars developed book clubs (specializing in almost every conceivable subject as well as the Book-of-the-Month Club, Literary Guild, Mystery Guild). Other marketing exploitation came with books written to order for particular use, as well as textbooks for specialized courses and for broader use as schoolbook and college adoptions.

In 1938, Robert deGraff persuaded Simon and Schuster to finance experimental publishing of a dozen "Pocket Books," to sell for a quarter. (Similar books today sell for upwards of $6.99!) The rapid growth of this niche of the industry was empowered by production development of web presses and adhesive binding. In retrospect this was probably the biggest publishing even of this century. It is the combination of the paperback and movie rights that enable the seven-figure royalty advances paid by some publishers for highly promotable titles.

Again, in the nineteen-seventies, teaching by machine was going to revolutionize teaching; teaching machines would replace teachers with pre-programmed classroom data, and students would effortlessly learn from suitably structured questions and answers. Major corporations, foreseeing a need for publishing distribution, marketing, and editorial skills, frantically went out and bought publishers, as, for example, Xerox Corp. bought R.R. Bowker Co., information center of the industry. Then reality set in and the teaching entrepreneurs realized that printed words on papers were so much cheaper a tool to produce and use that machine teaching slid into oblivion.

Will this be the fate of the Internet? How many people can afford the computer equipment, or one of its clones, to use the Internet? Will the growing concern for anti-social use of the Internet trammel its freedom? Can the system adequately replace books for entertainment and education?

Book publishing seems still to be firmly entrenched in today's markets. Two major marketing channels, which have developed in recent years, testify to the changes and modernization of book marketing demanded by many industry critics. Book stores are applying modern chain merchandising methods in meeting competition head on. Rack book distributors apply magazine distribution methods to selling books in supermarkets, drug stores, newsstands, and any other location with retail traffic that they can reach.

Publishers and bookstores alike have realized that their competition is not other books, but other media, sports, TV, movies, theater. Stores are reaching out into video materials, book-related toys, cassette music, and other similar products which they can merchandise. The traditional channel for book sales was the local bookstore, many buying their stock from wholesalers instead of from publishers, in much the same fashion of the corner grocery of decades past. A feature story in the *New York Times* tells of the imaginative TV marketing of books by the QVC shopping channel (2/14/98, p. D14).

Book chains, associated with major retailing firms such as Carter Hawley Hale, moved into the new shopping malls, and the B. Dalton and Walden books stores capitalized on the heavy mall traffic patterns. Then came free-standing super stores such as Barnes and Noble and Border's chains. These book supermarkets function as major chain markets, capable of carrying large inventories, buying at the best prices, and, with computers and the Universal Product Code on each book, monitoring sales details through heavy computer network use. These chains are also in a position to affect markedly reading patterns when publishers submit raw manuscripts to them for opinions on saleability and editing.[2]

We must remember, too, that the books we buy and read (Trade Books) represent less than fifteen per cent of all books published; textbooks, manuals, direct mail series, specialty works, Bibles make up the other eighty-five percent of the approximately 45,000 titles published yearly in the United States. The aphorism that publishers live on their backlist was never more apt.

Book people are moving in the direction of being part of the entertainment media so pervasive today. The contemporary marketing thrust is multimedia, and the book industry uses the media both as a source of materials and as sales tools. Thus the industry's response to change is creative and exciting.

Publishing's future will depend more and more on how well authors are tuned into the market and how well they meet the needs of that market, determining the moving changes in our tapestry as it is woven across the years, and at the same time harnessing the mechanical tools which make that market possible.

NOTES

[1] Snyder, who had built a publishing empire as head of Simon and Schuster, was known for his autocratic and lavish lifestyle. He was summarily fired in an event reported widely in newspapers and news magazines, all speculating about a non-existing disarray in the publisher's management, *Newsweek*, June 7, 1995; *Wall Street Journal*, July 6, 1995.

Another chapter in the Viacom/Simon and Schuster story is a report in the *Wall Street Journal* of January 22, 1998 that Viacom was restructuring its Trade Book Division of Simon and Shuster in cooperation with other publishers, and was putting the rest of its book division up for sale. This would include the textbook and other operations of Prentice-Hall, purchased by Paramount just as it combined with Viacom.

[2] It is worth noting here that Barnes and Noble is active in many markets as well as superstores. Starting as a bookstore in New York, it branched out into remainder sales by catalog and wholesaling, operating college bookstores, and a few years ago, buying the B. Dalton chain of mall stores. It is a marketing conglomerate in itself, and probably is the country's largest book retailer.

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