Printing and Writing Materials

A. M. Smith

PRINTING AND WRITING MATERIALS

JOHN GUTENBERG.
[From Lacroix.]

PRINTING AND WRITING MATERIALS: THEIR EVOLUTION

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PREFACE

IN the preparation of this handbook, the purpose has been to furnish in succinct form the leading facts relating to the history of printing, writing materials, and of bookbinding, and the processes by which they are made ready for general use. At present this information is usually found by laborious search through the pages of encyclopedias and other large volumes. While it is hoped that enough of general interest has been included to render the book pleasant reading, the aim has been also to supply a manual that will be useful for purposes of instruction.

The descriptions of the methods of type-founding, typesetting, newspaper printing, paper-making, bookbinding, and of the reproductive processes have been obtained from the offices and shops of companies of the highest standing, so that the information in each case coincides with what is actually practised in the workroom.

The historical sketch of Bookbinding has been compiled from the works of such authorities on the subject as Joseph Cundall, W. Salt Brassington, S. T. Prideaux, Henri Bouchot, and Brander Matthews.

The author desires to express her gratitude and indebtedness to the following persons and firms for important information respecting the various processes described: Mr. Theodore L. De Vinne, R. Hoe & Company, Mr. Philip T. Dodge, President of the Mergenthaler Linotype Company, the C. B. Cottrell & Sons Company, of New York; the editors of The New York World and The New York Journal; Mr. Henry Hoe, Sole Agent of Joseph Gillott & Sons, and Mr. John Winnacott, of New York; Mr. Talbert Lanston, of the Lanston Monotype Machine Company, Washington, D. C.; Mr. A. B. Daniels, of the L. L. Brown Paper Company, Adams, Massachusetts; Mr. H. A. Moses, of the Mittineague Paper Company, Mittineague, Massachusetts; Miss Mary H. Upton, of London, England; Mr. Charles H. Clarke, Mr. Frank S. Holby, Mr. Edward Hill (foreman), of the Avil Printing Company; Mr. J. Howard Avil, of the Phototype Engraving Company; Mr. J. Shoemaker, of the J. B. Lippincott Company; Mr. Charles R. Graham, of the Historical Publishing Company; Mr. A. E. Whiting, of the Whiting Paper Company; Mr. P. S. Collins, Manager of Circulation Bureau of the Curtis Publishing Company; Mr. W. Ross Wilson, Manager American Type-Founders Company; Mr. L. S. Bigelow, General Manager Keystone Type Foundry; Messrs. Irwin N. Megargee & Company; Messrs. Theodore Leonhardt & Son; the Moore & White Company; and the editors of The Evening Bulletin and the Sunday Press, of Philadelphia. Acknowledgments are also made to Mr. Brander Matthews, the Macmillan Company, G. P. Putnam's Sons,

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A. M. S.

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PRINTING

PRINTING is commonly understood to be taking impressions from ink-covered *types* upon paper or some other smooth substance. This, however, is typography, which is but one form of the art. A definition embracing all the processes which might be included under the head of printing could hardly be given in one brief statement. In a broad sense, printing is making copies by impression; but what is generally known as this art is the taking of impressions upon paper or other substance from a surface covered with ink or pigment.

Printing may be divided into four classes:

Typography, or the art of making impressions with movable types. This includes printing from electrotypes and stereotypes.

Xylography (Wood-engraving), or the art of taking impressions from a design engraved in high relief on a block of wood.

Lithography (Chemical Printing), or the art by which impressions are taken from a design made on the surface of a prepared stone, or sometimes on zinc or aluminum.

Intaglio Printing (Steel-plate and Copperplate Printing), or the art of taking impressions from a design cut below the surface of a plate of steel or copper.

In putting the characters or designs upon the respective surfaces, three processes are employed.

In Typography and Xylography, the characters, designs, or pictures to be printed are *in relief.* Ink is deposited on these characters or lines, paper is placed upon them, and pressure causes most of the ink to leave the printing surface and adhere to the paper.

In Lithography, the lines are *on* the surface, in very slight relief. A drawing is made with greasy ink on the surface of a prepared stone. The rest of the stone is moistened with water. The ink used for taking the impression adheres to the greasy drawing, but is repelled by the water. Pressure causes the ink to leave the stone and adhere to the paper. The design may also be put upon the stone by transfer from another stone or from prepared paper, by engraving, or by transfer from a photograph.

In Intaglio Printing (Steel-plate and Copper-plate Printing), the lines are cut *below* the surface of a plate of polished metal. Ink is deposited in these incisions, and any that is left upon the surface is wiped away before an impression is taken. Paper is laid upon the plate, pressure forces it into all the furrows, and a sharp, clean impression is obtained.

CHAPTER I

ANCIENT RELIEF PROCESSES

ALTHOUGH in Europe printing from movable types dates from the middle of the fifteenth century, the transfer of form by impression is one of the oldest of the arts. In Babylonia and Assyria, letters, pictures, and arbitrary signs were stamped on soft clay which was afterwards baked. In the ruins of the buildings of these ancient peoples, there has been found scarcely a stone or a kiln-burnt brick without an inscription or a stamp. The inscriptions on the stone were probably made with a chisel, but those on the bricks were made either from wooden stamps cut in relief or by the separate impressions of some pointed instrument. The bricks show various shapes: square or oblong tablets, cones, and cylinders, the latter often of considerable size. Some of the tablets are not more than one inch long; others found in the ruins of the palace of Nineveh measure 9 by 6½ inches. The cuneiform (wedge-shaped or arrow-headed) characters on

Babylonia and Assyria.

Clay tablets, cones, and cylinders.

BABYLONIAN TABLET WITH CUNEIFORM INSCRIPTION.

Size of the Original ($2 \times 3\frac{1}{8}$ inches) in the Museum of Drexel Institute.

most of the tablets are sharp and well-defined, but in some cases they are so minute as to be almost illegible without the aid of a magnifying glass. Whole libraries were formed of such bricks. These clay books, as they may be called, were arranged according to their subjects, numbered, catalogued, and placed in charge of librarians. The libraries were public property, and were intended for the instruction of the people. Each of the principal cities of Babylonia and Assyria possessed a library of this kind, of which the great national library of Assur bani pal (Greek, Sardanapalus), at Nineveh, was the most famous. Large numbers of the tablets found in Assur bani pal's palace have been placed in the British Museum. Fragments of the catalogue have also been found, and show that the library contained: legal, mathematical, and geographical treatises; historical and mythological documents; poetical compositions; works on astronomy and astrology; religious records; lists of stones, birds, and beasts; royal proclamations, and petitions to the king.

Libraries.

Contracts of marriage, sales and leases of property, and other business transactions were recorded on clay tablets. Sanction was indicated by an indentation made in the clay with

Contract tablets.

the finger-nail, preceded or followed by the mention of a name. From the contract tablets, which have been found in great numbers, much has been learned of the social life of Babylonia and Assyria.

Egypt.

In Egypt characters were impressed on bricks, but not to the same extent as in Assyria. Several old wooden stamps have been discovered in the tombs at Thebes, Meroe, and other places. The characters on their faces are cut in intaglio, or below the surface, so that impressions taken from them would be in relief.

Greece and Rome.

The ancient Greeks and Romans were acquainted with the art of metal-engraving. The Greeks engraved maps on metal plates by cutting lines below the surface. Impressions on vellum or papyrus could have been taken from these plates, but instead of thus quickly and easily multiplying copies, a new engraving seems to have been made for each map. Thin stencil-plates of wood were recommended by Quintilian as an aid for boys in learning to write. Cicero perceived that, with proper care, the letters of the alphabet might be so arranged as to form an infinite number of sentences; but we have no evidence that he thought of combining them for the purpose of printing.

Wooden and metal stamps.

The old Romans employed wooden and metal stamps with letters cut in relief. The potters marked their manufactures with the name of the contents of the vessel or of that of the owner. They seem also to have used movable types. Some

ROMAN STAMPS
[From Jackson]

of the inscriptions on their clay lamps were made by impressing consecutively the type of each letter. Brass stamps, with letters engraved in relief, have been frequently found in Italy and also in

France. They are all small in size and contain the names of persons only. Several of these ancient stamps are preserved in the British Museum; two are of curious shape, as shown in the illustration on the preceding page, and have the letters cut into the metal. In using such stamps, the Romans seem to have practised, to some extent, the art of printing with ink. A stamp in the British Museum Collection is in the form of a plate, about two inches long and nearly an inch wide. On the face, engraved in relief, are two lines of capital letters, cut the reverse way, as would now be necessary for printing. An impression taken from the stamp would read:

CICAECILI HERMIAE. SN.

Stamps for signatures.

which was probably the signature of one Cecilius Hermias. Nothing is known of this man. He may have used the stamp to save himself the trouble of writing or to hide his inability to write.

The use of stamps for affixing signatures continued until the beginning of the Renaissance, or the revival of learning which succeeded the dark age. We read that the Emperor Justinian made use of a perforated golden plate to assist him in signing his name. Theodoric, King of the Ostrogoths, did the same. It appears also that "the Emperor Charlemagne and the kings who were his immediate successors formed the strokes of their monograms by following with the pen all the openings cut into the plate or tablet laid upon the act to which they wished to subscribe."

Branding.

A method of making impressions, employed for centuries throughout Europe, was that of branding. Cattle and also human beings were marked in this manner. The Romans marked runaway slaves (*fugitivi*) and thieves (*fures*) with the letter F. Under the famous Statute of Vagabonds, enacted during the reign of Edward VI. of England (1547–1553), runaway servants and idle loiterers in the highways able to work were branded on the breast with the letter V, and fugitive slaves were marked on the cheek and forehead with the letter S. Branding was also a mild form of punishment for the gypsies, and in 1698 was made the penalty for theft and petty larceny. Cold branding was afterwards substituted as a nominal infliction of the penalty. This barbarous mode of punishment was discontinued in England in the reign of George III.; and was finally abolished in 1829. In France, as late as 1832, galley slaves were marked with the letters T F (*travaux forcés*). In Germany branding has never been recognized by the common law.

Lack of suitable materials for printing.

Except in the few cases mentioned, these ancient peoples seem not to have taken impressions from stamps nor to have multiplied impressions from the same stamp. Had they wished, however, to repeat the same inscription many times upon papyrus or parchment, there were mechanical difficulties in the way which would have rendered their work indifferent and unsatisfactory, and which explains, in some measure, why the world had to wait so long for the invention of typography. These nations were destitute of some of the commonest printing materials which to-day are considered indispensable. What we term paper did not exist, except in China, before the eighth century, and was not manufactured in Europe before the twelfth. The papyrus used as a writing surface could not be folded like ordinary rag paper, and would probably have torn apart under the action of a press. It could not be rolled upon itself, in the same way as a sheet of paper, but had to be wound around a wooden roller. Parchment, being greasy, resists ink, is hard to handle, and even at the present day is regarded as an undesirable printing material. The ancients lacked also a suitable ink. Trifling as it may seem, this would have been one of the chief obstacles in the way of success, even had there been an invention of types. Their ink was a thin wash made of soot thickened with gum, with an acid sometimes added to make it bite or sink below the surface of the papyrus. These watery inks would have collected in blotches upon a smooth metal plate, and if stamped upon paper or parchment the impressions would have been of irregular blackness and illegible in many places. The chief ingredients of printing-ink are lampblack and oil. The early printers of the fifteenth century took a lesson from an innovation which immediately preceded the invention of typography; this was the mixing of color with oil,[1] a step which wrought a revolution in the art of painting. The printers, finding that they could

[1] The introduction of this method has been generally attributed to Jan van Eyck of Holland, who lived during the early part of the fifteenth century; but it is believed that his brother Hubert has an equal claim to the honor of the discovery.

not use the ink of the copyists, mixed their black with oil, and succeeded in giving to the world books which after more than four centuries are still beautifully legible.

Besides the lack of suitable materials, the old Romans had no great mechanical skill. Architecture was about the only art requiring the cooperation of many persons, in which they achieved success. Simple labor-saving devices, so common at the present day, were unknown to them.

The civilization of ancient Rome had no great need of the art. There were many scribes and copyists. These professional scribes were educated slaves, whose food and clothing cost but little, and who produced books faster than they could be sold. They were read not only in the libraries, but in the porticoes of houses, at private dinners, and at the baths. Horace complained that his books were too common, and that they were found in the hands of vulgar snobs for whom they had not been written. Volumes produced by slave labor were, of course, cheap. Martial's first book of epigrams, in plain binding, was sold for six sesterces, or about twenty-four cents of American money.

The Chinese have practised block-printing for many centuries. Printing with ink from wooden blocks has been traced as far back as the sixth century, and some writers claim that China had a knowledge of the art even before the Christian era. The invention of movable types of clay was made by a blacksmith, Pi Shing, in the eleventh century. This method of printing was done by rubbing, but it did not supersede block-printing. The British Museum possesses a work printed in 1337, which is exhibited as the earliest instance of a Korean book printed from movable types. China.

Various attempts have been made to substitute types for engraved blocks, but this is difficult because of the great number of the Chinese characters. These characters do not stand for letters or sounds, but represent complete words or ideas; besides the two hundred and fourteen radicals, the characters formed by combinations have been variously estimated from forty thousand to over two hundred thousand in number; not more than fourteen or fifteen thousand, however, are in regular use. A Chinese missionary house employs about six thousand characters; for an ordinary newspaper only about four thousand are necessary; while magazines which treat of a greater range of subjects require ten thousand. The printing-offices arrange the characters by the radicals.

Movable types, both of wood and of metal, have long been employed in China. Movable types of metal were first cut in 1815, for the purpose of printing Morrison's Dictionary. Printing from metal types is practised in China mainly for the purpose of circulating the Bible and for newspapers.

It is indisputable that block-printing was first practised in China, but there is nothing to prove that Europe originally derived its knowledge of this art from the East.

Japan

In Japan the earliest example of block-printing dates from the middle of the eighth century. The Jesuits were the first to print from metal types in that country, in the seventeenth century. Because of the avidity with which the Japanese have taken hold of Western learning, printing is extensively carried on in Japan, both blocks and types of metal being employed.

CHAPTER II

PRINTING IN EUROPE

IN Europe until the second half of the fourteenth century, books of every kind, letters, and all private and public documents were written by hand. Figures and pictures were produced with either the pen or the brush.

Before the invention of typography in the middle of the fifteenth century, playing-cards, pictures of saints, and block-books were printed from engraved wooden blocks.[1]

Image prints and block-books.

When this method of printing began to be developed in Europe, it was in connection with playing-cards. The work was extended in the production of image prints (sometimes accompanied with a text), texts of scripture without pictures, and whole books,—each picture, text, or leaf being printed from one engraved block. The latter, called block-books, sometimes consisted only

[1] Block-printing on cloth and vellum seems to have been practised as early as the twelfth century, and on paper as early as the second half of the fourteenth century.

of pictures, sometimes they were half picture and half text, and occasionally they contained only text.

Image prints.

From their perishable nature, but few of the early image prints have come down to us. With a few exceptions, these prints were colored. They were pictures of sacred personages, and were undoubtedly copied from illuminated religious books then to be found in all the large monasteries. They were intended for religious instruction and comfort, and were bought by the poor and hung on the walls of their huts and cabins. These prints were produced as early as the fourteenth, perhaps as early as the thirteenth century. The earliest print still existing with a definite and unquestioned date is the *St. Christopher* of 1423. It is a rude wood-engraving, about 8 by 11 inches, and represents the Saint carrying the infant Saviour across a river. This print was discovered by Heinecken, in 1769, pasted inside the binding of an old manuscript volume of 1417, in the library of one of the most ancient convents of Germany, the Chartreuse at Buxheim in Swabia. The manuscript was placed in what was known as the Spencer Library, which afterwards passed into the possession of Mrs.

The St. Christopher.

THE BUXHEIM SAINT CHRISTOPHER, 1423.

Rylands, of Manchester, England.[1] In the book which contained the *St. Christopher* was also found another image print, the *Annunciation*, by some thought to be of the same age and workmanship as the former. It is about the same size and is printed on the same kind of paper. Many image prints, of course, were produced before the *St. Christopher*, but this bears the earliest date of any now in existence. The *Mary Engraving*, or the *Brussels Print*, was formerly thought to be of the year 1418; but the date had evidently been tampered with, and the authorities now consider it to be 1468. This print was discovered by an innkeeper, in 1848, pasted on the inside of an old chest, and was placed in the Royal Library at Brussels.

The Annunciation.

The Brussels Print.

Other old prints are the *St. Bridget*, supposed to be of nearly the same age as the *St. Christopher;* the *Martyrdom of St. Sebastian*, with fourteen lines of text and bearing the date 1437, found in 1799 in the monastery of St. Blaise in the Black Forest, and preserved in the Imperial Library at Vienna; the *St. Nicolas de Tolentino*, with the date 1440 written in by hand; a print representing

[1] This has been made a public library of research and reference in the city of Manchester, under the name of The John Rylands Library. It was formally opened on October 6, 1899, and takes its place as one of the great libraries of the world.

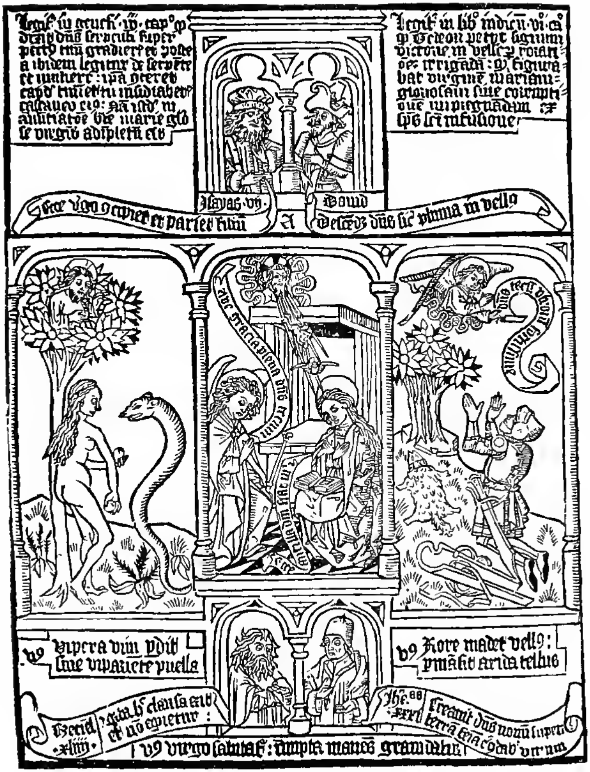
the bearing of the cross, *St. Dorothea* and *St. Alexis,* with the date 1443 also written in by hand. No other wood-cuts are known with dates prior to the second half of the fifteenth century. A number of engravings exist, which, judging from the style of the workmanship, may have been produced somewhat earlier, probably in the latter part of the fourteenth or early in the fifteenth century.

Block-books.

The block-books were printed wholly from carved blocks of wood. A whole page, sometimes two whole pages were printed from a single block. The block-books are of two kinds: books of pictures without text, but containing words descriptive of the picture at the foot of the page, in the corners, or in scrolls near the figures; and books of pictures containing explanations of the pictures in a full page of text, usually printed on the page opposite the picture.

Block-books without text.

Of the first class, pictures without pages of text, the best known are the *Biblia Pauperum* (*Bible of the Poor*), the *Apocalypse of St. John,* the *Canticum Canticorum* (*The Canticles*), and the *Story of the Blessed Virgin.* To the second class belong *Der Endkrist* (*The Antichrist*), the *Ars Memorandi* (*How to Remember the Evan-*



FIRST PAGE OF THE BIBLIA PAUPERUM.
(THE ANNUNCIATION.)

gelists), the *Ars Moriendi* (*How to Die Becomingly*), the *Mirabilia Romæ* (the *Wonders of Rome*), and the *Dance of Death.* The only block-book without pictures, of which we have knowledge, is the *Donatus*, or *Boy's Latin Grammar.* One of the best known of the block-books is the *Speculum Humanæ Salvationis* (*Mirror of Salvation*). This is of special interest in the history of typography, as it occupies a position midway between the block-book proper and the ordinary printed book. In the true block-book, both pictures and text were engraved on blocks of wood. In the four known editions of the *Speculum* the text is printed from movable types, except in one edition which contains twenty xylographic pages.

Block-books with text.

The Speculum

It is not known just how many different block-books are now in existence, but there are perhaps nearly one hundred. Sotheby, in 1858, described but twenty-one; the Encyclopedia Britannica of 1888 enumerates but thirty. It is probable that many have been lost and forgotten. Although but few distinct works were published, the editions were numerous. From the number and variety of the editions, there must have been a large demand for these books. They were made both before and after the invention of typography. They were issued after the invention of movable types because of the cheapness with which they could be produced. Many of those which have come down to us are unimportant, others are of so late a date as to be of little interest in the history of printing. An Italian adaptation of the *Biblia Pauperum* was printed at Venice as late as 1512, and a few block-books of less merit were printed after this. The latest block-book of any size was produced also at Venice. It is known as the *Figure del Testamento Vecchio* (Pictures from the Old Testament), printed about 1510, by Giovanni Andrea Vavassore. The separate issues are not editions in our sense of the term: they were not printed from one set of blocks after another, as the sets were successively worn out. The cutter who carved the blocks sold not the books but the blocks themselves, to private purchasers, who were men of wealth or heads of religious establishments. The editions, consequently do not always follow one another; a short interval may have sometimes elapsed between two issues; but when a work was popular, the blocks were often produced side by side by different cutters.

The block-books were printed on one side of the paper only, in brown ink. Impressions were taken off by rubbing; occasionally two sheets were pasted together to form one leaf. The paper was harsh and uneven. Books printed on both sides of the paper and in black ink are considered to have been produced after the invention of typography.

The image prints were usually colored after they were printed. In many the colors were painted in, but the later prints show that they were stenciled. The block-books, also, were often painted, or colored by means of stencil-plates.

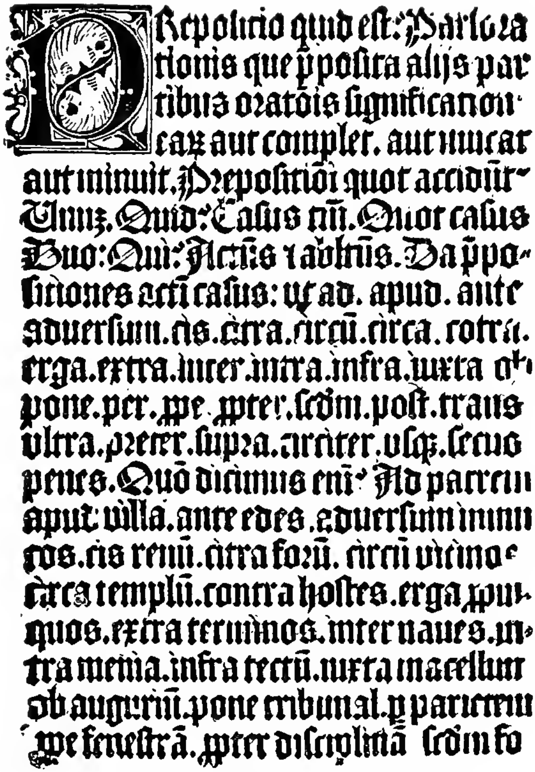
Most of the block-books are of a religious character, but the religion they teach is, of course, dogmatic and doctrinal. They were probably written by ecclesiastics of high position for the instruction of ignorant monks and curates unable to read. They gradually, however, found their way into the hands of the laymen, who admired the pictures if they could not read the Latin. Although written by ecclesiastics, we have no evidence that these books were printed in monasteries. The block-printers of a later day were laymen, and it is probable that the earlier books were also printed by laymen.

Biblia Pauperum, or Bible of the Poor.

The most famous of the block-books was the *Biblia Pauperum*, or *Bible of the Poor*. This name seems to have been given to it to distinguish it from the complete Bible in manuscript which, of course, could be owned only by the rich. The Bible proper of that day was in the form of two or more thick folios and was written on fine vellum. Although called the *Bible of the Poor*, this book was written for the clergy; the poor of the laity, however, were doubtless able to appreciate the pictures. It was the block-book most often reproduced, and was printed in both Latin and German. The edition supposed to be the first is in Latin, and contains neither date, place, nor name of printer. By some it is claimed to have been printed in Germany, by others in Holland. The *Biblia Pauperum* consists of forty wood-engravings, printed on only one side of the leaf. The prints face each other, two pages of pictures being followed by two blank pages. The Life and Passion of Christ are represented, with parallel subjects taken from the Old Testament.

Ars Moriendi, or How to Die Becomingly.

The origin of the *Ars Moriendi* is not known, but it was a popular work long after the introduction of the printing press. Its object is to set forth the temptations that beset both the good and the


Prepositio quid est? Pars ora-
tionis que p̄posita aliis par
tibus oratõis significationē
earū aut complet. aut mutat
aut minuit. Prepositioni quot accidūt
Unū. Quid? Casus tm̄. Quot casus
Duo. Qui? Acc̄tus & abl̄tus. Da p̄po-
sitiones acc̄ti casus: ut ad. apud. ante
aduersum. cis. citra. circū. circa. cōtra.
erga. extra. inter. intra. infra. iuxta. ob
pone. per. p̄pe. p̄pter. scd̄m. post. trans
ultra. preter. supra. circiter. usq̄. secus
penes. Quō dicimus enī? Ad patrem
apud villā. ante edes. aduersum inimi
cos. cis renū. citra forū. circū vicinos
circa templū. contra hostes. erga p̄pin-
quos. extra terminos. inter naues. in-
tra menia. infra tectū. iuxta macellum
ob augurīū. pone tribunal. p̄ parietem
p̄pe fenestrā. p̄pter disciplinā scd̄m fo

PAGE OF A DONATUS.

[From Bouchot.]

The original block is preserved in the National Library at Paris.

bad in the hour of dissolution. Angels and demons surround the bed of the dying person, and strive to win for themselves the departing soul. A kind of dialogue is kept up between the angels and Satan, which is set forth in the scrolls. In the illustration which represents the death of the rich man, one devil tells him to provide for his friends, another calls out "Pay attention to your treasures." In the next cut, an angel exhorts him not to heed the advice of the devils, but to leave his property to the church. In the last picture, the spirit of the dying man, represented by a manikin, is exhaled with his last breath, and is received by the angels. The book was apparently written to prepare man for another world, but its real purpose was the aggrandizement of the church. The work was popular for more than a century.

The Donatus, or Boy's Latin Grammar.

The *Donatus* is the only block-book without pictures of which we have any knowledge. Its author was Ælius Donatus, a Roman grammarian of the fourth century and one of the instructors of St. Jerome. The block-book was the grammar abridged, and is the only school-book known to have been printed from blocks. When printed in the largest letters, it contained but thirty-four pages;

when put in small letters it had only nine pages. As the *Donatus* was constantly used in every preparatory school, there was always a large demand for it. For so small a book, the engraving of the blocks would cost little more than type composition, consequently, xylographic editions were still produced at the end of the fifteenth century.

Originally, the *Donatus* was written for students who spoke Latin, and who, when the book was first published in the fourth century, could easily read it. The work continued to be used as late as the fifteenth century, because Latin was the only language taught in the schools. The use in the fifteenth century of a text-book written in the fourth, shows the little progress made in educational methods. From the forbidding appearance of the book, one infers that no effort was made to render the path of knowledge inviting.

Two original blocks of the *Donatus* were bought in Germany by Foucault, Minister of Louis XIV., about two hundred years ago, and are preserved in the National Library at Paris. There is part of a *Donatus* in the Bodleian Library at Oxford, with a colophon stating it to be the work of Conrad Dinckmut, who practised printing at Ulm from 1482 to 1496. Fragments are also preserved in several of the great European libraries.

CHAPTER III

INVENTION OF TYPOGRAPHY

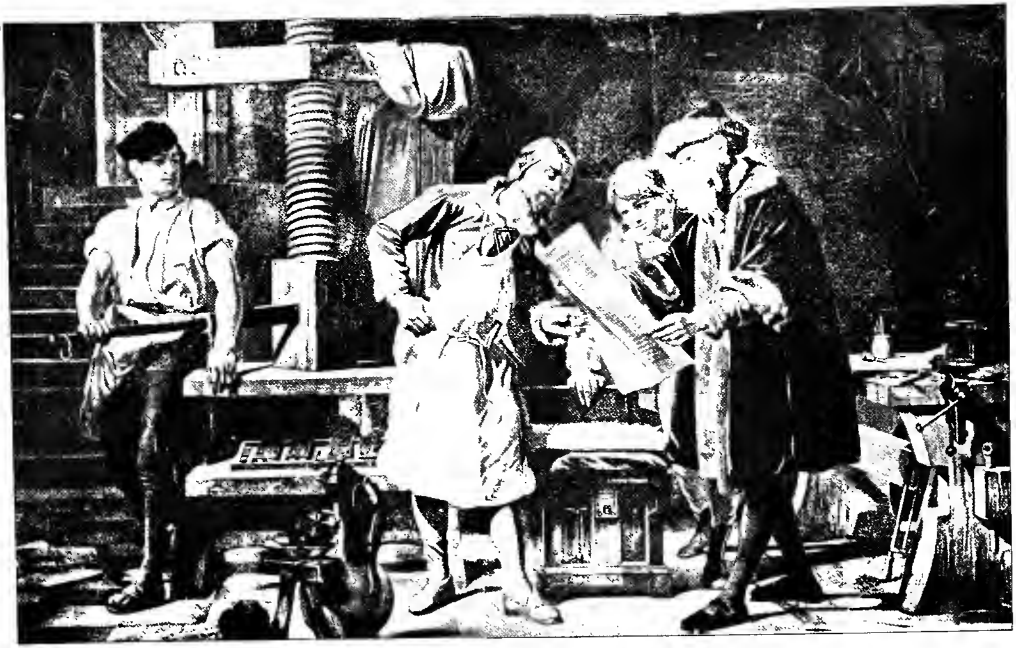
THE progress of the development of the art of impressing characters from engraved designs has thus far been traced from the clay bricks of Babylonia, Assyria, and Egypt to the block-printing of China and Europe. All the steps necessary to give the world the art of typography had been taken except one, and the people of Europe, especially in the North, were ready to receive the art. Paper had been manufactured for more than two hundred years and it was now in common use, although regarded by the cultured classes as a plebeian writing material. The printers had found a suitable ink for their work, and in Germany and the Netherlands, where typography was first practised, there had been for some time a steady progress in education, and consequently a developed mental activity which was put to practical use.

The final step needed was the *casting* of movable metal types. Printing could never have been practised on an extensive scale, if the idea of casting types had not been conceived. The key to the invention was the type-mould. The honor is due to the man who invented the first type-mould, for types which are cast are the only ones that can be used to advantage. There is no evidence to prove that engraved *wooden* types were ever used except in an experimental way. A fierce controversy has waged as to who first gave the world a knowledge of typography, but the weight of evidence is strongly in favor of John Gutenberg, a printer of Mainz.

The type-mould.

John Gutenberg.

We do not know when and where Gutenberg made his first experiments with movable types, but before 1439 he seems to have been at work at Strasburg, endeavoring to perfect his art. From Strasburg he went to Mainz, where his name appears in 1448, in a record of a legal contract. Here, about 1450, he entered into partnership with Johann Fust or Faust, a wealthy money-lender, who furnished the means necessary to set up a printing-press. In a few years (1455), Fust brought a lawsuit against Gutenberg, to recover the sum of money he had advanced. The verdict was in Fust's favor and the printing-press passed out of the hands of Gutenberg. Although now nearly



GUTENBERG TAKING AN IMPRESSION.

sixty years old, Gutenberg did not despair, but determined to found another office. Some of his printing materials still remained to him, and the clerk of the town of Mainz provided him with money. He continued his work for some time, but in 1462 all printing in Mainz was interrupted for several years, by the sacking of the town during the quarrel of the archbishops. In 1465 Gutenberg was made a courtier by Adolph II., Count of Nassau. His death occurred before February, 1468, but nothing is known of the circumstances.

The earliest specimen of printing from movable metal types known to exist at the present day is the famous *Letter of Indulgence*,[1] of Pope Nicholas V., to such persons as should contribute money to help the King of Cyprus against the Turks. A copy of this Indulgence is now preserved in the Meerman-Westreenen Museum at the Hague. It bears the earliest authentic date on a document printed from types,—November 15, 1454.

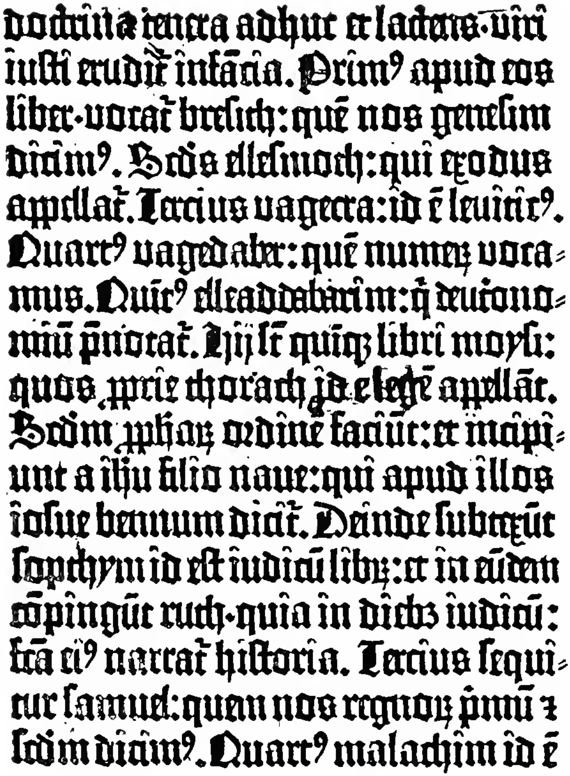
[1] A plenary indulgence of three years, granted by Pope Nicholas V., on the 12th of April, 1451, to all persons who from May 1, 1452, to May 1, 1455, should contribute money to aid the King of Cyprus then threatened by the Turks.

The work upon which Gutenberg's fame rests, as a great printer, is the Holy Bible in Latin. There are two editions of this work: one known as the *Bible of Forty-two Lines*, and the other as the *Bible of Thirty-six Lines*. The figures indicate the number of lines to the page in a column. It is not known which was printed first, but it is generally believed that the forty-two-line Bible is the earlier. This is generally called the *Mazarin Bible,*[1] because the copy which first attracted notice was discovered in 1760 in the library of Cardinal Mazarin at Paris; it is also known as *Gutenberg's First Bible.* It is believed that this Bible could not have been begun before August, 1450, and that it was finished in 1455, but the exact dates are not known. The Paris copy contains the rubricator's inscription, which shows that the work was completed before the 15th of August, 1456. The thirty-six-line Bible has received the name of *Pfister's* or the *Bamberg Bible,* because the type used in it was once owned by Albrecht Pfister of Bamberg. A copy of this Bible was discovered in 1728, in the library of a monastery near Mainz. A note found in the

Bible of Forty-two Lines.

Bible of Thirty-six Lines.

[1] The Earl of Ashburnham's copy of the *Mazarin Bible,* on vellum, was sold in 1897 for £4,000, or about $20,000,



doctrina tenera adhuc ex lacte viri
iusti erudit infanciam. Primus apud eos
liber vocatur bresith: quem nos genesim
dicimus. Secundus ellesmoth: qui exodus
appellatur. Tercius vagecra: id est leviticus.
Quartus vagedaber: quem numeros voca-
mus. Quintus elleaddabarim: qui deutrono-
mium prenotatur. Hii sunt quinque libri moysi:
quos proprie thorath id est legem appellant.
Secundum prophetarum ordinem faciunt: et incipi-
unt ab ihesu filio naue: qui apud illos
iosue bennum dicitur. Deinde subtexunt
sophthym id est iudicum librum: et in eundem
compingunt ruth: quia in diebus iudicum
facta eius narratur historia. Tercius sequi-
tur samuel: quem nos regnorum primum et
secundum dicimus. Quartus malachim id est

FRAGMENT OF THE FORTY-TWO-LINE BIBLE, KNOWN ALSO AS GUTENBERG'S FIRST BIBLE

manuscript catalogue of the library states that the Bible was given to the monastery by John Gutenberg and his associates. The date 1461 is written on a copy of the last leaf of this book, also preserved in the National Library at Paris.

These two editions of the Bible bear no printed date,[1] and were published, like all of Gutenberg's works, without name or place of printer. The great expense which he incurred and the fear of lawsuits may have led him to omit his name from the books he printed—a fact which makes it difficult to identify all of them.

Later works of Gutenberg.

Among some of the later works ascribed to Gutenberg were: the *Calendar* of 1457; a *Letter of Indulgence* of 1461; and the *Catholicon* of 1460, written by John of Genoa, of the fraternity of preachers or mendicant friars, which contains a Latin grammar and an etymological dictionary, and which was used as a text-book of authority in the higher schools. Five little pamphlets attributed to Gutenberg are: *A Treatise on the Celebration of Mass;* a *Calendar* or an *Almanac* for 1460; *the Mirror of the Clergy;* a *Treatise on the Necessity of Councils,* etc.; a *Dialogue between Cato, Hugo,*

[1] The first book with a *printed* date is the *Psalmorum Codex* of 1457, issued by Schoeffer.

and Oliver, about Ecclesiastical Liberty. It has not been proved that Gutenberg printed these works. Two books that he probably issued are: *A Treatise on Reason and Conscience,* by Matthew of Cracow, and *A Summary of the Articles of Faith,* by Thomas Aquinas. He may have printed many others which have been destroyed and forgotten.

Two friends of Gutenberg, who probably knew about his invention, erected tablets to his memory, —one soon after his death, in the church at Mainz, and the other in 1508, in a law school of that city. The inscriptions on these two tablets speak of him as the inventor of printing. Both Strasburg and Mainz have erected fine monuments to his memory.

John Fust.

John Fust, also known as Faust, was a wealthy money-lender living in Mainz between 1440 and 1460, and one of the three persons to whom has been ascribed the invention of typography. About 1450 Fust entered into partnership with Gutenberg, and advanced the money needed to establish a printing-office. In 1455 he brought suit against Gutenberg to recover the sum lent, which, of course, had increased through interest charges and other expenses The judges decided in Fust's favor, and as Gutenberg was unable to pay the money, the press passed out of his hands. Peter Schoeffer, son-in-law of Fust, who had been in the employment of Gutenberg, supervised the management of the printing-office after the departure of the latter. The business was carried on by Fust and Schoeffer until the capture of Mainz,[1] in 1462, which stopped the work of the press for a few years. Fust died in 1466 and Schoeffer became the head of the printing-house. He was successful in business and established agencies for the sale of books at other places in Germany. In the latter part of his life, he was made a judge, but continued the business of printing until his death, which occurred about 1502.

Peter Schoeffer.

The first book issued by the Fust-Schoeffer press, after the partnership with Gutenberg had been dissolved, was the *Psalter* of 1457, a folio of one hundred and seventy-five leaves. This is the first book with a *printed* date, and is almost as

Psalter of 1457.

[1] The archbishopric of Mainz was claimed by Adolph II., Count of Nassau, who was supported by Pope Pius II. In 1462 he attacked and captured the town which took the side of Diether, then archbishop and elector of the place. Many citizens were murdered and the town was sacked. All industry was, of course, destroyed. The workmen of the printing-offices fled to other places, carrying their art with them. For three years after the capture of the town, nothing of value was printed at Mainz.

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famous as the forty-two-line Bible. It is an imitation not only of the copyist's but of the illuminator's work, with black stately types and two-colored initials, red and blue. The letter is in one color and the ornament surrounding it in another. These capital letters are the most striking thing about the *Psalter*. It is not yet known exactly how they were produced. By many this book is regarded as the finest work issued by the early press, but others think that in order to produce the blackness of the type, some of the lines have been retraced and the initials have been repainted. No later work of this press equals the *Psalter* either in presswork or type-cutting. It is quite probable that the book had been planned and begun by Gutenberg before he severed his partnership with Fust. The colophon or imprint is so ingeniously worded that, while it does not expressly state that Fust and Schoeffer were the inventors of printing, the reader is left to infer that fact:

"This book of Psalms, decorated with antique initials, and sufficiently emphasized with rubricated letters, has been thus made by the masterly invention of printing and also of type-making, without the writing of a pen, and is consummated to the service of God, through the industry of Johan Fust, citizen of Mentz, and Peter Schoeffer, of Gernszheim, in the year of our Lord 1457, on the eve of the Assumption [August 14]."

The books issued by the early printers were in the gothic letter. When the new art was first introduced, the wealthy looked upon the innovation as an inartistic trade, and the printers therefore copied the characters of the contemporary manuscripts in order to sell their works. Gothic letter.

Koster is the person to whom the Dutch ascribe the invention of types. It seems that two men by the name of Lourens Janszoon lived in Haarlem during the first half of the fifteenth century. It is supposed that one was sacristan or *koster* in that city; it is claimed that he made his invention between the years 1420 and 1440. Until 1499 no one seemed to doubt that movable types had been first used in Strasburg by John Gutenberg, who afterwards went to Mainz and established the press which issued the Latin Bible, known as the *Mazarin Bible*. In the *Cologne Chronicle*, published in 1499, one chapter discusses the question of the origin of printing. The chronicler states that the new art was discovered at Mainz, about 1440, but that although it was discovered in Germany, "the first prefiguration was in Holland, in the form of the *Donatuses*, which were printed before that time." This statement

Lourens Janszoon Koster

started the controversy which has waged for four centuries as to the true inventor of printing. Junius, in his *Batavia*, printed in the Plantin office at Antwerp in 1588,[1] gives an account of the invention, which he said he had heard from old and trustworthy people. He states that in 1440 Koster, who was then living at Haarlem, while one day walking in the *Hout*, or woods near the city, "cut letters on the bark of a beech-tree; that he printed these letters on paper for the amusement of children; that he invented a suitable printing-ink, and afterwards printed whole sheets with pictures; and that still later he used leaden letters and then tin ones." Junius also states that in 1441 one of Koster's workmen stole the types and fled to Mainz, where he opened a workshop and published two works with these types in 1442.

The most severe assault upon the claim of Koster was made in 1870 by a Dutchman, Dr. van der Linde. He published a series of articles entitled *The Koster Legend*, in which he claimed that the documents brought forward to prove Koster the inventor of printing were false, and that the arguments in his favor had no historical

[1] It will be noticed that this date is about a century and a half later than the invention of typography.

STATUE OF GUTENBERG AT STRASBURG.
[From a Photograph.]

or bibliographical support. The work aroused such indignation in Holland that Dr. van der Linde thought it advisable to leave the country. Hessels, also a native of Holland, took up the subject, and after considerable research, he published in 1882, a book in which he stated that he could find nothing to prove Gutenberg the inventor of printing. The controversy between the two authors was kept up for some time, but the Koster theory has been abandoned everywhere except in Holland.

Spread of typography.

The art begun at Mainz soon spread to other cities and to other countries. Travelers were constantly passing through this town to the Netherlands, France, Italy, and Switzerland. The quarrel of the archbishops in 1462 dispersed the printers and probably sent Ulrich Zell to Cologne. Presses were soon set up in other cities, and by the end of the fifteenth century more than one hundred and fifty towns were practising the art. England made a beginning in 1477. France, Germany, and Italy were the countries where typography was most practised and where the greatest improvements were made. Three printers from Germany established a press in Paris in 1470, and others soon took up the work. Many beautiful books were printed in France within the next quarter of a century.

Nicolas Jenson.

In 1458 the King of France sent Nicolas Jenson to Mainz to learn the new art. On his return to Paris, he tried to get sufficient money to establish a press, but was not successful and went to Italy. In Venice he became famous. Printers had already preceded him and set up a press in Subiaco, in 1465. The art soon spread to Rome, Milan, and other Italian cities, but the centre of printing and book-making was Venice. At the close of the fifteenth century, this city was renowned not only for the number of its printing-presses but for the beauty of the works they produced. Before the year 1500, over two hundred printers had practised typography in Venice, numbering among them Aldus Manutius, who introduced the italic letter. Jenson perfected the roman type, which he used in 1471, but the letter had already been cast at Subiaco in 1465. Our roman letter of to-day is derived from the two scripts formerly used in Rome,—capitals from the letters used for inscriptions, and small letters from the cursive form employed for business correspondence.

Italic letter.

Roman letter.

The roman type of Jenson was a letter of extraordinary beauty; it has been frequently copied, but never equaled. The gothic and roman forms struggled together for some time after the introduction of printing, but the latter finally triumphed. Roman type was first used in England in 1518, and by the year 1600 books were generally printed in that character. William Morris adopted the roman letter of Jenson as the model for the Kelmscott Press when it was started at Hammersmith, England, in 1891.

CHAPTER IV

EARLY PRINTING-PRESSES

THE most celebrated of the early printing-presses were those of:

Aldus Manutius, at Venice, fifteenth and sixteenth centuries.

Anthony Koberger, at Nuremberg, fifteenth and sixteenth centuries.

Elzevir, in Holland, sixteenth and seventeenth centuries.

Estienne, at Paris, sixteenth and seventeenth centuries.

Plantin, at Antwerp, sixteenth and seventeenth centuries.

Aldus Manutius.

Aldus Manutius was an eminent printer who lived in Venice at the beginning of the sixteenth century. It is supposed that he went to Venice about 1489, and began printing there in 1494. He was a man of great learning and industry and exercised extreme care in the production of his works, which are characterized by good typography and correct texts. The Aldine press is celebrated for its editions of the Greek and Latin classics. To assist in the preparation of these volumes, Aldus gathered around him, as editors and proof-readers, the most scholarly men of his age. He established in Venice the Aldine Academy, the aim of which was to further the knowledge of classical Greek literature. To this Academy came artists and learned men from both the Levant and Western Europe.

Greek grammars and dictionaries were published also by Aldus. He introduced the type called *italic* by the Latin and English peoples, and *cursiv* by the Germans. It is supposed to be formed upon the handwriting of Petrarch. Aldus put his prefaces and introductions in this type, and sometimes whole books. The present system of punctuation may be said to have been devised by him, as before his time but few marks had been employed and the use of these was not well regulated.

The last of this family of printers died deeply in debt, and his printing apparatus was sold by his creditors. The house had existed about one hundred years. It had been noted for the superior character of its work and for its patronage by men of letters, and had been a source of the greatest credit to Italy.

Anthony Koberger.

Anthony Koberger began to print at Nuremberg in 1472. He was associated in business with Frederick Creusner, another famous Nuremberg printer. He is regarded by some as the most important printer and publisher of the fifteenth century. It is said that he had twenty-four presses at Nuremberg, besides having books printed for him in other towns.

In 1480 Koberger published an interesting catalogue containing the titles of twenty-two books, not all, however, printed by himself. A copy of this catalogue is in the British Museum. He is said to have printed twelve editions of the Bible in Latin and one in German. His best known work, and the most curious, is the *Nuremberg Chronicle*, published in 1493. This book is a summary of the history, geography, and wonders of the world, and contains about two thousand illustrations taken from three hundred wood-engravings, the same engraving being employed several times to represent different objects. The same cut was used to portray both Paris of Troy and the poet Dante.

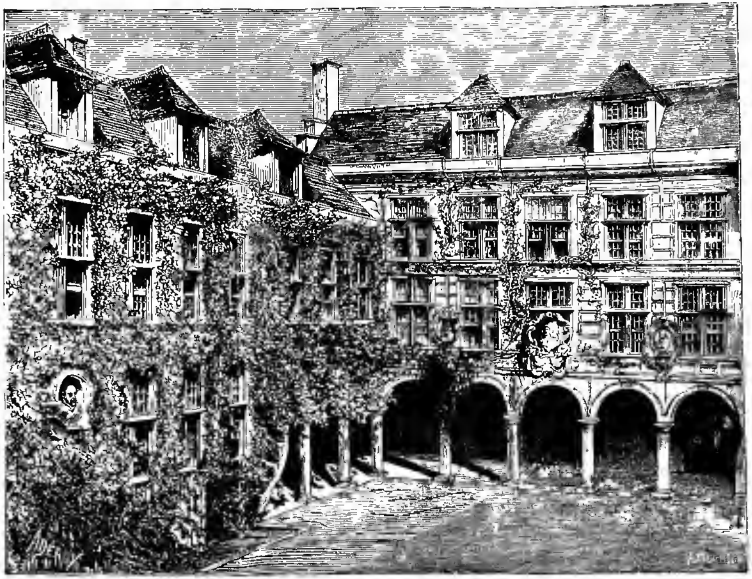
Elzevir is the name of a celebrated family of Dutch printers and publishers of the sixteenth and seventeenth centuries. Louis Elzevir, the founder of the house, issued his first work about 1583. There were twelve printers of this family. The press became famous for its editions, in small size, of the Latin classics and of works of French authors on historical and political subjects. As these printers were also booksellers, it is often difficult to determine the genuine Elzevirs. **Elzevir.**

The Estienne family flourished during the sixteenth and seventeenth centuries in Paris and Geneva. The name is sometimes given *Étienne*, or *Stephens*, *Stephanus* being the Latin translation of the French word *Étienne*. The name is regarded as one of the most honorable in the history of typography. The first printer of this house, Henry, was contemporary with the rise of printing, as he was born about 1460 and died in 1520. He published mathematical and theological works which were distinguished for their accuracy. His son Robert was a man of great learning; in his house conversation was carried on in Latin, even among the women and children. He issued about four hundred works and printed many edi- **Estienne.**

tions of the Bible. His most important work was his Dictionary of the Latin Language, a book on which he worked day and night for more than two years, and which was for a long time the standard authority on its subject. He inclined to the Protestant faith and attempted to publish such works as he chose; for this, he was obliged to leave France and went to Geneva. Henry, the son of Robert, also a learned man, printed in Paris and Geneva. He published many works, among them numerous editions of the Greek classics, but his fame as a scholar rests upon his Dictionary of the Greek Language. In the latter part of his life, as he suffered from pecuniary losses, he became restless, and shifted his residence from one place to another, doing much editorial work and also publishing books. After his death, which occurred in 1598, the reputation of the house was kept up for some time by other members of the family.

Christopher Plantin.

Christopher Plantin was a celebrated printer and publisher of Antwerp. He was born in 1514, near Tours in France, and studied under the king's printer at Caen. In 1555 he set up a press at Antwerp, and published in that year his first volume, entitled *Institution d'une Fille de Noble*



COURT OF THE PLANTIN MUSEUM AT ANTWERP.

Maison. Although a good linguist, Plantin made no claim to scholarly attainments. He was a skilful business man and spent large sums of money on the details of his work to insure good typography. He employed a number of scholars and artists to assist in the preparation of his works, which were famous for their beautiful letterpress and fine copperplate illustrations. Plantin published books, not only in Latin and Greek, as had been done by Aldus and Estienne, but also in the vernacular of the people—in French, German, Flemish, Dutch, English, Spanish and Italian. He had printing-houses in Leyden and Paris, and an agency at Salamanca. He died in 1589, leaving considerable property to his children. Plantin had no son, but as three of his daughters had married men acquainted with the printing business, the establishment continued in the family. John Moret or Moretus,[1] a son-in-law, succeeded Plantin as the head of the house in Antwerp.

The most noted of the publications of the Plantin press was the *Polyglot Bible,* printed from 1569 to 1573 by authority of Philip II. of Spain. It

[1] The name *Plantin Moretus* is sometimes given to the museum in the house of Plantin.

was in the form of eight folio volumes and was in Hebrew, Greek, Latin, Chaldaic, and Syriac. For four years forty men were continually at work on this book, and the labor alone cost forty thousand crowns. Only five hundred copies were printed, and a large number of these were lost at sea during transportation to Spain.

Musée Plantin.

The printing-house continued in the family until 1875, when it was ceded to the city of Antwerp, for 1,200,000 francs, to be forever maintained as a public institution under the name of the Musée Plantin. The museum consists of a number of buildings around a square. Some of the rooms were the counting-rooms and offices of the printing-house, others were the private apartments of the family. The old press, type, proof-sheets, and other printing materials of Plantin and his successors are still preserved. The establishment furnishes a unique picture of the dwelling and adjoining business premises of a Flemish patrician of the end of the sixteenth century. The museum is regarded by printers as one of great interest, value, and beauty.

CHAPTER V

ENGLAND AND AMERICA

William Caxton.

WILLIAM CAXTON is the first printer who practised the art in England. He was born, as he himself says, "in the Weald of Kent." The year of his birth is not definitely known, but it was probably near 1420 or 1422, as he was apprenticed in 1438 to the mercer's trade. A few years after the latter date he left England for Bruges in the Low Countries, which was then the centre of his trade, and remained there for thirty years. In 1462 he became manager, at Bruges, of a new association of English merchants. By 1470 he had entirely abandoned his business, and had entered the service of Margaret, Duchess of Burgundy and sister of Edward IV. Caxton had long been interested in the romances of the day and had translated some of them. *Le Recueil des Histoires de Troyes* was then in great demand, and as he wished to lend copies to his friends, he resolved to learn the art of printing. This was the first book printed in the English lan-

First book printed in the English language

guage, but was issued without date or place of publication. It was printed about 1474. *The Game and Playe of the Chesse* was the second book. About the place of its publication there has been much dispute, but it is generally supposed to have been printed at Bruges; some claim that it was printed in England. In 1477 Caxton left Bruges, and returned to England. Soon after his arrival in his native country, he began to print in Westminster. The first book printed in England was the *Dictes and Sayings of the Philosophers*. Some copies of this book are without the imprint, but one colophon gives the date of publication as November 18, 1477.

Caxton was not only a printer; he was also a translator and an editor. He edited all the books he printed and translated not less than twenty-two, among them the *Golden Legend*. The number of books he issued is about one hundred. They are mostly in English, although he was an excellent French scholar and had a fair knowledge of Latin. His influence, of course, was great in fixing the future of the English tongue. He died about 1491, and his printing-press passed into the hands of Wynkyn de Worde, who had been his apprentice and assistant and who continued the business in the same house at Westminster.

In America printing began in the city of Mexico. The first printer was Juan Pablos and the first book printed was *La Escala Espiritual para Llegar al Cielo* (*A Spiritual Ladder for Reaching Heaven*) of San Juan Climaco, issued about 1536. So far as known, no copy of this book now exists. The oldest American book extant, with a date, is the *Manual de Adultos*, printed in 1540 by Juan Cromberger, a celebrated printer of Seville, of whom Pablos is said to have been the agent. Only the last four leaves of this book are in existence and are preserved in the library of the Cathedral of Toledo. About ninety books printed in Mexico bear dates of the sixteenth century, the greater number being ecclesiastical works. After Spanish the language most employed was Latin; then came Aztec and other native tongues.

Printing in America—Mexico.

Peru was the next country in which printing was carried on. A press was established at Lima about 1584. The earliest known book issued by it was the *Doctrina Christiana*, in the Quichua and Aymara languages, printed by Antonio Ricardo.

Peru.

The first printing-press in North America was erected at Cambridge, Massachusetts, through the efforts of the Rev. Joss or Jesse Glover, who died while bringing the materials to this place.

United States.

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Glover's wife married Henry Dunster, the president of Harvard College, and he assumed the management of the press. It was operated by Stephen Daye, a workman who sailed with Glover, and in 1639 it issued *The Freeman's Oath* and an almanac. Its first important work was *The Bay Psalm Book*, printed in 1640. This press also issued the celebrated Indian Bible of Eliot and other of his works in the Indian language.

Printing was begun in Boston in 1676, by John Foster. The first press in Philadelphia was set up by William Bradford, under the patronage of the Friends. The first work issued by him was an almanac, in 1685. Bradford became involved in a religious controversy and removed to New York, where he began printing in 1693. An extract from some Virginia documents shows that printing was carried on in that Colony in 1682, and an imprint has been found dated St. Mary's, Maryland, 1689. Before the Revolution, about twenty-five towns were practising the art; and after the war ended and settlements were made west of the Alleghenies, the knowledge of printing spread rapidly through the country.

Havana had a printing-press in 1787, and Montevideo, South America, in 1807.

Among the early books published in America, a few still retain their interest, not only for their quaintness but because of the influence they have exerted on the national character.

John Cotton's Catechism—"Milk for Babes."

John Cotton's catechism, or *Milk for Babes*, first issued in England, was reprinted at Cambridge, Massachusetts, in 1656. The full title reads: "Spiritual Milk for Boston Babes in either England. Drawn out of the Breasts of both Testaments for their Souls' Nourishment. But may be of like use to any Children. By John Cotton, B. D., late Teacher to the Church of Boston in New England."

The New England Primer.

This catechism was afterwards included in another famous book, *The New England Primer*,[1] the first edition of which is supposed to have appeared between 1687 and 1690. Besides the alphabet and the syllabarium, the Primer contained the Lord's Prayer, the Apostle's Creed, the Ten Commandments; the Catechism, which consisted of either the Westminster Assembly's "Shorter Catechism" or John Cotton's "Spiritual Milk for Babes;" the poem of John Rogers, with

[1] A fine edition of the New England Primer, containing a history of its origin and development and fac-simile illustrations and reproductions, was prepared by Paul Leicester Ford, and published in 1897.

the picture of the martyr burning at the stake; sometimes another poem; and various verses and precepts intended to inculcate wisdom and virtue. The one feature which must have made it popular with children was its illustrations, especially the rhymed alphabet cuts; thus the letter A is followed by a picture of the partaking of the forbidden fruit, with the rhyme,

In Adam's Fall
We Sinned all

The Indian Bible.

In these early times a number of books were printed for the Indians. The Rev. John Eliot not only learned their language but translated the whole bible into it. This bible was printed by Samuel Green and Marmaduke Johnson in 1663; it is a typographical curiosity. Eliot translated also several other books for the Indians, and published in their language the catechism, a grammar, and a primer.

Early manuscript and printed news-sheets.

Manuscript journals, somewhat resembling our modern newspapers, existed in the time of Julius Cæsar, when the proceedings of the Senate and the principal events in Rome were published in the *Acta Diurna*. There is a tradition of a printed news-sheet at Nuremberg in 1457, but no copy is extant. The earliest German newspaper, the *Frankfürter Journal*, appeared in 1615. In England the first journal in print was the *Weekly Newes*, begun in 1622. Journalism in France is said to date from 1631, when the *Gazette* was first issued. The oldest official journal which is still published is the *Peking Gazette*. It has existed for centuries, but the date of its establishment is not known.

Early newspapers in America.

The first journal in America appeared in Boston on September 25th, 1690, under the name of *Publick Occurrences*. This was a pamphlet rather than a newspaper. It was intended to be issued monthly, but it was soon suppressed by the General Court because of the nature of the reading matter. *The Boston News-Letter* was started in 1704 and continued to be published until 1776. *The Boston Gazette* appeared on December 21st, 1719, and *The American Weekly Mercury*, of Philadelphia, one day later. *The New England Courant*, edited and printed by James Franklin, followed in 1721. This was the paper upon which Benjamin Franklin began his career as a printer; it was while setting type for his brother that the thought occurred to him that perhaps he could write as well as some of the contributors. *The New York*

Gazette was the first newspaper in that province. It was begun by William Bradford in 1725.

The Pennsylvania Gazette of Philadelphia was started in 1728 by Samuel Keimer, but in less than a year it was bought by Benjamin Franklin. In 1821 it took the name of *The Saturday Evening Post;* under this title the paper is still issued by The Curtis Publishing Company, and is the oldest existing journal in America.

The first daily newspapers in England and America.

In England the first successful daily newspaper was *The Daily Courant*, which appeared in 1702. It was a small sheet printed on one side only. *The Postboy* had started as a daily paper in 1695, but only four numbers were issued. *The London Times*, the most influential journal in Europe, is usually dated from 1788, but the paper was really founded in 1785, under the title of *The London Daily Universal Register*. In America daily newspapers began with the first issue of *The American Daily Advertiser* of Philadelphia in 1784. The early American newspapers were small and contained little home news, the space being given up mainly to extracts from foreign journals.

No sketch of the early history of printing in this country would be complete without some mention of Benjamin Franklin, the most illustrious American who has ever practised the art; for he was not only a printer, but philosopher, statesman, diplomatist, author. Born in Boston in 1706, he was apprenticed at the age of twelve years to his brother James, to learn the printing trade. Because of the harsh treatment he received at his brother's hands, he slipped away from Boston on a sloop to New York. Failing to find employment there, he went on to Philadelphia, where he arrived, a boy of seventeen, with only a "Dutch dollar" in his pocket. He began work at his trade, and in a few years succeeded in getting the government printing and bought *The Pennsylvania Gazette.*

Benjamin Franklin.

In 1732 Franklin issued the first number of *Poor Richard's Almanack,* which was published every year for a quarter of a century. "Poor Richard's Almanack" made Franklin famous. He had noticed that in many homes this almanac was the only book. He therefore filled the spaces between the remarkable days in the calendar with proverbial sentences inculcating industry and frugality as the means of obtaining wealth and thereby (according to Franklin's belief) securing virtue; for he thought that the way to make people good was to help them to be happy. To the counsels

"Poor Richard's Almanack."

of Poor Richard are due to some extent the shrewd, industrious, and thrifty habits of the typical American.

"Speech of Father Abraham."

Franklin's *Speech of Father Abraham* was reprinted in England and twice translated into French. It has been issued since in the principal European languages. It has been called "the most famous piece of literature the colonies produced."

It is impossible to notice within the limits of this volume Franklin's important work as colonial agent in England and as ambassador of the United States to France, and the innumerable benefits he conferred upon his countrymen by his inventions and discoveries and the many organizations he either founded or improved. He died in Philadelphia, on April 17th, 1790, "full of years and honor."

CHAPTER VI

TYPE-FOUNDING

FROM the time of the invention of typography until the middle of the sixteenth century, printers made their own type. Many printing-offices had only four or five sizes, and but small quantities of these. After 1550 the casting of types became a distinct business.

Beginnings of type-founding.

Claude Garamond of Paris, a pupil of Geoffroy Tory, the great French engraver and printer, is known as the "father of letter-founders."

In England, the first founder of note was Joseph Moxon, who began letter-cutting in 1659; but neither Moxon's types nor those of his immediate successors could compare with the type cast in France and Holland. William Caslon, who established a foundry about 1720, had greater success. His work possessed such technical excellence that England soon ceased to purchase type from Holland. This house was controlled by the Caslons to the fifth generation, and is still successful and flourishing.

In America, type-casting was attempted as early as 1768. The first regular foundry was established by Christopher Sauer, at Germantown, Pennsylvania, about 1772. Several unsuccessful efforts to establish foundries in the United States were made by various persons, among whom was Benjamin Franklin. In 1796, Binny & Ronaldson, of Edinburgh, began the business in Philadelphia. This was the first foundry which lasted for many years. The house was subsequently known as the Johnson Foundry, afterwards as the Mac Kellar, Smiths & Jordan branch of the American Type-Founders Company. Successful foundries were also established in New York, early in the nineteenth century, by Elihu White and D. & G. Bruce.

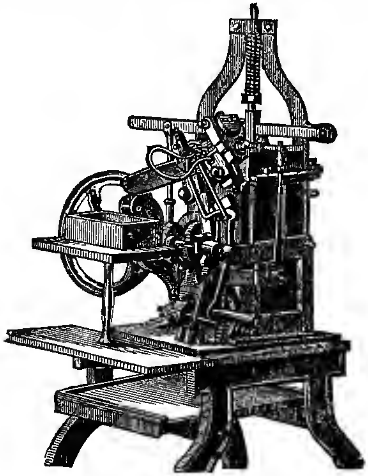
Until near the middle of the nineteenth century, all type was cast by hand. About 1828 William M. Johnson, of Long Island, made the experiment of casting type by machinery, but his types were too light and porous to be of practical use. In 1838 David Bruce, jr., of New York, took out a patent for a type-casting machine which was more successful. This machine was afterwards improved and was generally adopted by the foundries of the United States; it was gradu-

Type-founding by machinery.

ally introduced, with modifications, into European foundries.

Type-metal is an alloy of melted lead, tin, and antimony, sometimes hardened by an addition of copper or nickel. Large types for posting-bills

Type-metal.



BRUCE TYPE-CASTING MACHINE.

are made from close-grained wood, such as box, maple, or pear; for this purpose, types of wood are lighter and cheaper than those made from metal.

The tools made before the letter is cast are, first, the Counter-punch and the Punch, or more fre-

The tools.

quently at the present day, an engraved Master-type; from the punch or the master-type is made the Matrix, or the mould for the letter or face of the type. The tool termed the Mould is that which holds the matrix during the process of casting.

The punch-cutter first draws a geometrical framework, on which is determined the position of each line and the height of each character. The beauty of a printed page consists in the apparent precision of the types. The characters must seem uniform in every particular, but some allowance must be made for optical delusions; occasional deviations must also be made to render each letter pleasing to the eye in any combination with other letters.

The counter-punch.

The interior of the letter is not cut out, but the hollow of the letter, or that part of it which does not show black in the printed impression, is formed on steel in high relief. This is the Counter-punch.

The punch.

The Punch is made by impressing the counter-punch into the end of a short bar of soft steel. The interior of the letter is thus quickly made at one stroke, with much neater edges than could be given by cutting. The outer edges are cut away, and the model letter stands in high relief.

The punch is hardened and is forced into a flat, narrow bar of cold-rolled copper. The result is a reverse or sunken imprint of the letter on the punch, which is known as a strike, a drive, or an unjustified matrix. This is carefully finished and becomes the Matrix. The matrix is really the mould for the face of the letter, but it is not the tool known by that name.

The matrix.

Matrices are also produced by the electrotype process. In this method the punch of steel and the operation of striking are not needed. The characters are first cut on type-metal; after some preparation the model letters are suspended in the bath of a galvanic battery, containing a solution of sulphate of copper. By the action of the electric current on the zinc and copper plates, atoms of copper are liberated, which adhere to the suspended letters. When the deposit has become sufficiently thick, the letters are taken out of the bath and the shells of copper are removed. The shells are then backed up and are fashioned into movable matrices.

The electrotype process of making matrices.

The Mould consists of two pieces which are counterparts. When brought together, the interior sides of these two parts are in exact parallel. In the upper end is a seat for the matrix; the lower end is left open for the inflow

The mould.

of molten type-metal; between the two ends is the hollow into which the metal flows. The mould is immovable in the direction of the body[1] size of the type, which determines the height of the letter, but can be adjusted to suit the varying widths of different letters. However types may vary in width of face, for any given size of type they must be exactly alike in body. Uniformity of body is secured by having only one mould for all the letters of that body; it is only necessary to change the matrix for each character. Each character requires a separate matrix.

After the mould has been attached to the type-casting machine and the matrix placed in the mould, the process of founding is as follows:

The process of casting type by machinery

In the machine is a melting-pot to hold the metal, which is kept fluid by a gas-jet or a small furnace. In the centre of the pot is a pump with a plunger. At each revolution of the crank, the plunger forces through an aperture enough of the molten metal to fill the mould and the matrix. The halves of the mould separate; by nicely adjusted leverage the matrix is drawn back from the face of the type, and the type is thrown out. The mould then closes automatically, and the plunger

[1]By body is meant the size of a letter considered down a page, at right angles with the printed lines; as, pica body, brevier body, etc.

injects a fresh supply of metal which is dislodged as before in the form of a type. The mould is kept cool either by a blast of cold air or by cold water.

The type comes out with a wedge-shaped strip of metal, called a jet, adhering to its lower end, which is broken off either by automatic breakers or by hand. On the corners of the bodies of the type are burs or sharp edges of metal; these are removed by a workman known as the "rubber." The types are then set up in a long row, and are fastened face downwards in a grooved channel. Here the roughness at the jet-fracture is plowed out by a "dresser," with a hand-plane; this leaves the types with a shallow groove between the feet, which enables the body to stand on its feet, thus securing uniformity of height. After other processes of smoothing, the types are examined under a magnifying-glass and every imperfect type is rejected. The perfect types are then packed in paper ready for use. The casting-machine is operated either by turning a small hand-crank or by steam.

Hand-casting.

In hand-casting the workman held in his left hand the mould, which was shielded to protect him from being burned by the hot metal. With a spoon he poured the fluid metal into the mouthpiece of the mould. At the same moment, with a violent jerk, he threw up his left hand, to drive the metal with force against the matrix. This required great dexterity, for if the mould were not thrown up quickly and at the right instant, the metal would not penetrate the matrix. By this process only about four thousand types could be cast in a day.

During the last thirty years, many improvements have been made in automatic type-casting machines. At different times attempts have been made to invent machines which should perform all the processes and deliver types without recourse to manual labor. The most successful of these machines was the one for which Henry Barth was granted a patent in 1888. This machine, automatically, breaks off the jet, plows the groove between the feet, and smooths the feather-edges at the angles. By hand, the average amount cast was 400 an hour; by the Bruce machine, of ordinary sizes of book type, the average is 100 in a minute; of small sizes of type, 140 or more can be cast in a minute.

CHAPTER VII

TYPESETTING

AS the hand-compositor works he has before him two inclined cases, one above the other, called, respectively, Upper Case and Lower Case. These contain the types—the upper case, capitals and small capitals, and the lower case, small letters. The compositor selects the proper types and forms with them a line in an instrument held in his left hand, known as the composing-stick. This "stick" is really a three-sided tray or box; for ordinary book and newspaper work, it is from six to eight inches long. The width of the matter composed, or the length of the line, is regulated by a sliding piece of metal and a screw. The line is "justified," or made the proper length, by the insertion and rearrangement of spaces, or pieces of metal of standard widths, which separate one word from another. After the stick has been filled, the type set up is placed on a shallow frame or pan, called a galley. When no greater spacing is desired between the lines than the

Typesetting by hand.

types themselves afford, the matter is said to be "solid." When wider spacing is desired, thin strips of metal, called leads, are inserted between the lines; the work is then known as "leaded." The composed types are made into pages, and are locked up in forms on the imposing stone.

Typesetting by machinery.

Until 1821 no attempt was made to set type by machinery, and even then the effort was only theoretical. In 1822 Dr. William Church, a native of the United States, while endeavoring to bring out other inventions in England, announced that he had discovered a method of casting and composing type automatically at an unusual speed; this, however, did not include distribution. He was granted a patent in England, but it seems that nothing more than a wooden model of the machine was ever made. In America the first patents were granted in 1840 and 1841 to Frederick Rosenberg and to Young and Delcambre. The first typesetting machine which continued to be used for practical work for a number of years was the one invented by William H. Mitchel, a brother of the Irish patriot. He took out his first patent in 1853, but his machine was finally superseded by others, for want of a good distributer.

The Alden machine was built in 1857, but was not continued in commercial use. The Burr-Kastenbein machine, requiring hand-justification, came out in the 70's; the Thorne, also requiring justification by hand, was invented about 1880. These were the only machines successfully used in the United States until 1886, when the Linotype was introduced. The Mergenthaler, or Linotype, is the typesetting machine generally employed in this country; among other machines are the Simplex, the Burr-Kastenbein or Empire, and the Lanston. Among the machines brought out in Great Britain were the Fraser, the Hattersley, and the Mackie.

Probably the first attempt to produce a machine to set ordinary types and justify them automatically was made by Felt, who was granted a patent in 1867. The machine failed to operate successfully. The first successful machine to set, justify, and distribute type automatically was the Paige, completed about 1890. This machine is not in the market because of its great expense.

Simplest form of typesetting machine.

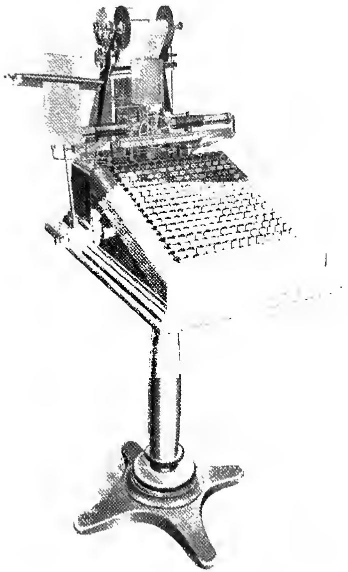
The typesetting machine in its simplest form merely sets the type supplied by the founders; spacing out, justifying, making-up, and distributing must all be done by hand or on other machines.

In this style of machine about eighty-four characters are employed. The types of each character are placed in a brass channel about two feet long, side by side, and in a vertical position before the compositor. The machine is operated in the same manner as a typewriter: when the compositor strikes a certain letter on the key-board, the corresponding character falls in position. This machine can only *set* types in a continuous line; another operator is required to justify them, or make them up in lines of uniform length. The McMillan machine has a mated justifying apparatus, but the distributer is a distinct machine. This machine was used successfully for some time in the office of the *New York Sun*.

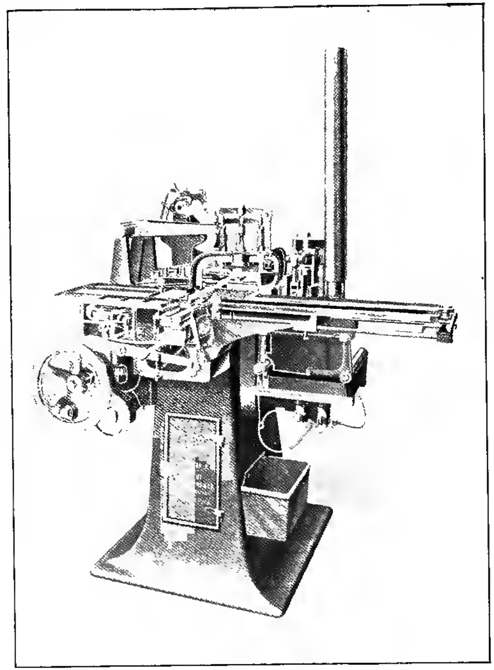
All the simpler forms of typesetting machines have been generally superseded by those in which composition, casting, and distribution are combined in one machine.

The Lanston machine.

The Lanston machine, which went into commercial use about 1899, both casts and sets individual type. It permits the free and equal use of all the upper and lower case characters; these it casts and composes in justified lines by a single automatic operation, which is controlled by a perforated paper ribbon, the product of the manual



LANSTON KEYBOARD.



LANSTON CASTING-MACHINE.

operation of the key-board. The composed matter has the same appearance as handwork, except that the types are always new and the lines are more evenly justified. Corrections are made by the withdrawal of the wrong character and the insertion of the right one; the Lanston machine is therefore preferred by some authors for book-work, because it permits the correction of errors without discarding the whole line. This typesetting machine is in use in a large number of printing-offices, and it is claimed that it furnishes a letterpress equal to that of the best foundry type.

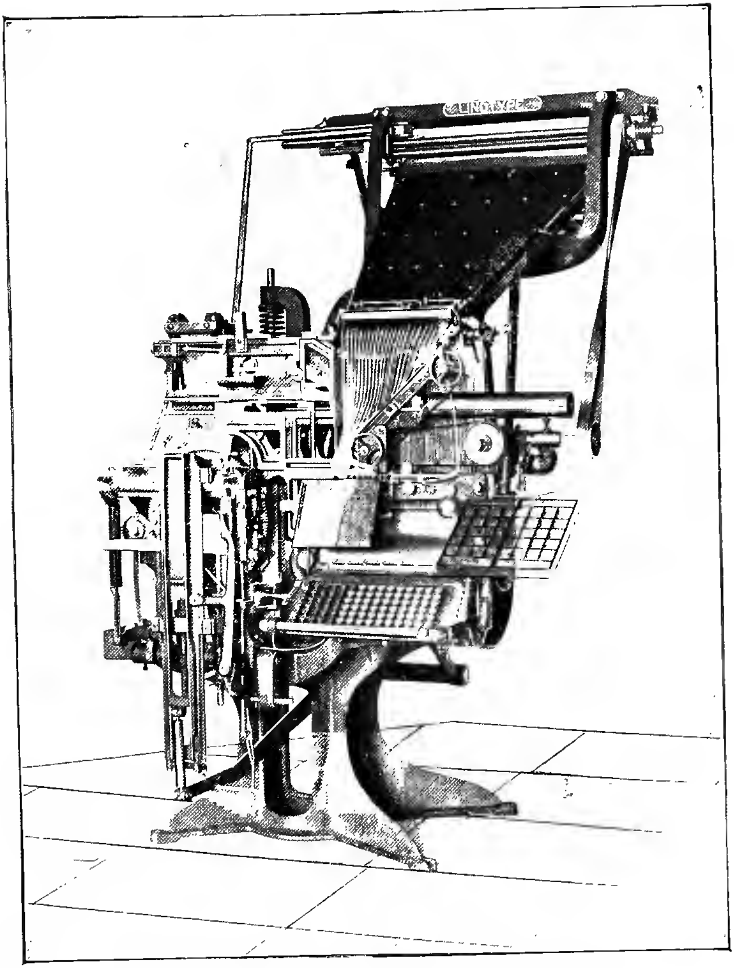
The Mergenthaler machine, or Linotype.

The Mergenthaler, or Linotype, casts the letters properly justified, with spaces between words, in solid bars of the length of line desired. The compositor dislodges brass matrices instead of types, and also space-bands. The latter are wedge-shaped, and are released, one by one, at the end of each word. The wedges are about three inches long; the thin part only at first is inserted, but just before the bar is cast, an apparatus is released which drives the whole series of letters and space-bands to just the right pressure required to produce the even justification of the line.

The matrices are then carried in front of the mould. The mould passes before the pot containing the molten metal, which is ejected through a row of holes into the mould. The metal chills and solidifies immediately, and the casting is accomplished without delaying the work of the operator. The cast line, or *linotype*, passes between knives to be finished to exact size, and is then placed on the galley. The matrices are at once returned to their channels in the magazine, and the space-bands slide back into their box ready for immediate use.

During composition on the Linotype, corrections can be made by changing or transposing any matrix in a line. If a correction is desired after the bar is cast, the whole line must be reset. The discarded bar is thrown into the melting-pot; the linotypes are also remelted after they have served their purpose. In operating the machine, as soon as one line is finished, the compositor starts another line; all that he is required to do is to manipulate the keys and start the lines.

The present Linotype is the result of experiments begun in 1876. In a crude form it was developed about 1883, and was put in commercial use in 1886. It is employed in about thirteen hundred offices in America, including both large and small newspapers and many book houses, such



THE MERGENTHALER TYPESETTTING MACHINE (LINOTYPE).

as Harper and Brothers and D. Appleton and Company. The Mergenthaler machine is used also by most of the leading newspapers of Great Britain, quite extensively in Germany and France, and indeed, to some extent, in almost every part of the world. In the Boston Public Library, where the Linotype is employed to produce card catalogues, etc., twenty-three languages are printed.

Typesetting machines are employed chiefly for newspaper printing and for work which must be done quickly, but many publishers also use them; in quality, the product of the machine is not equal to handwork, although in some instances only an experienced eye could detect the difference. The machine reduces the cost of composition,—one of the simpler forms setting types three or four times as fast as can be done by hand, and the output of the Mergenthaler being six or eight times greater than that of the hand-compositor. It is only by employing the Linotype, which has so greatly cheapened typesetting, that our newspapers can afford to furnish to the public the vast amount of reading matter which is received daily.

CHAPTER VIII

HISTORY OF THE PRINTING-PRESS

Early Presses of Wood

The Gutenberg press.

THE simple press of Gutenberg consisted of two upright timbers, with crosspieces of wood at the top and bottom, and two intermediate cross-bars. It was operated entirely by hand. The type, supported on one of the cross-timbers, was placed on wooden or stone beds, in frames called "coffins," which were laboriously moved in and out. After the type was inked and the paper laid, the platen[1] was forced down upon the bed by means of a large screw. After each impression the platen had to be screwed up again, in order that the printed sheet might be removed and hung up to dry. Only about fifty impressions could be made in an hour. The early presses required two workmen—one to ink the type, and one to pull or to print.

The Gutenberg press continued in use for about one hundred and fifty years, or from the middle

[1] The platen is the flat part or "plate" of a hand-press, which is brought down upon the form of type to make the impression.

OLD WOODEN PRINTING-PRESS, 1508.
[After woodcut by Badius.]

of the fifteenth century to the early part of the seventeenth.

The Blaeu press.

About 1620 improvements were made in the old printing-press by William Janson Blaeu of Amsterdam. By a device attached to the press, the bed could now be easily moved in and out, and a new form of hand-lever turned the screw. This machine could be made to produce in ten hours 700 sheets, but the average performance was less. The Blaeu press contained about the only improvements made in printing-presses between the time of Gutenberg and of Stanhope, and was used for about a century and a half. It was introduced into England, and is substantially the press upon which Benjamin Franklin worked during the time he spent in London, at the beginning of his career.

Iron Presses

The Stanhope press.

Very little further improvement was made in the construction of printing-presses until the year 1798, when the Earl of Stanhope had one built entirely of iron.

About this time, paper began to be provided in larger sheets, as in 1799 Louis Robert of France, aided by St. Leger Didot, invented a machine for making it in a continuous web. The Stanhope press printed on one side of a large sheet by one impression. It lightened labor, but it did not materially increase production.

The Franklin press.

In the latter part of the eighteenth century, the Franklin press was introduced. This was only a modification of the Blaeu press; it could print 250 impressions an hour.

Inking-balls.

The old presses were operated entirely by hand; the type was inked with a pair of stuffed balls covered with skin. Until the middle of the nineteenth century, the bed-and-platen system was the favorite method for printing fine books and illustrations, and for that purpose it is still employed to a considerable extent.

The Columbian press.

About 1816 George Clymer of Philadelphia designed a printing-press which dispensed with the screw. This machine was used to some extent in England, under the name of the Columbian press. In 1822 Peter Smith devised a machine in which a toggle-joint was substituted for the screw with levers.

The Washington press.

The Washington Press, invented about 1829 by Samuel Rust of New York is the hand-press in general use at the present day in the United States. The platen is depressed by means of a bent lever acting on a toggle-joint, and is lifted by springs on either side. Automatic inking-rollers have been attached to the press. This machine is used for taking proofs of woodcuts, electrotypes, line-plates, and type matter mixed with cuts. An extra strong pattern made by Hoe and Company is employed for proving half-tones and other plates requiring excessive pressure. It gives a clear, sharp proof of the full size of the platen; a good print is obtained from the first "pull."

Job or Treadle-Presses. Power Presses

In the line of improvements in the art of printing, America did not lead. She watched the experiments of foreign inventors, imitated them, and in some cases built upon them and made great advances. Printing by machinery from a rotating cylinder was made practicable in England as early as 1814, and the effort to quicken the bed-and-platen system was then given up by European experimenters. In America, however, the platen movement was taken up from a new point of departure and was made successful. The first improvement made by an American was in the direction of treadle-presses.

American experiments.

Treadle-presses.

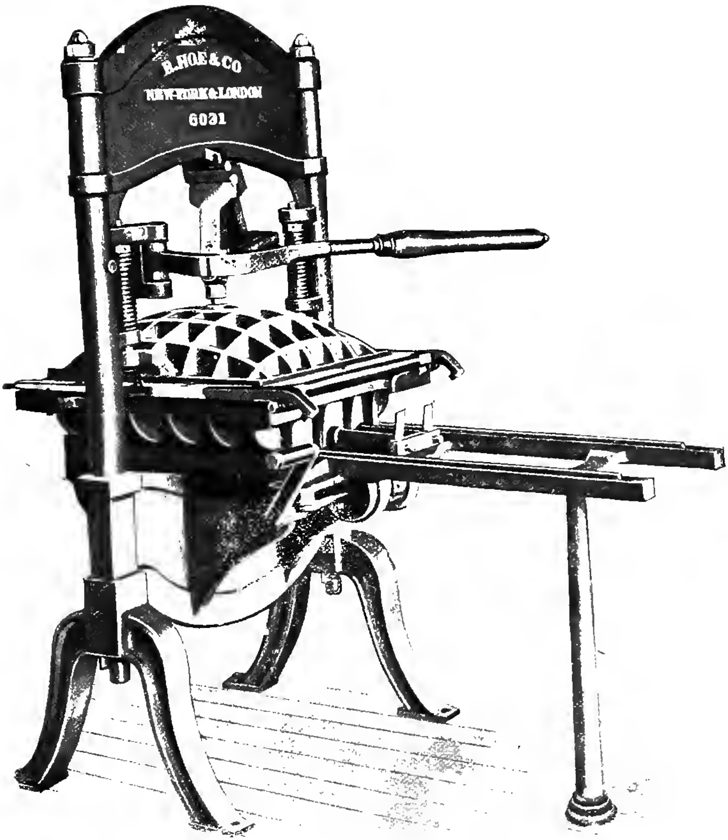
About 1820 Daniel Treadwell of Boston went to England and took out a patent for a treadle-press. This was the beginning of a series of important improvements in printing-presses. By utilizing foot-power, the hands were left free to feed the machine and to take away the printed work; the press could thus be run by one operator. The speed of treadle-presses varies from 800 to 1,500 impressions an hour, according to the skill of the workman. The inking of the form is automatic: a series of rollers, playing on a revolving disk, feeds the ink from a reservoir in the back part of the machine. The later treadle-presses have a wheel attached for belt-power, which increases their capacity and secures the steadier working of the machine.

The Gordon press.

The Gordon is a small job-press which can print over 1,000 cards or small sheets an hour. The inventor, George P. Gordon, a printer of New York, began his experiments in 1834 or 1835, but did not apply for a patent until 1850. The Ruggles press was considered the best of the small presses; its manufacture began before 1840.

The Ruggles press.

About 1824, after returning to Boston, Treadwell attempted to bring out a power- or steam-press on the bed-and-platen principle, but his



THE WASHINGTON HAND-PRESS.

establishment was burned, destroying his machine, and he was compelled to abandon the project. It is said that at least one book was printed on Treadwell's press. About 1830, Isaac Adams, also of Boston, took out a patent for a press which embodied many of Treadwell's ideas. In this machine the platen was stationary. The bed of type did not move backward and forward as in the old hand-presses; it simply moved upward to press against the platen, and then down to its former place. Inking-rollers passed between the form and the impression surface. The press was afterwards enlarged and improved, so that it did in one day the work of ten ordinary hand-presses quite as well as had been done before. The larger sizes of this press have a maximum speed of 1,000 sheets an hour. The Adams presses were favorites for more than fifty years, and some are still in use. The Riverside Press employs a large number of these machines.

The Adams press.

Cylinder Presses

The system of printing from a flat bed carried backward and forward beneath a cylinder was employed to some extent as early as the fifteenth century by printers of copperplate engravings. When this method was introduced into typography, it

The flat-bed cylinder press.

worked a revolution in the art. There are many cylinder presses, but in all the radical principles are the same; the great number of patents granted have been mostly for improvements and devices of detail. In some the type is on a flat bed and the cylinder gives the impression; others have two cylinders, one holding the form and the other making the impression.

At the present day the greater number of presses employed in ordinary book and job-work are job and cylinder presses. The cylinder presses have come into use since 1814, when the London *Times* was first printed by machinery. At that time there was a great desire in England for information concerning the state of Europe, as Napoleon had not yet been banished to St. Helena. More newspapers were demanded than could be quickly and promptly printed. About twenty-four men were required for an issue of six thousand copies of a journal, within twelve hours after the copy was set. Friedrich Koenig, who had come to England from Saxony, claimed to be able to solve the difficulty. After trying for many years to improve the old method of printing from two flat surfaces, he abandoned it entirely, and with the assistance of some London inventors, among whom were Bensley and Napier, he had a machine built which was fairly tested in 1811.[1] In this press the type was placed on a flat bed. The cylinder which revolved above it stopped three times: the first third of the turn received the sheet upon one of the tympans[2] and secured it by the frisket;[3] the second made the impression and permitted the removal of the sheet by hand; the third returned the empty tympan for another sheet. This machine was a turning point in the printing art, for it showed the greater speed and merit of the cylinder press.

The Koenig presses.

Koenig afterwards devised a continuously revolving cylinder press; he also designed a two-cylinder press which printed one side of the paper at a time, and a two-cylinder press which printed

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1 Many printers believe that Koenig's success was due to his adopting the ideas of William Nicholson, a scientific man of the day. Nicholson had taken out a patent for improvements in the construction of the printing-press, but had put none of them to practical use.

2 The tympan is a framed appliance hinged to the outer end of the bed of a hand-press. It receives the sheet to be printed and completely covers the bed when folded down upon it. Its purpose is to soften and equalize the pressure by means of blankets between its two parts.

3 The frisket is a thin framework of iron hinged to the top of the tympan. A sheet of paper is pasted over it; from this, spaces are cut out to permit contact between the type and the sheet to be printed. It holds the printed sheet in place, and the sheet pasted upon it keeps clean the parts not to be printed. The frisket is folded down upon the tympan and the tympan is then folded on the bed; this brings the sheet down on the face of the form ready to receive the impression.

both sides of the paper at one operation. The latter has received the name of the *perfecting-press.* In this press there were two forms of type, one at each end of a long bed. After the paper had been printed on one side by one cylinder, it was carried to the other cylinder and printed on the opposite side. The cylinder presses erected by Koenig in the office of the London *Times,* in 1814, printed on one side of the paper at the rate of about 1,000 sheets an hour. His press which printed on both sides of the paper could turn out 1,500 or 1,800 perfect copies in an hour. There was no further important advance in newspaper printing for many years.

The cylinder press was afterwards simplified and improved by other men, and by 1824 the design was substantially that of the cylinder press of the present day.

The first cylinder press employed in the United States was made about 1832 by Robert Hoe, the founder of the firm of R. Hoe and Company. This was the single large cylinder press. In this machine the cylinder made one revolution for each impression and never stopped.

The single large cylinder press.

Hoe and Company and Adams, who also introduced a press about 1830, made nearly all the printing-presses used in America for the next thirty years—Hoe manufacturing cylinder presses and Adams platen presses.

The stop-cylinder press was brought out by a Frenchman named Dutartre, in 1852. It was afterwards introduced into the United States and improved in many ways. As its name indicates, the cylinder is stopped and started again; the type is carried on a flat bed. It can print from 1,000 to 1,500 impressions an hour, and the finest engravings at the rate of 800 impressions an hour.

The stop-cylinder

On the cylinder presses, only one sheet could be printed at each forward movement. A double speed was secured by having a feeder at each end, and, after one sheet had been printed, stopping and reversing the cylinder, so as to print another sheet on the return movement. Printing on the return movement was the method adopted by Koenig in his improved press.

The Koenig press, introduced in 1814, was run by machinery, but it was extremely complicated. It was Augustus Applegath who first made practicable the use of the steam-press for popular printing. *The New York Sun* was the first newspaper in America to use steam instead of man-power; it made the substitution soon after the establishment of cheap newspapers in 1833.

Use of steam-power.

Some firms employed a horse or a mule, which they drew up in the morning by tackle to an upper story and let down at night in the same way.

The early cylinder machines were used exclusively for newspapers. They wore the type badly, and for this reason they were not liked by book-printers. The pressmen gave them the name of "type-smashers." In 1835 Harper and Brothers printed all their books on hand-presses, and as late as 1849, the law books of the firm of Banks and Gould were printed on these presses, but after this the use of the hand-press was discontinued for commercial book-work in New York city.

Composition inking-rollers.

Rapid printing did not become a possibility until the introduction of cylindrical inking-rollers made of glue and molasses, a compound which had long been used in the potteries of Staffordshire. It is said that two persons, Forster and Harrild, first tested, by the use of balls, the adaptability of this material for ink-printing; the press-builders soon began to cover their inking-cylinders with it, instead of leather or india-rubber. The discovery that this composition could be used instead of the balls took place about 1810, but it was many years before rollers were generally adopted. The Donkin and Bacon machine built in

1813 for the University of Cambridge (England) was the first printing-press in the world to discard the ancient balls for the composition inking-rollers. As late as 1835 every printer's apprentice in England learned the use of the pelt balls. Composition rollers seem to have been introduced into New York about 1826. The chief ingredients now used are glue, sugar, and glycerine.

Until 1847 the newspapers of the United States were printed on single small-cylinder and double-cylinder machines. On the single cylinder presses, 2,000 impressions could be taken in an hour; on the two-cylinder, 4,000, printing, however, on only one side of the paper. The demand for papers containing the latest news led to experiments in making faster machines, and the outcome was the type-revolving press. The actual introduction of this press was due to Richard M. Hoe of New York.

The type-revolving press.

The first Hoe type-revolving machine was placed in the office of the *Public Ledger* in Philadelphia, in 1847. The distinctive feature of this new press was the fastening of the forms of type on a central cylinder placed in a horizontal position. The type was held firmly in place, and the cylinder was revolved at any required speed without danger of the type's falling out. Around the central cylinder, from four to ten impression-cylinders were placed, according to the amount of work required. The sheets were fed in by boys. The capacity was about 2,000 sheets to each feeder an hour. A four-cylinder machine could thus print about 8,000 sheets an hour, and with ten impression-cylinders the capacity was 20,000 sheets an hour, in both cases printing on only one side at a time. To print the other side of the paper, a second rotary press was needed, and the folding was done by the old method.

Although it did not overcome all difficulties, this machine effected a revolution in newspaper printing. The circulation of the old papers was greatly increased, and many new journals came into existence. The first Hoe press used in Europe was erected in the office of *La Patrie* in Paris, in 1848. Augustus Applegath, an Englishman, devised a machine of the same nature as the Hoe press, but with a vertical instead of a horizontal cylinder. The Hoe press preceded this machine by several months. The *London Times* finally discarded the Applegath presses and substituted those made by Hoe.

Curved plates.

A still further advance was made by the introduction of stereotype plates on a curve. For fine work, such as the illustrations of magazines and some color-plates in newspapers, electrotypes are used, as they give a clearer impression and are more durable than stereotypes; but for ordinary newspaper printing, a curved stereotype plate is made for each page. The page is first set by the linotype, then a mould in papier-maché is taken of the type. These moulds, when dried, are put into the casting-box and filled with melted metal. By the Hoe machines, a matrix and four stereotype plates can be made in seven minutes; the plates are moulded and cast with a curved surface which fits them to the cylinder. By duplicating the forms, several presses can be run at the same time.

Since about 1860 stereotype plates made by the papier-maché process have been largely employed by the newspapers of both England and the United States.

The continuous web.

About 1835 Sir Rowland Hill conceived the idea of a press which should print both sides at once from a roll of paper. In the first World's Fair held in London in 1850, Thomas Nelson of Edinburgh exhibited a little cylinder press, which demonstrated the possibility of printing at one operation both sides of an endless roll of paper. It was regarded by the public and also by Nelson as nothing more than a mechanical toy. European press-builders failed to utilize the principle, but it was developed and put into practical operation in the United States. The first machine to print on both sides of a continuous web was constructed in 1865 by William Bullock, of Pittsburgh, Pennsylvania. The Cincinnati *Times* used the first press built in his shops; the roll contained five or six miles of linear measurement. As at first constructed, this press was unreliable, especially in the delivery of the papers, but it was afterwards improved and was used to a considerable extent. It printed ten thousand newspapers an hour, without the assistance of feeders.

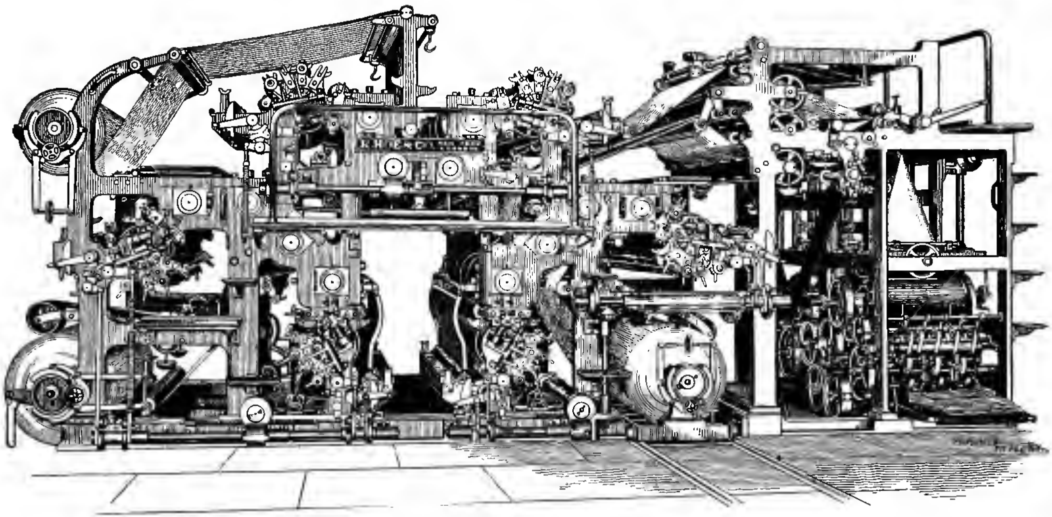
The Bullock press.

About 1868 the proprietors of the London *Times* built a rotary perfecting-press. This was similar in construction to the Bullock press, except that the cylinders were all of one size and were placed one above the other. A press on the same principle was also devised by Marinoni of Paris.

The Walter press.

Several difficulties were encountered in the construction of rotary perfecting-presses to print from a single roll or continuous web of paper, and these were not overcome until 1871, when the Hoe web press was devised. The first press of this kind was placed in the office of *Lloyd's Weekly London*

The Hoe web-perfecting press.



THE HOE SEXTUPLE NEWSPAPER PERFECTING-PRESS.

Newspaper, and the first in the United States in the *Tribune* office in New York. The Hoe machines are used by most of the large newspaper offices of the United States and Great Britain.

Hoe and Company continued their experiments, and produced the Double-supplement, the Quadruple, the Sextuple, and the Octuple press. They consist of a multiplication of cylinders and plates, while the general principles remain the same.

Automatic folders.

Hand folding-machines were for a long time used in newspaper offices, but it was highly desirable that the press should deliver the papers folded. Folders were attached to the fast presses, but the output was not more than 8,000 an hour. A rotating folding-cylinder was patented by Hoe and Company in 1875; this folded papers at the rate of 15,000 an hour. These folding-cylinders were first placed on presses built for the Philadelphia *Times*, and were operated in the Centennial Exhibition of 1876.

Presses for illustrated work.

Hoe and Company have also built rotary presses for illustrated work. In 1886 a perfecting-press was constructed for Theodore L. De Vinne, of *The Century Magazine*, to print the plain forms of that periodical. This magazine is printed on two kinds of rotary presses. The plain forms, without cuts, and the advertisements are printed from an endless roll of paper, on sixty-four curved electrotype plates, fastened on two cylinders. The paper is printed on two sides, thirty-two pages to a side, and is cut and folded ready for the binders. On the other press, at each revolution, sixty-four pages, largely of the finest illustrations, are printed on one cylinder, necessarily on one side only. To preserve full blackness and fineness of line, in the full-page illustrations the second side is not printed until the first side is dry. The illustrations are printed with the type, always in black ink. Hoe and Company have built for the *Century* a machine that will print two colors at each revolution. The fine colored illustrations which appear in the November and December numbers of this magazine are printed on flat-bed presses with the stop-cylinder movement.

The Cottrell presses.

Among other fast printing-machines which do good work are the Cottrell, the Miehle, and the Goss. The Cottrell presses comprise a variety of types,—a lithographic press, a stop-cylinder, a two-revolution, a flat-bed perfecting, and a web press. The Flat-bed Perfecting press prints on the second side of a sheet already carrying half-tone pictures on the first. "Offset," or smirching, is prevented by means of the shifting tympan mechanism which unwinds from a manila roll sufficient paper to cover the impression surface. After the mechanism is set, the tympan makes the changes automatically at stated intervals, according to the length of time the offset roll is needed. The large editions of many illustrated papers and magazines are printed on the Cottrell Rotary Machine, which gives the impression on both sides of a web of paper at one operation, and cuts off the sheets, folds and trims them, ready for binding. This press is adapted to fine illustrated work in one or more colors. On the Cottrell presses the Curtis Publishing Company issues every month 950,000 copies of one of its periodicals, and every week 340,000 copies of another journal. The weekly editions of other magazines sometimes reach 500,000. For pages containing fine illustrations, presses are not run at the speed with which newspapers are printed.

The Miehle press.

The Miehle presses are built for book and job-work, and also for newspaper printing, and have remarkable speed.

The present tendency in press-building seems to be towards greater compactness and directness.

The Goss press.

The Goss, which is a straight-line machine, prints from four separate rolls of paper; the sheets issue in parallel lines, and are united, after cutting, in folded papers.

Presses for book-work.

Rotary presses have proved indispensable in newspaper offices, where only one size of paper is used and where a large edition must be printed in a short time. For book and job-work, in which many sizes of paper are required because of the different sizes and numbers of pages, much of the printing is done on flat-bed machines, some of which are perfecting presses with shifting tympans. Many books, pamphlets, and illustrated periodicals, however, are printed on the Hoe Electrotype Rotary Perfecting Press, which, as its name indicates, gives the impression on both sides of the sheet at one operation.

Printing by electricity.

At the present time an effort is being made in England, to introduce a system of printing[1] from types by the electrochemical process, which dispenses with the use of ink. Mr. Friese Greene, a London photographer, has produced an electrographic paper, and a syndicate in London has

[1] An account of this system is given in the supplement to the *New York Tribune* of February 11th, 1900; also in the *Scientific American* of November 24th, 1900.

been engaged for a year or more in perfecting the process. The experiments seem to have yielded satisfactory results, and the syndicate is now demonstrating the workings of the new system. Several of the great London dailies have placed their plants at the disposal of the syndicate for a complete test of the process.

The materials with which the paper is sensitized are mixed with the pulp in the process of manufacture. The electricity flows through the paper from the face of the type, and the chemicals contained are turned black. The paper is said to be unaffected by any other agent than the electric current; it may be kept for any length of time, and sent to the press directly from the roll as manufactured; it yields instantly a deep black, permanent impression, and is ready for distribution immediately, as no drying is required.

An ordinary printing-press is used, divested of its inking mechanism, and having the cylinder which carries the paper covered with a suitable conducting metal.

The intensity of shade is regulated by the degree of influence exerted on the paper; this influence is proportional to the amount of electricity passing through the paper.

It is claimed that the cost of the current for the actual printing is much less than that of ink, also that the power necessary to drive the press is diminished, and that there is a saving of at least one-third in the original cost of the press.

The new process is said to lend itself to all speeds, even to that of the fastest web-press. The work is considered perfect in every particular.

Printing by photography.

As these sheets pass the press, an account is published of an experiment in printing by the photographic process, which, if successful, will do away with movable types. The originator of the idea believes that if pictures can be multiplied by photography, there is no reason why the text should not be reproduced by the same method.

A machine, which is substituted for the linotype, sets up lettered cards in the rack according to copy and photographs them, one line at a time; the glass sensitive-plate moves automatically and takes the matter line by line until it is all set up. The negative is developed in the usual manner. After the plate is etched it is ready for the press, and is printed in the same manner as a line-plate is printed at the present time. It is said that within thirty minutes after the first exposure of the negative the zinc plate is ready to go to press.

A fact of great importance, as regards the cost of printing, is that one set of letters is to serve for all sizes of type. The distance of the camera from the letters determines the size of the text as it is to appear in the finished work.

If the discovery can be put to practical use, the saving in the cost of printing materials will be almost beyond computation, as in place of the expensive stock of type the publisher is now obliged to carry, he will need only a few photographic machines and the lettered cards which can be kept in small space.

These two systems are, of course, still in their infancy, but if proved to be of real advantage they will work another revolution in the art of printing.

CHAPTER IX

NEWSPAPER PRINTING

The consecutive processes in the printing of a newspaper.

ASIDE from its general framework, a newspaper press consists of the apparatus for the feeding-in of the paper, the ink-fountains or troughs, the rollers and cylinders for distributing and transferring the ink, the cylinders carrying the stereotype and the electrotype plates, the impression-cylinders, the paste-fountain, the folder, and some minor appliances.

The paper from which newspapers are printed is made in long webs or rolls, varying in length from three to nine miles, and is prepared at special mills. Each roll is made upon an iron core, which forms the hub through which a metal axle is passed. This roll or wheel of paper is placed at one end of the press just above the floor, and the end of the sheet is led between the cylinders; when the machinery starts the paper unwinds as fast as it is needed. These long rolls are sometimes uneven, varying in tenacity or being more tightly wound in some places than in others; the result is that the paper snaps in two and necessitates the stopping of the press. This difficulty is overcome either by tension springs, which permit the sheet automatically to adjust itself to all conditions, or by an endless belt which rests on top of the paper and pushes it along at a speed equal to and sometimes greater than that of the plate-cylinders.

The receptacle for the ink, known as the ink-fountain, is a trough located almost directly over the web of paper. A system of rollers and cylinders distributes and transfers the ink from one to another until it is applied evenly to the surface of the stereotype or the electrotype plates.

Each plate-cylinder is in contact with a blanket-covered cylinder, and by passing between these the continuous web of paper receives the impression. The paper is drawn between two pairs of cylinders, one pair giving the impression for one side, and the other the impression for the other side. The web is then carried up to the top of the machine and is cut in two lengthwise, or between the newspapers, so as to free one from the other. These sections are passed over the angle-bars, which switch one directly over the other, so that they may enter the folder in their proper order. By passing over a triangular metal piece, called the "former," they receive a fold the length of the paper; they are then cut crosswise and folded almost simultaneously, the second fold, in the middle, leaving the paper just as it is commonly sold by the news-dealers. The papers are counted automatically, in lots of twenty-fives, fifties, or hundreds, every twenty-fifth, fiftieth, or one-hundredth paper, being thrown out a few inches in advance of the others, so as to make a sharply defined line in the pile. Some newspapers are pasted at the back by an appliance on the press; others are issued without being pasted.

The Improved Double Quadruple Combination Octuple Press is the latest newspaper perfecting press designed by Hoe and Company; they are now building a number of this type for the Chicago *Tribune*. For ordinary black work, this press can print, cut, paste, fold, count, and deliver, in an hour, 24,000 papers of eighteen, twenty, twenty-two, or twenty-four pages; 48,000 of twelve, fourteen, or sixteen pages; 72,000 of ten pages; and 96,000 of four, six, or eight pages. When printing twelve pages, the press can issue 60,000 papers an hour: 48,000 in book form and 12,000 composed of two six-page sections laid on each other and delivered folded together. This method is called "collecting" twelve-page papers.

The output of the latest Hoe newspaper web-perfecting press.

When printing colored plates, this machine can produce in an hour 96,000 four-page papers, with all the pages in two colors; or 48,000 six or eight-page papers, all inset,[1] with all the pages in two colors.

This is one of the largest printing-machines of this design that has been constructed, up to the present time, for newspaper work.

Some of the leading newspapers issue supplements with colored pictures. The plates for the different colors are placed upon separate cylinders, opposite to each of which is attached an impression-cylinder. Color-printing.

The large newspaper offices which issue supplements with colored illustrations, have two distinct styles of presses, one being used for ordinary newspaper work in black only, or having some color-attachments added in a manner which permits the work to be done in a short space of time —an essential feature for a daily. On this press, the color work is printed from stereotype plates, against soft felt blankets, and the printing is done on the web of paper without any preparation, except the proper placing of the plates on the cylin-

[1] In newspaper work, inserted or "inset" means that the sheets are delivered folded one inside the other, as the sheets are arranged in a quire of writing-paper, but not necessarily pasted, although this is generally done. When the sheets are not all placed one inside the other, but the sections are laid one on top of the other, full-page size, and then folded together to half-page size, the method is called "collecting."

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ders, so that the colors will be printed in their respective places according to the design.

The electrotype multicolor press.

The other press is the Electrotype Multi-Color Machine, and is used to produce the best class of color and half-tone work for Sunday magazines, comic, and music sheets. This press prints from electrotype plates, against a very hard surface on the impression cylinder, called hard-packing, which shows up all the imperfections of the plate. These imperfections have to be equalized and overcome by processes called "overlaying" and "making ready"; an "overlay" paper is placed over a plate to bring out the solids, middle tones, and different shades that go to make a perfect picture; on the amount of time spent on this preliminary work and the fineness with which it is done depends the quality of the printing when the press is started. Some of the leading journals of New York City have presses of this description, printing automatically as many as eleven colors at one operation. The whole eleven colors can be printed on one double-width web of paper, i. e. a roll the width of four newspaper pages, giving five colors on one side and six colors on the other side of the web; or the eleven colors can be printed on two double-width,

"Overlay" and "making ready."

or four-page, webs. In the latter case one web is printed in four colors on one side and two colors on the other side; the other web in two colors and three colors; these webs, when the sheets are cut apart, brought together and folded, make a publication of from eight to thirty-two pages, with all the pages in either two, three, or four colors. The papers are printed at a running speed of 16,000 to 24,000 copies an hour, or as many as 48,000 for the lesser number of pages.

The output of 96,000 eight-page or 48,000 sixteen-page papers an hour, with part printed in four colors in a fine manner, is equal to an issue of 270 papers of eight pages, or 145 sixteen-page papers, per second.

The Electrotype Multi-Color Press, as stated, has eleven pairs of cylinders, or couples, each couple consisting of one plate- and one impression-cylinder. Each pair has its own ink-fountain and numerous ink and distributing-rollers for the different inks. The paper passes from one couple of cylinders to the other to receive the various colors. Before the press is started on its regular run for producing the editions, which sometimes amount to as many as 800,000 copies for one week's issue, a proof of each color is taken separately to discover the imperfections of the plates; these defects are overcome by the processes of "overlaying" and "making ready," already mentioned.

The register of the colors.

Another reason for proving each color is to get the "register," which means so arranging the plates on the cylinders that each color will be printed in its proper place. The secondary colors are produced by printing one primary color over another. A plate which receives a primary color that is to appear in an illustration prints the same color where it is to be the base of a secondary color; thus, a plate taking red and printing red as a primary also takes and prints red as the base of orange; a plate taking blue as a primary receives also the blue as the base of purple. The colors are printed first; the black, called the "key-plate," is printed last, and all the colors must register within the outlines of the key-plate.

The driers.

The ink contains chemicals, called driers, which cause it to dry immediately, one color being quite dry, through the presence of the chemicals and the absorption of the paper, before the web passes to another pair of printing cylinders. When a sheet or web is printed on both sides, an "offset" sheet or web of paper runs with the paper which is printed and takes off the surplus ink. When the colors are printed on one side only the "offset" web is not needed.

Regulating the flow of ink.

The flow of ink is regulated by a large number of screws, set about two inches apart. These govern the pressure of a knife-blade against a roller which revolves in a fountain filled with ink, allowing either more or less to feed forward to the inking rollers, which, in turn, give it to the printing-plates. The screws are operated on the same principle as the tension screw of a sewing-machine.

The Electrotype Multi-Color Press is 35 feet long, 17 feet high, 10 feet wide, and weighs 100 tons. It consists of over 200,000 separate pieces and requires 50 horse-power to keep it in motion.

The combination octuple multi-color machine.

Another style of press, which is the largest in the world, is the Combination Octuple and Multi-Color Machine, which consists of a regular sextuple newspaper press with a full five-cylinder multi-color press on top and working in conjunction with it, the upper portion printing from electrotype plates, the lower section from stereotypes, thus producing an ordinary newspaper product with a fine cover section. This press carries four rolls of paper, each the width of four carries four rolls of paper, each the width of four newspaper pages and weighing from 1500 to 1800 pounds each.

Color-plates of some magazines.

The fine colored plates which illustrate certain numbers of some magazines are printed on the same kind of presses that is employed to a great extent for book-work—flat-bed presses with the stop-cylinder movement. These colored illustrations are produced at the rate of 800 impressions an hour for each separate color. The merit of a colored illustration begins with the design and its adaptability to color. If the design is not good and adaptable, it will not make a good print. The dissection of a colored sketch requires an artist of great ability and experience. He must know (not guess) how much or little color to put on each plate; he must understand the proper sequence of overlapping colors. That done, the printing of the plates is comparatively simple work.

These mammoth presses possess a wonderful fascination when running at full speed. To watch the paper enter the machine simply as a blank roll, fly swiftly from cylinder to cylinder to receive the impressions of stereotypes, electrotypes, and half-tones, in black and in color, separate into newspapers under the action of the knife, again divide into sections, and issue from the press neatly folded and counted, ready for delivery, gives one the impression of a force not only wonderful but superhuman. One marvels at the inventive skill which has achieved this mechanical triumph and which holds within itself the power to further the march of civilization by aiding in the dissemination of knowledge among the people.

Arrangements for furnishing late news.

In the large newspaper offices every arrangement is made for performing each step of the work with the greatest possible speed and also for furnishing the most recent news even up to the last few minutes. A button is turned, a red light flashes through the pressroom, and the rapidly-flying cylinders stop immediately; a green light shows, and the pressmen are ready to take up important news. When games and races are being held, a man seated alongside the press is in direct communication with the scene of action by telegraph and by telephone. "Crawford wins," flashes over the wire. "Crawford wins!" cries the operator to a workman seated on the press. The words are instantly set and inserted, and in a few seconds they appear in the finished paper. Within three minutes after a game ends, two of the leading dailies of New York sell on the streets papers announcing the result.

REPRODUCTIVE PROCESSES

REPRODUCTIVE PROCESSES

CHAPTER I

STEREOTYPING AND ELECTROTYPING

STEREOTYPES are plates of type-metal and are made by casting; electrotypes are produced by galvanic action.

Stereotyping and electrotyping have proved a source of great economy to both the printer and the publisher. Before the discovery of these processes, a work to be printed as occasion required had to be kept standing in type or else reset for each edition. By electrotyping the forms, only a small number of the first edition need be printed, as additional copies can be taken off at any time. The plates occupy much less space than type matter kept in form, and can easily be stored away for future use. The printer's type is released for other work, which in itself is a decided advantage. These two processes also save wear of the original type or cut. Electrotypes have superseded stereotypes for book and magazine work, as they give a clearer impression and are more durable.

Stereotyping.

Three methods of stereotyping are known,—the plaster, the clay, and the papier-maché. Only the last is now much employed.

The plaster process

The process of casting type-metal in moulds of plaster-of-paris was discovered by William Ged, a goldsmith of Edinburgh, who began his experiments about 1725. His method proved successful, but he could not get the printers to use his plates. Numerous experiments followed, but all other methods were superseded by that of the Earl of Stanhope, which was introduced about 1804. The plaster process served for types on book-work for about fifty years, but it was unsuitable for engravings, and was found too slow for daily newspapers.

The first work stereotyped in America was the Westminster Catechism, produced in New York, by John Watts, in 1813. Watts, however, sold out and went to Austria in 1816. The actual introduction of the art in America was due to David Bruce, one of the two brothers who afterwards established the type-foundry known by that name. In 1813 Bruce returned from England, where he had been endeavoring to study the methods of Lord Stanhope; he began his experiments, and in 1814 succeeded in casting plates for the New Testament.

The papier-maché process was discovered by Genoux of France, in 1829, and was introduced into Great Britain in 1832.

The papier-maché process.

In the papier-maché process, a paper matrix is first made of the page of type by machinery. The material for the matrix is formed by pasting together layers of thick unsized paper and tissue paper, each layer being carefully rolled smooth with a heavy iron roller. The matrix is dried by steam-heat; to expel any remaining moisture, it is exposed for half a minute, either in an oven or to the flame of a gas-jet. After the edges are trimmed, the matrix is placed in the casting-box and filled with melted metal. On being removed from the casting-box, the superfluous metal is cut off from the plate, which is then trimmed by hand, and shaved on the reverse side until it is brought to the exact thickness required. These operations are performed by machinery.

The papier-maché process is more expeditious than any other method. By the Hoe machine a matrix and four stereotype plates can be made in seven minutes; it is possible to cast a plate a minute after the matrix is made. Curved plates can be made as easily as flat, and as many as forty plates can be cast from the same matrix.

This process has been adopted by all large daily newspapers.

Electrotypes.

Electrotypes are plates produced by means of electricity; they are made from type, woodcuts, and engraved plates. The process of causing one metal to be deposited on another by galvanic action is not new, but the electrotyping of type, woodcuts, and plates is of comparatively recent date. An engraving made by this method appeared in the *London Journal* for April, 1840. In America Joseph A. Adams, a wood-engraver of New York, produced plates which were used in *Mapes's Magazine* as early as 1841. Before 1855 the art of electrotyping was in general use in New York.

To make an electrotype plate, copper, placed in a state of solution, is caused by electric action to spread itself over the surface of a mould and there be deposited in a sheet.

The process of electrotyping.

A wax mould is first made of the engraved plate, cut, or type. To produce this, beeswax is poured on a leaden slab and is left to cool, after which graphite is brushed evenly over the surface.

The form of type or the plate is forced into the wax by means of a steam-press. This gives a mould of the type or plate in the wax. The surplus wax is removed with a sharp knife.

As the mould comes out uneven, it has to be built up; this is done by filling the large blank spaces and the surfaces between the lines with hot wax, so that the deposits of copper may be shallow. The mould is then given a coat of graphite in the black-leading machine. The graphite makes the mould a conductor of electricity.

After the deposit of this metallic surface, the superfluous graphite is washed out by water. Iron filings are then sifted on the mould and a weak solution of sulphate of copper is stirred in. This coating of copper is given to facilitate the plating. To make the electrical connection, a piece of copper or lead is imbedded in the edge of the sheet of wax.

The mould is then suspended for one or two hours in a bath of sulphate of copper solution. By the action of the electric current, the coating is increased until it is about .005 of an inch thick.

The shell of copper is removed from the wax and is washed in boiling water. It is brushed on the back with a solution of chloride of zinc, and sheets of tinfoil are laid over it and melted. Enough molten lead is poured on the shell to give it the necessary thickness—about one-eighth of an inch. An air-blast causes the plate to cool and solidify immediately.

Any defects or indentations on the face of the plate are hammered up from the back, and it is afterwards passed through machines which finish it and give it a bevel on the side. When mounted it is ready for the press. A plate to be used on a Hoe web-perfecting press, is given a curvature to fit it to the cylinder. When red ink is used, electrotypes are usually given a coating of nickel, to protect the copper from the action of the mercury.

An electrotype plate will stand from five hundred to six hundred thousand impressions. A stereotype plate lasts for only about one hundred thousand impressions. Both stereotype and electrotype plates are now sometimes made as large as two pages of a newspaper.

By hurrying each step of the process, it is possible to make an electrotype plate in an hour; but for a high grade of work more care is taken, and it then requires several hours to produce a plate with fine finish.

Electrotyping is a much cheaper process than either half-tone or line work, the price being from one to three cents a square inch. Line work costs about seven cents, and half-tones from twelve to fifteen cents a square inch.

CHAPTER II

HALF-TONE AND LINE PLATES

THE numerous illustrations which give life and add to the value of our books, magazines, and newspapers,[1] without greatly increasing their cost, have been brought into existence by the development of the relatively new art of photo-engraving, which by 1880 was beginning to supplant the reproducing of woodcuts. Reproduetions of photographs, wash-drawings, paintings, or of any picture or object in which there is a gradation of color, are made by the half-tone process. Drawings or pictures consisting of simple lines, that is without tones of color, such as pen sketches or fac-similes of old writings, are reproduced by line-plates.

An illustration printed from a line-plate resembles a pen and ink drawing; that is, it consists of lines in relief. A half-tone has no lines at all:

[1] The illustration of English journals dates back to 1832 when the *Penny Magazine*, a periodical somewhat of the nature of a popularized cyclopedia, was first published; but it cannot be said that illustrated journalism had fairly begun until *The Illustrated London News* was founded in 1842. *Gleason's Pictorial* was started in Boston about 1850. *Frank Leslie's* followed in 1854, and *Harper's Weekly* in 1857. The first illustrated daily paper in America was *The Daily Graphic* of New York, established in 1873.

it is composed of dots, and has middle tones, full tones, and high lights.

To produce a half-tone, a negative is made of the picture by the wet collodion process, with the use of a screen, and a copperplate is made of this negative. Line-plates are prepared by the same process without the use of a screen, and are made of zinc. In newspaper work, both half-tone and line plates are produced by zinc etching, as copper requires too much time.

If a plain negative of a photograph were printed and etched on metal and then mounted the proper height and placed on a printing-press, the impression taken from it would be entirely black and white, the shades being black and the high lights white. There would be no relief to the black portions, and the white parts would be etched entirely away. A printing-plate must have these parts broken up in some way, so that the light and the dark parts may be given their proper values. In the half-tone process, this is accomplished by the use of a transparent screen, generally of glass, which consists of two plates and on which have been made fine lines, the lines of one plate intersecting those of the other at right angles. This screen is placed in the plate-holder, in front of the

Half-tones.

negative, and the rays of light passing through it break up the parts in such a way as to show the gradation of color. When the lines are close together the engraving will be finer than when a coarse screen is used, but it will be more difficult to print. One hundred and thirty or forty lines to the inch is the average number.

As stated above, for newspaper illustration, both half-tone and line work are printed on zinc. A negative is first made from the photograph or sketch, and is developed in the dark-room. A plate of zinc is sensitized with a solution consisting of bichromate of ammonium (or potassium), distilled water, and albumen. This solution is poured several times over the plate. The sensitizing is done in the dark-room, and the zinc plate is then placed in the printing-frame. The plate is laid flat upon the negative and the cross-bars are screwed down very tight, to insure perfect contact. Exposure to strong light, either sunlight or electric light, from two to eight minutes, then follows; the light passes through the transparent parts and prints on the metal. Nothing shows on the plate when it is taken out of the printing-frame. It is rolled with printer's or lithographic transfer-ink, and is laid face upwards in a tray containing enough

Line-plates.

water barely to cover its surface. The plate is afterwards rubbed very gently with a piece of clean absorbent cotton which removes the superfluous ink. The print appears in the form of black lines against a bright background. The ink clings to the parts acted on by the light; it rubs away the parts not acted on and leaves the plain metal. After the plate is washed and heated it is powdered with dragon's blood, which protects the lines of the engraving when the plate is etched in the acid bath. In the etching all the parts not so protected are eaten away, the lines being left in relief. The etching solution is composed of nitric acid and water. In ordinary commercial work, three or four baths, sometimes more, are necessary before the plate acquires the proper depth; for newspaper work the plate is given from two to four bites, as time permits.

The next step is the routing, or drilling. On the routing-machine, in those parts where the acid did not bite deep enough the plate is still further cut away, and large parts which are not to show at all are removed. The plate is then mounted, or nailed to a block, and is ready for the composing-room. In printing from the plate on the press, the projecting parts show black and the indentations white.

The body-work, or background, of an illustration is sometimes produced by rubbing the plate, before it is etched, through films which are made of a preparation of gelatine and which are inked. By placing films on parts of the plate to be strengthened, and gently rubbing on the back of the film, various lines or dots are produced. The films are so made as to give different shades of color—small dots and fine lines for delicate tones, heavy lines and large dots for deeper tones. The stipple-work which forms the background of colored illustrations is produced in this way.

The films.

In printing a half-tone on copper, the plate is sensitized in a silver bath instead of a solution of bichromate of ammonium. The etching mordant is perchloride of iron instead of nitric acid.

Half-tone and line plates for newspapers are made in about the same way as for books and magazines, except that for the former, each step of the process is performed with greater rapidity. Daily journals have many little devices for facilitating the work: they spend less time in taking the negative and use an electric fan for drying. For book or magazine work, several hours are required to make a plate carefully; a newspaper produces a

Plates for newspaper work.

plate in an hour. If a fire or some unusual occurrence takes place a little before midnight, a sketch artist is sent out, a cut is made, and the illustration appears in the two o'clock edition of the paper.

The plates for colored pictures, with which many of our newspaper supplements are illustrated, are prepared by about the same process as an ordinary line-plate; the main difference consists in making a separate plate for each color, as on the press the paper passes from one cylinder to another to receive the various colors. [For Color-printing on the Press, see page 97.]

Printing on the press from plates.

In newspaper work, a line-plate is locked up with the form of type, which is set by the linotype and which is the size of one full page of the paper, and is stereotyped with the type. To get a clear impression of the cut, in making the matrix, an "overlay," or piece of stiff prepared paper, is placed directly over the plate, so as to keep it down as tight as possible.

Matrices are made from half-tones, but in order to get better effects, some newspapers print directly from the plate itself, as is done in fine work. A depression or space is left in the matrix and the half-tone is inserted in it; when the molten lead is poured over the matrix, the cut is soldered into the stereotype plate. To save wear, half-tones are nickel-plated for color work, as nickel is not easily affected by colored inks. A plate to be used on a web press is made with a curve which fits it to the cylinder. In printing a half-tone, a paper or "overlay" is placed between the plate and the impression-cylinder, so as to bring out the lights and shades that should appear in the picture.

WRITING MATERIALS

WRITING MATERIALS

CHAPTER I

MATERIALS USED BY ANCIENT PEOPLES

THE chief substances which have been used as writing materials are stone, clay, bark, leaves, skins of animals, metal, potsherds, wood, linen, papyrus, parchment, wax, and paper.

Rocks—sharp-pointed instruments.

It is probable that the primitive races first wrote on rocks with some sharp-pointed instrument, to delineate familiar objects or to convey information to passers-by. The Eskimo of Alaska, at the present day, cut characters upon the smooth sides of their ivory drill-bows with sharp pieces of iron or steel. They thus graphically depict their hunting expeditions and various social and religious practices. The prairie tribes of Indians, also, incise characters upon the shoulder-blades of the buffalo and other large animals, when they are on the hunt, to inform members of their band of the course of travel.

Tablets of stone—the stilus.

When men were able to give fuller expression to their ideas, instead of making inscriptions on rocks, they wrote on tablets of soft stone with a pointed tool, called a stilus, made of iron or other metal. The pen used by the early Hebrews was probably such an instrument. In some instances the stilus was pointed with diamonds, as mentioned in Jeremiah xvii., 1.

Wooden tablets. Wooden tablets were used at an ancient date. Sometimes the inscriptions were made upon the bare wood; in other cases, the tablets were coated with some kind of composition, the writing being scratched upon the surface with a pointed implement. The Egyptians employed tablets covered with a glazed composition, upon which they wrote with ink. Wooden tablets containing the names of the dead have been found with mummies.

Tablets of lead. Lead was employed in very early times. Pliny states that the public acts of the most remote nations were recorded in leaden books. Tablets of lead have been discovered which contain petitions to oracles, and in some cases the answers; charms and incantations were also inscribed on leaves of this metal. These leaden plates were often so thin that they might easily have been rolled up. For literary purposes, lead was employed to some extent in the middle ages in Northern Italy.

Bronze was a material used in both Greece and Rome, on which to engrave laws, treaties, and other solemn documents.

Babylonia and Assyria-tablets of clay.

In Babylonia and Assyria, tablets were made of soft clay; after receiving impressions, they were dried in the sun or baked in ovens. The scribe, who held an important position, was always provided with slabs of fine plastic clay, sufficiently moist to take an impression easily, but also sufficiently firm to prevent the inscriptions from becoming blurred or effaced. The writing, of course, was done with the stilus.

Greece and Rome—waxen tablets.

The Greeks and Romans used wooden and ivory tablets covered with a thin layer of wax; the instrument was still the stilus, made of metal, bone, or ivory. The tablets were sometimes fastened together with wire. They were employed for memoranda, accounts, school exercises, correspondence, literary composition, and legal documents. The stilus was sharpened at one end for the purpose of writing, and was left blunt at the other, to make erasures when necessary. Wax tablets continued to be used to a limited extent in Europe until the fourteenth or fifteenth century.

Inscribed potsherds.

In Egypt inscribed potsherds have been found in great numbers. The inscriptions are sometimes scratched with a pointed instrument; generally, however, they are written in ink with a reed. In Greece this material seems to have been used only on rare occasions or from necessity. Such inscribed fragments have received the name of *ostraka*, a term which we associate with the ostracism practised by the Athenians, in which the votes were recorded on pieces of broken vessels. In Egypt the ostraka were generally receipts for taxes or letters or orders to officials.

Graffiti. Graffiti, or wall-scribblings, abounded in nearly all places under Roman domination. They have been discovered in the ancient cities of Italy, but in the greatest numbers at Pompeii. The scribblings and rude drawings are generally scratched with a sharp instrument or scrawled with red chalk or charcoal, and were evidently traced by idle loungers or triflers; inscriptions of a more serious nature were drawn with a brush. We find doggerel and amatory verses, caricatures, quotations from the poets, idle words, names to which opprobrious epithets were attached, pasquinades, and satirical remarks; among the tracings of a serious import were notices of household events, advertisements and announcements of games, appeals to the public, prayers, and invocations to the martyrs. These inscriptions disclose the current life of the people, afford material for the study of the Roman cursive writing, and are often of historical and archeological importance.

The Egyptians covered with inscriptions the stone walls of their buildings,—their palaces, temples, monuments, the walls and ceilings of subterranean passages, and even the interiors of their tombs. The history of the nation was thus written in hieroglyphics, and on stone walls and tablets kings recorded their exploits, their campaigns into distant lands, their victories, and their triumphant returns.

Writing materials of the Hebrews.

In the earliest ages of their history the Hebrews, in common with other primitive peoples, engraved the record of their important events upon stone; they also wrote with the stilus on rough tablets of wood, earthenware, or bone; at a later period they employed the skins of animals. The Law was written in golden characters on skins in the form of a scroll. Leather is still used by the Jews for their synagogue rolls. Parchment was also employed by the Hebrews as a writing surface.

Skins of animals, bark and leaves of trees.

Among other materials used by primitive peoples to receive writing, besides the skins of animals, the most common were the bark of trees, and leaves, principally those of the palm. The Latin word for bark, *liber*, came to mean also book. Linen cloth was employed as a writing surface by the ancient Egyptians, also by the Romans for certain rituals in their history. The Ojibwa Indians of North America still make records on birch-bark, and own scrolls which they say have been in their possession for centuries. The Indians have also painted on skins of animals, but of recent years they have employed muslin and canvas as a writing surface. The Oriental traveler, Mr. F. Jagor, observed in India and elsewhere the use of birch-bark and palm and similar leaves to receive writing. The characters are usually inscribed with a finely-pointed instrument of steel or other hard substance, after which a composition of grease and powdered charcoal is rubbed into the indentations.

The calamus, or reed.

With ink the writing implement was the calamus, or reed, sharpened and split like the pens of the present day. The reed pen was employed for writing upon papyrus or parchment. This instrument was made from the tubular stalks of grasses growing in marshy lands and from the hollow joints of the bamboo. The calamus is the true ancient representative of the modern pen. In

Greece and Rome the reeds in common use were obtained from Egypt, but persons of wealth often wrote with a silver calamus. Some of the ancient reed pens are still preserved; one found in a papyrus at Herculaneum is now kept at Naples. The natives of Persia and of some neighboring countries still employ the reed, as the metal pen is not adapted to their mode of writing. The Japanese and Chinese use a hair pencil or small brush.

Ancient inks.

The ink of the ancients was made from the black fluid of the cuttle-fish, or of lampblack or charcoal and gum. The thick inks were applied with a brush; for the reed a thinner ink was made of gall-nuts and sulphate of iron. Red and blue inks were employed for titles and initial letters. The ancient inks were thicker and more durable than those of the present day. The writing on the ancient Egyptian papyri is legible even now after the lapse of several thousand years.

Gold and silver writing fluids.

Gold and silver have both been employed as writing fluids. Manuscripts of purple-stained vellum were written in gold, and ordinary white vellum was also so inscribed, particularly during the reigns of the Carlovingian kings of the ninth and tenth centuries. The practice of gold writing survived until the thirteenth century, after which date only a few isolated examples are to be found. Silver would produce little effect on a white ground; its use as a writing fluid therefore ceased with the disuse of stained vellum.

CHAPTER II

PAPYRUS

THE *Cyperus Papyrus* of Linnæus was a plant extensively cultivated in ancient times in the Delta of Egypt. It is now extinct in Lower Egypt, but is found in Nubia and Abyssinia. It is said to grow also in Western Asia and in Sicily.

The papyrus plant.

One of its ancient names was P-apu, from which the Greek title *papyrus* was derived. The Greeks called it also *byblos* and *deltos*. Its Hebrew name was *gomê*, a word resembling the Coptic *gom*, or "volume." In modern Arabic its name is *berdi*. In hieroglyphic writing the papyrus plant is used as the symbol of Lower Egypt.

On the ancient Egyptian monuments, the papyrus is represented as a plant about ten feet in height. Theophrastus gives the first accurate description of it, and says that it grew in shallows of about three feet or less, its main root, which lay horizontally, being of the thickness of a man's wrist and ten cubits in length. From this main root, smaller roots extended down into the mud;

the stem of the plant rose to the height of six feet or more above the water, being triangular in form with a tufted head of numerous drooping spikelets.

The papyrus plant was used for many purposes, both useful and ornamental. Of the tufted head, garlands were made for the shrines of the gods. Its roots were dried for fuel and its pith was boiled and eaten. Of the stem, were made sandals, boxes, boats, sails, mats, cloth, cords, and writing material. In sculptures of the period of the fourth dynasty[1], workmen are represented in the act of building a boat of stalks cut from a neighboring plantation of papyrus. Isaiah probably refers to boats of this kind when he speaks of "vessels of bulrushes upon the waters" (xviii., 2).

Papyrus as a writing material.

The widespread use of papyrus as an ancient writing surface is attested by early writers and by numerous documents and sculptures; the material was employed in Egypt at a remote period. The names of the plant, given above, were applied to the writing material, which by the Greeks was called also *charta*. Papyrus rolls are represented in the sculptures of Egyptian temples, and numerous examples of the rolls themselves are still in exist-

[1] From about 3998–3721 B. C.

ence. The dry atmosphere of Egypt has been peculiarly favorable to the preservation of these documents; in many instances they remain untouched by decay, and are as fresh as when first written.

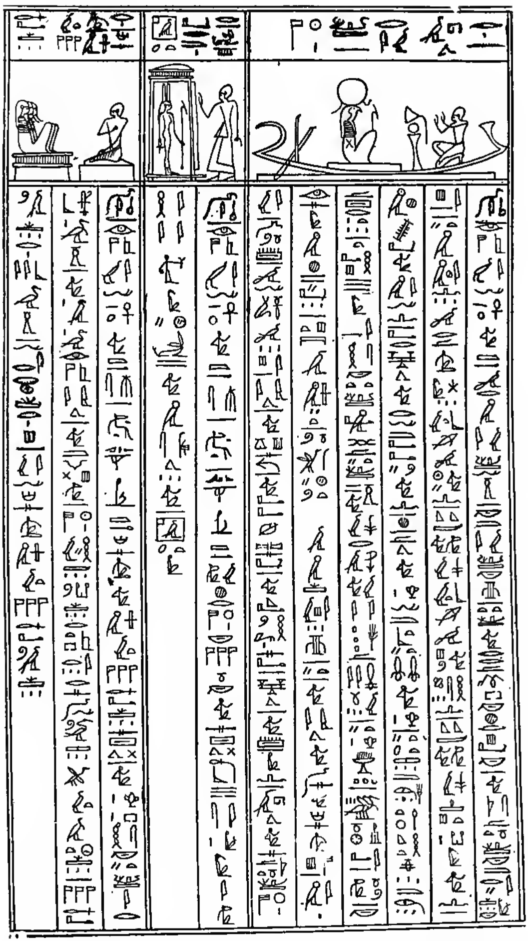
Manufacture of papyrus paper.

Pliny's account of the manufacture of the writing material from papyrus refers to the process followed in his time, but it is probable that the same general method of treatment had been practiced for many centuries. The stem was cut into longitudinal strips, those from the centre being, of course, the broadest and therefore the most valuable. The strips were laid on a board, side by side, until the desired width was obtained; across the layer thus formed another layer of shorter strips was laid at right angles. The two layers were soaked, Pliny says, in water of the Nile. It is supposed that they were joined either by the juice of the plant or by a thin gum. The layers were then pressed and dried in the sun. Any inequalities in the surface were removed by the use of ivory or a smooth shell. Newly-made papyrus was white, or brownish white, and flexible, but the papyri which have been preserved until the present day have become of a light or dark brown color and so brittle as to break at the touch. The sheets varied from four or five inches to nearly eighteen inches in width; the usual width was about eight inches. Any required length could be obtained by fastening a number of sheets together, end to end. The sheets were put together in the order of their quality, the best sheet on the outside of the roll and the worst sheets in the centre. They were thus arranged, not for the purpose of concealing the bad material, but that the strongest sheets should be placed where there was most wear and tear. Besides, if the entire roll should not be needed, the poorest sheets could be better spared and easily cut off. The papyrus roll, as a rule, was written on one side only, and was fastened to a wooden rod or roller, around which it was wound.

Papyrus rolls.

The rolls were of various lengths. A fairly full copy of the ritual of the dead, the whole or a part of which was buried with every person of consequence from the eighteenth dynasty[1] to the Roman period, required a roll fifteen inches wide and from eighty to ninety feet long. The Harris papyrus, in the British Museum, is the longest known, having a length of one hundred and thirty-three feet. The most ancient of the papyri now ex-

[1] From about 1587-1328 B. C.



SELECTION FROM THE BOOK OF THE DEAD—TURIN (HIEROGLYPHIC) PAPYRUS. [From Davis. By permission of G. P. Putnam's Sons.]

tant is the Prisse papyrus, so called from the name of its former owner, and is preserved at Paris. It is supposed to date from about 2400 B. C., or earlier, and contains a work composed during the reign of a king of the fifth dynasty.[1] The papyri of Egypt have usually been found in tombs, or in the hands, or wrapped with the bodies, of mummies. Besides the ritual of the dead, which is most frequently the subject, and religious rolls, there are civil and literary documents, in the hieratic style of writing, and the demotic or enchorial papyri, relating generally to sales of property.

Discoveries of papyri.

The discovery of papyri containing works of classical Greek authors, begun about the middle of the nineteenth century, has resulted in a great gain to literature. There were brought to light four or five quite complete orations of Hyperides, an orator who before had been known only by name. Additions were made to the works of Euripides and Alcman, and early manuscripts were found of parts of Homer, Plato, Thucydides, Demosthenes, and Isocrates. In the great discovery in 1891, of more than one hundred and sixty ancient mummies in a subterranean passage at

[1] From about 3721-3503 B. C.

Deïr el Bahari, near Thebes, many Egyptian papyri were given to the world. These contained the usual ritual passages and extracts from the Book of the Dead. In the same year the British Museum obtained from Egypt papyrus rolls containing almost the whole of a lost work of Aristotle on the Constitution of Athens. There were four of these rolls, the longest seven feet, the shortest three feet in length. They date from about the end of the first century A. D.

It has been thought that the early Chaldeans had a knowledge of papyrus paper, and either made it themselves or had it brought from Egypt, but if they possessed papyrus writings they have entirely disappeared. Egypt was the true home of this plant, where paper was manufactured from it at least 2000 years B. C. It was for a long time an article of export and in great demand. It is supposed that the manufacture of papyrus in Egypt ceased about the middle of the tenth century.

Use of papyrus in Greece and Italy.

Papyrus was used among the early Greeks but it did not come into general use until after the time of Alexander the Great, when it was exported from the ports of Egypt. It is not known when papyrus was first used in Italy, but under the Empire there was a great demand for it. It was then employed not only for making books, but for domestic purposes, correspondence, and legal documents. It is said that during the reign of Tiberius the failure of the papyrus crop almost caused a riot. Although the plant was cultivated in Italy, the staple was doubtless imported from Alexandria. It is thought by some that papyrus paper was never manufactured from the native plant anywhere except in Egypt.

Papyrus continued to be employed to some extent as a writing material in Europe until the tenth century; by the twelfth century it had entirely disappeared. Its use for books ceased sooner than for documents. During the later period of its use in book-making, it was no longer made in rolls but was cut into square pages and bound like a modern book. To the square form of book, the name *codex* was given. [See Codex, page 183.]

CHAPTER III

PARCHMENT AND VELLUM

THE skins of animals were employed as a writing surface at a very early period. The word parchment is derived from *Pergamum*, the name of a city in Mysia, where it is said the material was first used. The story as told by Pliny is that Eumenes II., King of Pergamum (B. C. 197–159?), wishing his library to rival that of the Pharaohs at Alexandria, was forced to develop the manufacture of parchment in consequence of the prohibition of the exportation of papyrus from Egypt through the jealousy of Ptolemy Epiphanes. Papyrus was used as a writing surface in Italy as late as the tenth century, but parchment was also employed. From the tenth century until the fourteenth, when paper became generally known, parchment was the ordinary writing material. It was the influence of the Christian Church that eventually caused vellum to supersede papyrus as a writing surface. Because of its durability, it was used for new volumes, also to replace damaged works on papyrus. When Contanstine desired copies of the Scriptures for his new churches, he ordered the manuscripts to be inscribed on vellum.

During the middle ages, vellum dyed purple, or other brilliant color, was used for valuable manuscripts, such as the Gospels, the Psalter, and important Codices. The entire surface of leaves of this material was sometimes gilded, but this mode of decoration must have proved too expensive to be very generally employed.

Kinds of parchment.

Parchment[1] is skin so prepared that both sides can be written upon. Ordinary parchment is made chiefly from sheepskin and sometimes from those of the goat. Fine parchment, or vellum, is prepared from the skins of calves, kids, and dead-born lambs. A coarse variety used for drumheads, tambourines, etc., is made from the skins of goats, calves, and wolves; for battledores the skins of asses are employed; for bookbinders' use parchment is sometimes manufactured from pigskin. Sheepskins are often split so as to produce two sheets of parchment. The Eskimos make this

[1] In modern times the term parchment has given place to that of vellum. The true vellum is made from calf-skin or from the skins of kids or dead-born lambs, but the name is now applied to a medieval skin book of any kind. The use of the word parchment is generally restricted to sheepskin or a skin on which law deeds or other formal writings are engrossed.

material from the entrails of seals, and manufacture from it blankets and clothing. The skin of the fur-seal is sometimes converted into parchment, which is used for making cases for holding valuable papers or other articles.

Preparation of the skins.

With some slight differences, all the skins are prepared in the same way. They are first soaked in water and then in milk of lime for the purpose of removing the hair. They are shaved, washed, and gone over with a sharp knife to remove superfluous parts. The skins are then stretched on a stout wooden frame, called a *herse*, and dried in the air. The finer varieties are dusted with chalk and rubbed with pumice-stone. Parchment intended for the use of bookbinders is planed, in order to produce a rough surface capable of being dyed or written upon.

Vegetable parchment.

Vegetable parchment, or parchment paper, is made by dipping ordinary unsized paper for a few seconds in dilute sulphuric acid and immediately removing all traces of the acid. Paper thus acted upon undergoes a remarkable change: it becomes translucent, horny, and parchment-like, and acquires about five times the strength of ordinary paper. It is impervious to water, but becomes soft and flaccid when dipped into it; it is not affected by boiling water. The same effect is produced by subjecting paper to a solution of chloride of zinc.

Stout varieties of vegetable parchment have been employed for book-covers and as a writing surface for deeds; its chief use, however, is for covers of vessels, such as preserve-jars and bottles. Thin sheets of it are employed for tracing plans and charts.

Parchment for printing purposes is imported into the United States from Europe and is sold in rolls of sixty skins. It is made in Hanover, at Augsburg, Breslau, Dantzic, and Nuremberg, and in Holland, England, and France.

CHAPTER IV

PAPER

THE earliest material which resembled the paper of the present day was made from the Egyptian papyrus. From the Egyptian word *P-apu* were derived the Greek and Latin terms *papyrus*, and from these all similar writing material has been named.

Paper made by the Chinese.

The Chinese seem to have had a knowledge of the art of making paper many centuries before the material was introduced into Western Asia and Europe. At a very remote period they made paper of sprouts of bamboo, of Chinese grass, and of the bast of a special mulberry-tree. Fang Mi-Chih, author of an encyclopedia, states that at first the Chinese wrote on bamboo boards; but that for a long time, both before and after the Christian era, the usual writing material was paper made of silk waste. The manufacture of paper from fibrous matter and from the wool of the cotton-plant, reduced to a pulp, has been traced back by some writers to the second century B. C. The invention of paper made of vegetable fibre is attributed to the statesman Ts 'ai Lun. It is said that in 105 A. D. he had succeeded in making paper of bark, of hemp, of rags, and of old fish-nets.

The Hindus, the Persians, and the Arabs.

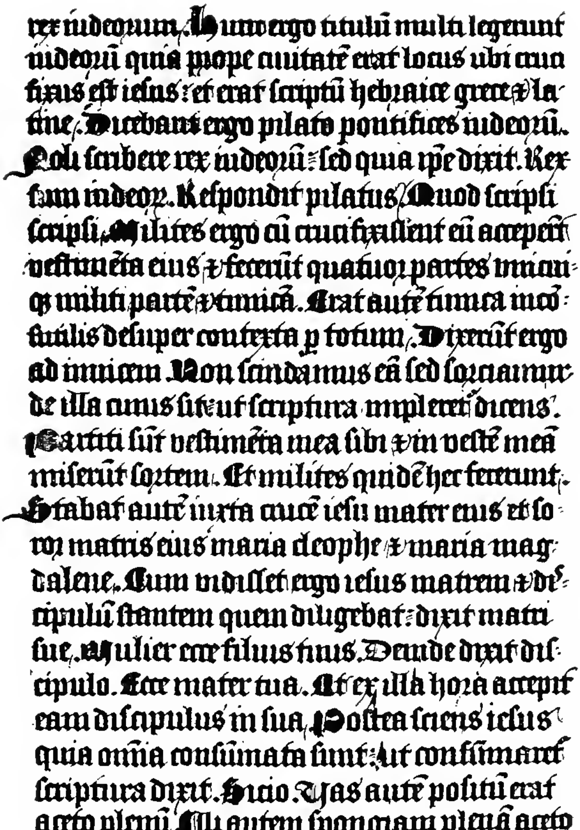
By the Chinese the art was made known to the Hindus, the Persians, and the Arabs. A paper manufactory was established at Samarkand in the latter part of the sixth or early in the seventh century of the Christian era. The Arabs conquered this city in 704 A. D., and there learned the use of the material. From this time paper became available for the rest of the world. At Bagdad its manufacture was carried on from about 795 A. D. until the fifteenth century. The art was practised also in Damascus, Egypt, and the North of Africa. From the large quantities made at Damascus, paper received the name of *charta Damascena,* a term by which it was generally known in Europe in the middle ages; the titles *charta* and *papyrus* were transferred to it from the Egyptian writing material; cotton paper was called also during the middle ages *charta bombycina, gossypina, cuttunea, xylina, Damascena,* and *serica.*

The use of paper in Europe—Greece.

Paper was probably introduced into Greece through trade with Asia, and thence carried to other countries in Europe. It seems not to have been used very extensively in Greece before the middle of the thirteenth century.

Spain, Italy, Germany, and France.

The first paper manufactured in Europe was made by the Moors in Spain. In 1154 there was a paper-mill at Jativa; factories were also established at Valencia and Toledo. The Arabs introduced paper-making into Sicily; from Sicily it passed over into Italy, where there is evidence, in the city of Genoa, of a trade in this material as early as 1235. In Germany the first factories seem to have been established between Cologne and Mainz towards the end of the thirteenth century, and in Mainz itself about the year 1320. Mills were started also at Nuremberg, Ratisbon, and Augsburg. Paper was introduced from Spain into France, where it is said to have been manufactured in the district of Hérault as early as 1189. The Netherlands and England first obtained their supply from France and Burgundy. It is believed that the first paper-maker in England was a person named Tate, who is said to have had a mill in operation in Hertford early in the sixteenth century. Very little is known of the manufacture of the material in that country, however, until about the middle of the sixteenth century, when there was a paper-mill at Dartford.



rex iudeorum. Hunc ergo titulū multi legerunt
iudeorū quia prope civitatē erat locus ubi cruci
fixus est iesus: et erat scriptū hebraice grece & la-
tine. Dicebant ergo pilato pontifices iudeorū.
Noli scribere rex iudeorū: sed quia ipse dixit. Rex
sum iudeorum. Respondit pilatus. Quod scripsi
scripsi. Milites ergo cū crucifixissent eū acceperūt
vestimenta eius & fecerūt quatuor partes unicui-
que militi partē & tunicā. Erat autē tunica incō-
sutilis desuper contexta p totum. Dixerūt ergo
ad invicem Non scindamus eā sed sortiamur
de illa cuius sit: ut scriptura impleretur dicens.
Partiti sūt vestimēta mea sibi & in vestē meā
miserūt sortem. Et milites quidē hec fecerunt.
Stabat autē iuxta crucē iesu mater eius et so-
ror matris eius maria cleophe & maria mag-
dalene. Cum vidisset ergo iesus matrem & dis-
cipulū stantem quem diligebat: dixit matri
sue. Mulier ecce filius tuus. Deinde dixit dis-
cipulo. Ecce mater tua. Et ex illa hora accepit
eam discipulus in sua. Postea sciens iesus
quia omnia consūmata sunt: ut consūmaretur
scriptura dixit. Sicio. Vas autē positū erat
aceto plenū. Illi autem spongiam plenā aceto

PART OF A PAGE FROM A MANUSCRIPT MISSAL WRITTEN IN GERMANY—ABOUT THE PERIOD OF GUTENBERG'S FIRST BIBLE.
[From Humphreys.]

In America paper was first manufactured by William Bradford, the printer, in 1690, at Germantown, near Philadelphia. Having discovered a paper-maker among the immigrants to the colony, with the help of some of his neighbors, he started a paper-factory, which was operated by the Rittenhouse family for several generations. **America.**

The paper first manufactured in Europe was made from the cotton-plant; rags were afterwards mixed with the raw material or substituted for it.

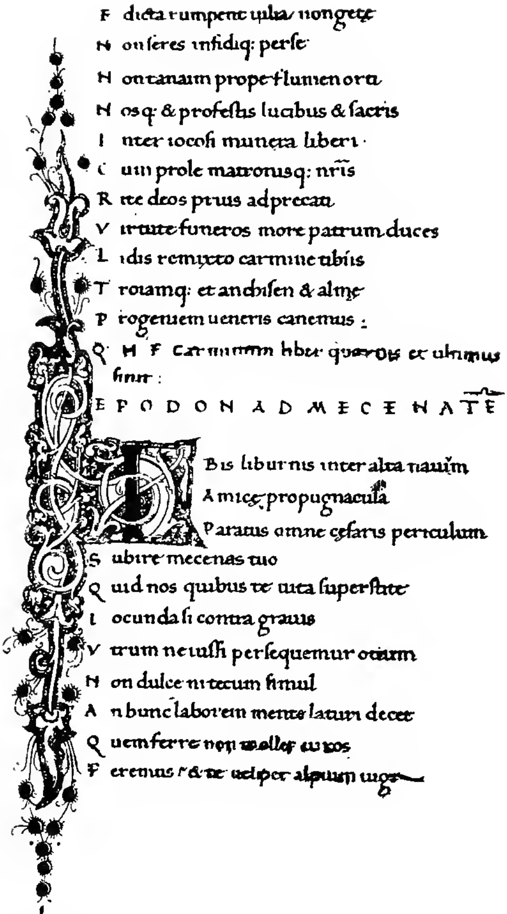
Many early Arabic manuscripts on paper, dating from the ninth century, are still in existence. Among the earliest dated documents is the *Gharîbu 'l-Hadîth,* written in the year 866 A. D. This is a treatise on the rare and curious words found in the sayings of Mohammed and his companions, and is preserved in the University Library of Leyden. The oldest dated Arabic manuscript on paper in the British Museum is of the year 960, and is a treatise by an Arabian physician on the nourishment of the different members of the body. In the Bodleian Library (Oxford), is preserved a manuscript of a grammatical work of 974. As this was written at Samarkand, the paper was probably made at that seat of early Arab manufacture. **Early Arab manuscripts on paper.**

Early documents on paper, written in Europe.

Of the documents on cotton paper written in Europe, the oldest is the deed of King Roger of Sicily, of the year 1102; other deeds of Sicilian kings of the twelfth century are recorded. The oldest known imperial deed on paper is a charter of Frederick II. to the nuns of Goess in Styria, of the year 1228, now kept at Vienna. This emperor, however, in 1231, forbade the use of paper for official documents, which he desired inscribed on vellum. The British Museum possesses astronomical treatises written on paper, in an Italian hand of the first half of the thirteenth century. Examples of Spanish-made paper are the letters addressed from Castile to Edward I. of England, in 1279 and subsequent years.

Manufacture of paper—first paper-machines.

At first, paper, both ancient and modern, was made entirely by hand. In 1799 a paper-machine was invented by Louis Robert, a clerk employed by the Messrs. Didot of the celebrated Essonnes mills near Paris, and this caused a great development of the industry. The manufacture was introduced into England, through the agency of the Messrs. Fourdrinier, and the first paper-machine in that



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P rogeniem ueneris canemus :
Q H F Carminum liber quartus et ultimus finit :
EPODON AD MECENATEM
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Amicę propugnacula
Paratus omne cęsaris periculum
S ubire mecenas tuo
Q uid nos quibus te uita superstite
I ocunda si contra grauis
V trum iussi persequemur otium
N on dulce ni tecum simul
A n hunc laborem mente laturi decet
Q uem ferre non molles uiros
F eremus & te uel per alpium iuga

A PAGE FROM THE "ODES OF HORACE," AN ITALIAN MANUSCRIPT OF THE FIFTEENTH CENTURY. [From Humphreys.]

country was erected in 1804, at Frogmoor Mill, near Boxmoor, Herts. Henry and Sealy Fourdrinier, of London, bought the English patents, and so perfected the machine that it has since been given the name of Fourdrinier. In America the first steam paper-mill was started at Pittsburg, in 1816. The first cylinder machine for the manufacture of paper was designed by Thomas Gilpin, and was employed by him, in 1817, in his mills on the Brandywine. Since 1820 paper made by machinery has supplanted hand-made paper, except fine grades used for special purposes.

Paper staples.

The staples, or the materials, from which writing and printing papers are made are wood-pulp, rags, and esparto.[1] The staple of wrapping-paper is old ropes and jute. The finest writing and printing-papers, whether made by hand or machinery, are manufactured from linen and cotton rags. A great part of paper-making material is a by-product obtained from the refuse of other manufactures, such as waste paper, rags, old rope, old bagging, etc. At the present day paper is put to so many uses that rags cannot be procured in

[1] Esparto is the name of two or three species of grass found in Southern Europe and Northern Africa.

sufficient quantities, hence the greater amount of even white paper is now made from wood-fibre. Paper can be made of almost any vegetable fibre, but those fibres are strongest which are most completely interlaced. The woods generally used are the poplar, pine, spruce, and hemlock.

Wood-pulp and wood-fibre.

The idea of making paper from wood-pulp arose in the early part of the nineteenth century. Various patents were granted, but it was not until about 1855 that wood began to take the place of rags for book and newspaper work. A distinction must be made between wood-pulp and wood-fibre: the pulp is produced by mechanical means, or by grinding; the fibre by chemical treatment, or by a process which separates from the wood all resinous and gummy substances, and leaves what is called *cellulose*, or fibre divested of all incrusting matter. Wood-pulp generally receives an admixture of wood-fibre to give it strength.

Preparation of the stock.

The manufacture of paper really begins with the first step required to prepare the stock. In making wood-pulp, the bark and knots are first separated from the wood. The wood is then cut into convenient lengths and put into a machine termed a wood-pulp grinder, which tears off the fibres. To produce wood, or chemical, fibre, the wood is cut into chips, dusted, and then boiled in an alkaline or acid solution in a vessel known as a digester. The chemicals separate the gummy or resinous substances from the fibre which, when washed and bleached, is almost pure cellulose. It is soft and of considerable strength.

Esparto, or Spanish grass, is cleaned and sorted by hand, and is afterwards boiled in an alkaline solution. Jute, hemp, and waste paper are all treated in about the same way, being boiled in alkaline solutions. Cotton and linen rags are passed first through threshers, then through cutters, and are afterwards boiled in a solution of caustic soda.

After the preparation of the staple, the making of it into pulp and the manufacture of the pulp into paper are about the same whether rags or other varieties of stock are employed. The process of the preparation of the pulp, whether for machine or for hand-made paper is substantially the same, but in making paper by machinery each operation is performed on a larger scale.

Paper-making by machinery.

In making paper by machinery, the rags are first put into a thresher or dusting-machine. After they have passed through this, women sort them by hand, and remove all extraneous substances, such as buttons, hooks and eyes, bone, india-rubber, leather, and pieces of metal, at the same time loosening all hems and knots. The rags are then cut into small pieces, either by hand or machinery; for the common qualities of paper, machine-cutting is used. When the rags are cut by hand, the sorter stands at a long table, to which scythe-blades are attached; the back of the blade is towards the sorter, who draws the cloth against the edge. The rags are again dusted and sent to openings in the floor of the room, underneath which are brought the mouths of large boilers called rotaries. The boilers contain a solution of soda ash, caustic soda, or lime in water. The mouths of the rotaries are closed, steam is introduced, and the rags are boiled under pressure for several hours; by this treatment all fatty, glutinous, or coloring substances are separated from the pure fibre. Afterwards, the rags are drained and taken to the washing-and-beating engines. They are sometimes washed in one engine and beaten in another, sometimes both operations are performed in the same machine. This engine is an oblong shallow tub or vat. The rags are placed in it, with a sufficient quantity of water, and are brought by power under the action of two sets of knives, by which they are subdivided. The water in the washing cylinders is constantly changing, thus affording a continual supply of fresh water and the carrying off of the dirty fluid. The rags are thus treated from three to five hours, at the end of which time they are sufficiently cleansed. They are now known as *half-stuff*.

The next step is bleaching. A solution of chloride of lime and some sulphuric acid are added to the half-stuff, which is emptied into a chest or drainer. Here the bleaching is finished. The pulp is then washed to free it from the chemical products adhering to it, and for this purpose it is again put into the engine or tub, the roller with knives being raised to avoid cutting the fibre. The stock is now beaten to the desired fineness and sent to the stuff-chest. This completes the preparation of the pulp.

From the stuff-chest the pulp is pumped into a regulating-box, or supply-box. The stuff is sent to the Fourdrinier machine through a pipe containing a rapidly-flowing stream of water. After passing through the preliminary parts of the machine, the pulp is deposited upon a wire-cloth, which is a huge belt, having both a forward and a lateral motion. The pulp is laid upon this belt evenly, and is still in a liquid condition; the water oozes out through the bottom into a depression below. The constant vibration of the wire-cloth, by means of a shake attachment, throws some of the fibres across the machine, while the motion or travel of the belt causes the lay of the fibre in the other direction. Endless rubber-bands, called deckles, extend on each side on top of the wire; these prevent the pulp from spreading beyond the edges of the wire, and also determine the width of the paper. The deckles continue about two-thirds of the distance of the run of the belt; by that time the paper is formed, but is not sufficiently compact. A cylindrical frame covered with wire-cloth, known as the dandy-roll, passes over the paper and presses the fibres more closely together. Upon the dandy-roll are frequently placed letters, monograms, or other signs, which may be seen in the finished paper when held up to the light. To produce these marks in the paper, some of the wires are made to project a little more than usual, or other wires are fastened over them, the paper thereby being made thinner in such places. These letters or signs are produced also by depressing the wires where a mark is desired, thus causing the paper in those places to be thicker.

The web then passes over the suction-boxes, and just as it leaves the wire-cloth it passes under the couch-rolls, after which moisture is expelled by two sets of rollers. The remaining moisture is driven out by heat. So far, no heat has been employed.

Driers.

The paper is now sent to the driers, a series of iron cylinders of large diameter, heated by steam. Accompanied by a belt of duck, it passes over and under the cylinders, becoming drier and more solid as it approaches the end of the machine. The web then passes into a tub of animal sizing. If the paper is to be "loft-dried," it is cut into sheets and taken to the loft, where it is hung on poles. The cheaper varieties remain there two days, the finer grades a week. "Machine-dried" paper passes from the size-tub into a mechanical drier, without being cut into sheets.

The Fourdrinier machine.

The Fourdrinier machine, above described, has been improved in all its details, but in theory its construction is about the same as when invented by Robert. This machine was first employed in the United States about 1827 at Springfield, Massachusetts.

The Cylinder machine.

On the Cylinder machine no lateral motion is given to the wire-cloth; the paper therefore felts in but one direction. Paper made on the Cylinder machine is stronger in the direction of its length than that made by the Fourdrinier, but is weaker in its breadth. This machine is used in the United States for the manufacture of hanging papers, wrapping papers, and straw and binders' boards.

Calenders.

To receive a finish, all papers pass through a "stack" of calenders, which consists of a series of polished iron rollers, mounted one above the other. Paper which goes but once through the calenders is given the name of "machine-finish." Loft-dried paper is calendered in single sheets; machine-dried in the roll.

Supercalenders.

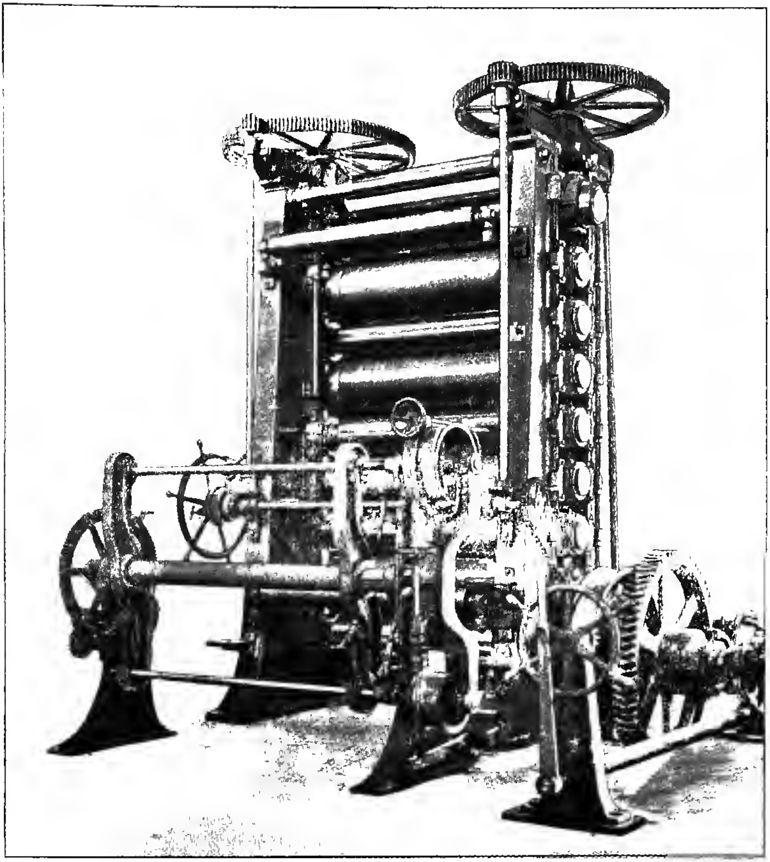
To supercalender paper, it is passed between a series of rollers called supercalenders; some of these are made of chilled iron, others of sheets of paper or of compressed disks of cotton.

Sizing.

Sizing is given to paper for the purpose of removing its porous and absorbent character, so that when written upon the ink will not spread. Vegetable sizing is put into the engines; animal sizing is given on the machine, by passing the web through a trough containing a solution of gelatine.

Loading.

To fill up the pores or interstices, paper is loaded with some other substance. This not only



STACK OF 52-INCH SUPERCALENDERS—FRONT VIEW.

gives the paper a finer surface but also makes it heavier. Kaolin or china clay is the loading material for ordinary paper; for the finer grades, sulphate of lime or pearl hardening is used. The clay is made into a thin cream and is put into the pulp while the latter is in the beating-engine.

Surface-coating.

When paper first comes from the machine, little ridges or hollows are found on its surface, resembling those on the rind of an orange. To make the paper smoother, it is surface-coated with some white substance, and the most delicate half-tones can then be printed upon it. In surfaced papers the mixture is applied by brushes, and the paper is calendered by steel rollers to the degree of finish desired. The oftener the paper passes through the rollers, the higher will be the finish. Some papers are brushed to a finish instead of being put through the rollers.

Shading.

It is not possible to make from the raw materials absolutely white paper, as the web always inclines either to blue or yellow. Paper is therefore shaded slightly towards a buff or bluish tint. This is generally accomplished by putting a coloring substance, which dissolves very slowly, into the pulp in the engine.

As has been stated above, the preparation of the pulp, whether for hand- or machine-made paper, is substantially the same. The old stamps or beaters have been superseded by the Hollander or beating-engine which is still in use. In making paper by hand, the pulp is carried to the working-vat, a vessel either of wood or stone, about five feet square and four feet deep, with a flaring top. In the vat the pulp is mixed with water and is heated by means of a steam-pipe. The mould for making the paper is a wooden frame, with bars about an inch and a half apart, flush with one edge of the frame. Parallel wires, about fifteen or twenty to the inch, are laid upon these bars, lengthwise of the frame. A movable frame, called a deckle, fits upon the mould, the two forming a shallow tray, with a wire bottom like a sieve. Paper made in such a mould is known as "wove" paper. When small wires placed close together, with coarser wires running across them at equidistant intervals, form the bottom of the mould, in place of the wire-cloth used as the bottom for wove paper, the paper made in such a mould takes the impression of all these wires. It is then given the name of "laid" paper.

Paper-making by hand.

Wove paper.

Laid paper.

The mould or wire-frame on which the pulp is formed is raised where the water-mark, or trade-mark, is desired. The sheet in that part is thereby made thinner than in other places, and the design remains impressed in each sheet.

The water-mark.

The workman dips the mould into the vat containing the fluid pulp, and takes up a sufficient quantity to form a sheet of paper. Great dexterity is needed to make a perfect sheet, and to follow this with other perfect sheets, all of even weight; this depends on the skill of eye and hand acquired by experience. The vatman gives the mould an oscillating motion, to cause the intermixture of the fibres necessary to secure uniformity of texture. Gradually the water drains through, the pulp solidifies and assumes a peculiar shiny appearance, which indicates the completion of the first step of the process. The deckle is then taken off, and the mould is sent to a workman known as the "coucher," who deposits the sheet upon a piece of felt. Another piece of felt is placed upon the paper, and this process is continued until the pile contains six or eight quires. The pile is then subjected to great pressure. A workman known as the "layer" separates the pieces of felt and the paper. The sheets are again pressed to remove, so far as possible, the felt-marks and the moisture, and are then hung in a loft to dry. When dry, the paper is sized. Sizing is made of some material containing a great deal of gelatine, such as sheeps' feet or pieces of skin cut off by curriers before the hides are tanned. These materials are boiled to a jelly and strained, and a small quantity of alum is added. The sheets are spread out in a tub containing the sizing diluted with water. Care is taken that the sheets shall be equally moistened. After sizing, the paper is again pressed and slowly dried. Women take out the knots and imperfections with small knives, and separate the perfect from the imperfect sheets. After being again pressed, the paper is finished and counted into reams. These reams when pressed and tied up are ready to be sent to the warehouse. There is but one mill in the United States which produces hand-made paper, that of the L. L. Brown Paper Company at Adams, Massachusetts. In the vat-mills of Europe, after the preparation of the pulp by machinery, paper is made by hand in about the same way as in this country. In some towns the same process has been employed for several centuries. In a number of the ancient mills at Amalfi, Italy, the rags are still beaten by hammers.

Deckle-edge is the name given to papers which are rough on the outer edges. In making paper by hand, the pulp is shaken in a sieve, and the sides therefore are uneven. When paper first issues from the machine, it is rough on the outer edges, next to the deckles, and is afterwards trimmed. Deckle-edged machine paper, however, can be made in narrow strips of any desired width. This is done by putting in a number of deckle-straps on the wire-cloth, so as to give the true deckle. The edge thus formed is more feathery than that of regular hand-made paper; it occurs on two sides instead of four.

Deckle-edged papers.

Paper may be divided into four general classes: Printing-paper (book and newspaper), Writing-paper, Wrapping- or Packing-paper, and special or miscellaneous papers.

Classes of paper.

Machine-finish.—A paper with an unglazed surface, having passed but once through the calenders.

Printing-papers.

Wove.—A paper which receives no other impression than that made by the weave of the wire-cloth and the dandy-roll.

Laid.—When made by hand, a paper which takes the impression of both the small and the coarse wires which form the bottom of the mould. In machine-made paper, the equidistant parallel lines are produced by a series of wires which pass around the exterior of the dandy-roll.

Calendered.—A paper which receives a surface by being passed through a series of polished iron rollers, known as calenders. This operation makes the paper even and also gives it a gloss.

Supercalendered.—A paper which receives a still higher finish by being subjected to the action of supercalenders, which are a series of rollers, some made of chilled iron, others of sheets of paper or of compressed disks of cotton.

Coated.—A paper which has received a coating of a white substance, such as china clay, or gypsum, sulphate of barytes, etc.

Coated and supercalendered papers are used for first-class magazines and for illustrated books, as they take the impression of a plate better than many other papers.

Enameled papers are coated with a colored substance which adds both to their weight and thickness. They are used for covers.

Deckle-edged papers are rough on the outer edges. They are made both by hand and machinery.

Plate paper.—Paper which has passed between highly polished metal plates or heavy rollers that give a powerful pressure. Plate paper is a high grade of book stock, and has the same finish on both sides. It takes well the impression of printer's ink, and receives the most delicate lines of half-tones.

Copperplate paper is unsized paper, unfinished on one side and calendered on the other.

Writing-papers.

Writing-paper has a smooth surface, as it is made with a sizing or glue. Without the sizing, the ink would penetrate the paper and render each line of the writing too thick. It sometimes has the same name, but not always the same size, as printing-papers.

Among writing papers are:

Bond.—A fine stock of paper, usually uncalendered and very strong.

Linen.—A paper made from the same stock as bond, but laid and usually of a rougher finish.

Ledger.—The finest qualities of writing-paper large in size. Ledger-paper is very strong and has good erasing qualities.

The fine varieties of writing-papers are, of course, made of linen rags.

Special and converted papers.

Some of the special papers are used just as they come from the mill; others are prepared for special purposes by manufacturers known as converters. These products may be divided into special papers and converted papers. Among special papers may be mentioned blotting, copying, India, Japan, manifold, parchment, rice, sand, safety, silver, sponge, and tracing paper; among converted papers are carbolic acid, carbon, emery, glass, gold or gilt, oiled, photographic, satin, silver, and test paper. Coated paper, safety paper, and tracing paper are sometimes subjected to treatment by converters.

CHAPTER V

PENS AND LEAD-PENCILS

THE quills of geese and crows were probably employed as writing instruments as early as the first century A. D. Quills are obtained principally from the wings of the goose, although the wing-feathers of the swan and some other birds are used. During the middle ages the quill was the writing implement universally employed, and it continued to be the favorite instrument until the introduction of the steel pen in the nineteenth century. The best quills were prepared in Russia and Holland. Writers sometimes made their own pens from prepared quills, but the art was a very difficult one to acquire. To prepare quills, they are sorted, clarified in hot sand, and divested of the outer skin; they are then dipped into boiling alum water or a boiling solution of diluted nitric acid, which gives the necessary degree of hardness. Some writers still prefer quills, and these articles can be obtained from the large stationers.

Quill pens.

Experiments with other materials.

In order to furnish an instrument more durable than the quill, experiments were made with horn, tortoise-shell, glass, steel, silver, and gold, resulting in the adoption of steel as the most satisfactory substance. The glass pen was merely a ground stick. Horn and shell softened under the action of the ink, and silver pens, although thought to be a success, were finally abandoned because of a failure to temper them properly and their liability to wear at the point. Quills were also pointed with metal, and pens of horn and tortoise-shell sometimes had small pieces of hard gems embedded in them, or bits of gold attached to the points; such pens, however, were too costly to become articles of common use.

Metal pens.

Metal pens were evidently used to some extent by the ancient Romans. A bronze pen, nibbed like a modern steel pen, was discovered at Pompeii, and is now preserved in the museum at Naples; another pen of the same material was found at Herculaneum. Bronze and silver pens were sometimes employed in the middle ages; but these and all metallic pens of dates prior to the nineteenth century, were never in general use, and may be regarded in the light of curiosities.

Steel pens.

The honor of the invention of making steel pens from sheet-metal has had many claimants, but the first manufacturer of these articles is really unknown. It is said that Arnoux, a French mechanic, made metal pens with side-slits in 1750. The earliest English steel pens, of the manufacture of which we have any positive knowledge, were those made for Dr. Priestley, by Mr. Harrison, split-ring maker of Birmingham, towards the end of the eighteenth century. They were made of sheet steel, in the form of a tube, and were filed into shape, the slit being made by the joining of the metal. Brass pens were in use in England before the close of the eighteenth century. Barrel pens of steel were sold in London in 1803, but they were too high in price for the general market. In 1808 the first English patent for the manufacture of steel pens was granted to Bryan Donkin. In America the first patent for the manufacture of metallic pens was obtained in 1810 by Peregrine Williamson of Baltimore. Mr. James Perry made steel pens at Manchester in 1819, using the best Sheffield steel. Afterwards he removed to London and continued his experiments in the production of better pens. In 1830 Perry took out a patent for improvements. Joseph Gillott began experiments in 1821. The improvements made by these two manufacturers, Perry and Gillott, put on a permanent basis the steel-pen industry, and the introduction of machinery by the Birmingham manufacturers, Gillott, Mason, and Mitchell, enabled pens of this metal to be sold cheaply and to become the common writing instrument. It was not until 1845, however, that the quill was generally superseded, in Europe and America, by the steel pen. The Asiatic peoples still use reeds or camel's hair pencils.

From the sheet of steel to the varnishing, the last stage in the manufacture, seventeen main processes, besides minor operations, are included in the making of a steel pen.

Steel pens are manufactured chiefly in Birmingham, England. France and Germany have several manufactories, and in the United States, there are about half a dozen, situated in New Jersey, New York, Pennsylvania, and Connecticut.

Gold pens.

In England the first gold pens seem to have been produced in 1825; in the United States, about ten years later. As gold is too soft a metal to afford a durable point, it is necessary to tip the pens with a harder substance. Diamonds and rubies were at first attached to the points; gold pens are now usually tipped with a native alloy of osmium and iridium. The iridium was formerly soldered to the gold, but about 1850 it was discovered that better pens could be produced by embedding the iridium in the gold. From the gold bar purchased from the United States Assay Office, already alloyed, to the finished product, gold pens pass through at least forty-five different processes. As they are so costly, it is absolutely necessary that every pen should be perfect, therefore only experts are allowed to test them before they are put on the market. At least four in a dozen are rejected under this scrutiny.

Although the steel pens of Great Britain surpass those of the United States in quality of metal and workmanship, the latter country stands first in the manufacture of gold pens, and sends these articles to Great Britain and other European countries.

During the first half of the present century, various experiments were made to produce self-feeding pens, but it was not until about 1879 that they were made to operate successfully. The fountain pen, as usually constructed, consists of a tubular holder tightly closed at its upper end. At the lower end is inserted a nib pen of gold,

Fountain pens.

with an ink-feeder near it, to draw the ink from the reservoir. The admission of air at the lower end secures a constant automatic feeding by means of capillary attraction between the feed-plate and the pen. The principle of the fountain pen is the retention, by atmospheric pressure, of a sufficient quantity of the fluid to serve for several hours of continuous writing, thus preventing the interruption caused by constantly dipping into an ink-well.

Lead-pencils. The first pictures were probably traced with lumps of colored earth or chalk, cut in such forms as could be conveniently held in the hand. As early as the fourth century B. C., artists in Greece used wet colors which were applied with fine hair-brushes. Some of the papyri and other early documents were ruled with ordinary metallic lead. In the early years of the nineteenth century, pencils called "plummets" were still made of soft lead hammered into form. At the present day graphite, also known as plumbago or blacklead, mixed with soft clay, is the material generally employed.

It is not known when pencils of graphite first came into use, but it is probable that they were employed by the middle of the sixteenth century.

In that century a mine of very pure graphite was discovered in Cumberland, England, and was famous for a long time as the Borrowdale mine. This mine has been exhausted since 1850, but while the supply lasted pencils were made of the native graphite as taken from the mine. After this source failed, graphite was hardened by an admixture of clay, both substances being finely subdivided and purified. This method was introduced at the close of the eighteenth century by the Count of Paris.

The Borrowdale mine.

At the present time, lead pencils are made as follows: Graphite, finely ground and freed from all grit and impurities, is mixed with clay to give it hardness. The mixture is spun through dies by pressure, and the leads are cut into the required lengths. The strips are baked to render them strong and are afterwards placed in grooved cedar slabs. The slabs are fashioned by machinery into pencils and are finished in any style desired.

The method of making lead-pencils.

Colored pencils are made of colored pigments and wax. They are manufactured in about the same way as black pencils, except that, owing to the nature of the materials, they cannot be subjected to the baking process.

The great pencil factory of the Faber family was established at Nuremberg in 1761, and the manufacture of black and colored lead-pencils is still extensively carried on there. Pencils are also made in the United States and in France and Austria. The cedar is obtained largely from the forests of Florida and Bohemia.

CHAPTER VI

INK

VERY little is definitely known of the composition of ancient inks. The black liquid of the cuttlefish was employed in the early ages as a writing fluid. As the ancients used the stilus they must have had also carbon inks similar to the inks still employed by the Asiatic peoples. According to Pliny, Dioscorides, and other ancient writers, carbon in the form of soot was the principal ingredient of the inks of their time. The soot was mixed with a mucilaginous or adhesive fluid, with an acid sometimes added to make it bite or sink into the papyrus. The use of iron salts seems also to date from a remote period. Ancient inks.

The term *ink* is applied to two distinct conditions of coloring matter: the one a fluid to be used with the pen or brush; the other a glutinous or adhesive mass, such as printing-ink.

The common ingredients of black ink are nutgalls, sulphate of iron, and gum arabic, the first two being chemically combined. The galls are first crushed, then extracted with hot water, with cloth filters, in vats made for the purpose. These Black ink.

filters separate the clear solution from the woody and gummy residue. The galls are allowed to steep for a week or more, until the solution becomes sufficiently concentrated. This liquid is then mixed with a solution of copperas, and to this mixture are added free sulphuric acid, the indigo and aniline blues, a solution of gum arabic, and an antiseptic, usually phenol (termed carbolic acid) or salicylic acid. The gum keeps the ink from spreading on the paper, and thus enables the writer to make fine strokes with the pen. The acid gives to the ink greater fluidity, and also prevents the formation of solid particles of iron tannate, and precipitation in the vessel. The antiseptic is added to keep the ink from moulding.

Color is given to ink by the addition of indigo-carmine and some aniline blue. True fluid inks containing a blue coloring matter were first made in 1856, by Stephens of London. He employed only the indigo, as aniline blue was not then known. The color of the ink is at first a deep blue, turning to black after writing.

The yellow appearance of old writing is due to the decay of the vegetable matter, mere rust or peroxide of iron being left. Such writing can be rendered blacker and more legible by the use of prussiate of potash and dilute hydrochloric or sulphuric acid, or by the infusion of galls. Very ancient manuscripts have been thus restored. A work on Roman Law, by Gaius, was deciphered by applying an infusion of galls.

Printing-ink.

Printing-ink is a mixture of boiled oil and black or colored pigment. In black ink, the pigment is lampblack or other carbonaceous matter. To these chief ingredients, are added rosin, turpentine, and common yellow rosin soap.

Colored inks.

Inks may now be manufactured of almost any color. The introduction of the coal-tar or aniline dyes has added greatly to the variety and richness of colored inks. Formerly, red ink was made of either cochineal or Brazil-wood. Cochineal inks are deep and rich in color, but are expensive. They are undesirable because of the amount of caustic ammonia necessary to dissolve the cochineal and keep it in solution. Solutions of coal-tar colors have supplanted the more expensive Brazil-wood and tin-salt red inks. Crimson, scarlet, and red inks are the common names of these solutions. The coloring matter known as eosin[1], discovered by Caro in 1874, is now gen-

[1] Eosin is derived from the Greek, and means "dawn of the morning."

erally employed to produce these inks. Writing in an eosin ink copies easily, but when exposed to a strong light soon fades.

India ink or China ink.

India ink contains the same ingredients as the inks of the early ages and is the form in which ink is still made and used in China and Japan. In these countries it is used with a brush, both in painting and writing. It is made from lamp-black and a glutinous substance. In India ink the carbon is held suspended in the fluid and is not dissolved or chemically combined, as are the iron compounds in writing-inks. A perfume, such as a mixture of Borneo camphor and musk, is added to the finer varieties. This ink is prepared in the form of cakes or sticks, which are rubbed down in water when used. Fluid India ink can be purchased in small quantities. Various depths of shade can be obtained, according to the degree of dilution with water. India ink is seldom used for ordinary writing, but is employed by engineers, architects, and artists, and for special purposes. It is blacker than other inks and is largely employed in photo-illustration, which requires a really black ink to produce the best effects.

Writing in sympathetic inks becomes visible only when brought out by heat or the influence of some chemical reagent. Among the substances used are solutions of cobalt acetate, cobalt chloride, and nickel chloride. The hydrous cobalt salts are of a pale pink color which is invisible on the paper; when heated they become anhydrous and turn blue.

Sympathetic or invisible ink.

Indelible inks are used for marking textile fabrics, and become a deep black when the material is exposed to the direct rays of the sun. The ink generally used for this purpose is an ammoniacal solution of nitrate of silver. The stain produced by the ink cannot be removed by any reagent that would not also destroy the texture of the fabric.

Indelible ink for marking textiles.

Copying ink is more concentrated than the ordinary writing fluids. It contains some soluble substance, such as gum arabic, sugar, or glycerine, which does not make the ink copy but which prevents it from drying too rapidly or too thoroughly. When paper written upon with copying ink, is placed against a moistened sheet, a part of the ink is transferred to the wet surface, making a reverse copy. Translucent paper is used for taking a copy. It is turned over so as to bring the letters into their normal position and the writing is read from the upper side.

Copying ink.

Sepia.

Sepia is a dark-brown coloring matter obtained from the ink-sacs of a few species of cuttle-fish, principally from *Sepia officinalis,* which is abundant in the Adriatic and the Mediterranean Seas. As soon as the animal is captured, the ink-sac is extracted and at once dried to prevent putrefaction. The contents are afterwards powdered, dissolved in a solution of ammonia or soda, and then precipitated by neutralizing the alkali with hydrochloric acid; the precipitate is washed with water, dried, and is then ready to be made up into any desired form. Sepia is used by itself for drawings; in combination with other colors it affords various subdued tints. The color is permanent unless exposed to sunshine. Sepia also furnishes an India ink.

Removing ink stains.

The reagent to be used depends on the kind of ink which has produced the stain. The stain should first be dipped into water to ascertain the nature of the ink. Aniline inks spread more than other inks, and become greenish in color; iron and logwood inks turn brown. If this test shows the ink to be nigrosine (made from a coal-tar color), the stain should be treated with an alkali. To remove an iron or a logwood ink, an acid should be employed. Muriatic acid will remove logwood ink stains, but should not be used for an eosin (red) or a nigrosine ink. Oxalic acid will efface the stain of an old style iron-gall ink. In general, aniline inks can be removed by the use of an alkali; those failing to be affected by an alkali, should be treated with an acid.

An effective way to remove an ink stain is to cover the spot first with bleaching-powder; when this is moistened with a weak mineral acid the chlorine will be set free. Strong acids and alkalies must not be used on colored or very delicate fabrics.

Ink should always be kept in a covered vessel, as it becomes thick when left standing in an open receptacle, owing to the evaporation of the water. When ink contains much gum, it assumes a ropy condition and a sediment is formed in the vessel. When the solution has become too concentrated, it may be diluted with distilled water.

BOOKBINDING

BOOKBINDING

CHAPTER I

ANCIENT COVERS—EARLY BINDINGS

THE earliest attempts to enclose written matter within some kind of a cover were made long before the Christian era. The object at first was merely utility, or the preservation of the writing by protecting it from injury. The ancient peoples of Assyria and Egypt devised simple means of encasing their documents, and to the efforts thus made may be traced the origin of the art of bookbinding.

Attempts of ancient peoples to enclose writings.

The Babylonians and Assyrians sometimes enclosed one clay tablet within another, the outer case forming a cover for the inner. The outer coating of clay contained an exact copy of the original, and rendered the latter inaccessible to forgers.

Babylonia and Assyria.

In Egypt sheets of papyrus were glued together to form one long roll. The papyrus roll, as a rule, was written on one side only, and was fastened to a wooden rod or roller, around which it was wound.

Egypt.

The old Greek and Roman books were also scrolls of papyrus resembling the ancient Egyptian manuscripts. The rolls were often beautifully written and richly decorated; they were frequently protected by covers, which were made of leather or parchment, dyed purple, yellow, or scarlet. Two strings of leather or ribbon were attached to the last sheet or the cover of the manuscript, and were fastened around the roll to keep it tight and firm and to protect it from dust and insects. The title was either written on a square piece of vellum or parchment, pasted on the outside of the cover near the top, or inscribed on a label attached to the roll. The ends of the rod were sometimes level with the edges of the papyrus, sometimes they projected beyond the roll and were ornamented with balls or knobs of wood or ivory, or even of gold or precious stones. In appearance such a scroll was not unlike a modern map, and in this form it was passed from one person to another to be read.

A Greek or Roman roll.

While the roll was the form adopted by the Greeks and Romans for lengthy works of a literary character, for a long time they made use of pugillaria, or, literally, *hand-books*. These tablets, or table-books, were of ivory, wood, or metal,

Pugillaria.

covered with a thin layer of wax, and were connected at the back by rings; they consisted of from two to eight leaves, and were employed for taking notes, keeping accounts, etc. Small leaden volumes have been discovered composed of six or eight leaves joined at the back by rings. The square form proved so convenient in the tablet that it was finally adopted for almost every kind of writing. The introduction of covers consisting of separate leaves is credited to Eumenes II., King of Pergamum, but the flat book seems to have been used earlier than his reign (197–159 ? B. C.).

Introduction of the flat book.

The term *codex*, which originally meant the trunk or stem of a tree, was applied to these wax-lined wooden tablets. The name was given also by the Romans to the folded parchment volume, more especially to account-books. For literary compositions, the term was first applied by Christian writers to the sacred Scriptures. It was occasionally employed by secular writers at the end of the third century, but was not generally used until the fifth century. The name has been retained to designate the more important ancient manuscripts.

The codex

The square form of book was even more beau-

Decoration of the square book.

The diptych.

tifully decorated than the manuscript roll, as it lent itself more readily to the embellisher's art. Carved figures were generally placed on the diptych, the name applied to a two-leaved tablet of large dimensions used by consuls and other functionaries. The Roman consular diptychs are considered important works of art, those discovered dating from the middle of the third to the middle of the sixth century. In later times the ivory panels of the diptychs were often transferred to the covers of valuable manuscripts; owing to this practice, many fine specimens of sculptured ivories have come down to the present time.

Roll superseded by the folded volume

In the fourth century of the present era, the roll was gradually superseded by the folded volume. The use of the flat form of book, with its decorated and often sumptuous cover, was due, in a great measure, to the influence of the Christian religion. It was the custom, in these early days of the Church, to keep a copy of the Gospels on the table or altar; and for this purpose and for reading certain portions of the Scriptures during the service, the book was found much more convenient than the scroll. As the ritual advanced the covers of the volumes were decorated in a style to accord with the rich furniture of the altar. Only the front of the book could be seen as it lay upon the table, therefore only the upper side of the cover was ornamented, the reverse being left plain.

From the beginning of the art of bookbinding, the first portion of the work, known in modern times as the forwarding, has always been substantially the same. The sheets were stitched together in their proper order and were attached at the back to leather bands, which extended about an inch beyond the edges of the book; the ends of the bands were fastened to wooden boards which formed a cover for the sides of the volume; the back and exterior surface of the wood were covered with skin or leather, the margins being turned over the edges of the board, and glued down on the inside. Since the fifteenth century, the principal changes have been the substitution of cords or strings for leather bands, of pasteboard for the heavy wooden sides, and of paper or cloth for the leather covers.

Process of binding.

Before the sixth century precious stones began to be used in the decoration of covers. Byzantine coatings were chiefly of metal,—gold, silver, and copper-gilt,—into which jewels were introduced. An ivory carving was often placed in the centre, with a border of gold and jewels around it.

Precious stones.

We find that in the middle ages bindings and the works they contain often belong to quite distinct periods. Bindings made originally for small volumes have been used at a later date as the centres of larger covers and surrounded with borders. When the covers were veritable works of art, decoration was frequently added in subsequent periods, hence it is often difficult to fix the date with certainty.

Monastic bindings.

During the middle ages the monasteries were the principal depositories of learning and art. The monks not only wrote and illuminated books, but also bound them, and continued to follow the calling until the introduction of printing. The bindings of the books made by the monks were oaken boards, often an inch thick. Ornaments of precious metal were sometimes placed on the boards themselves. When the boards were first covered, skins of animals were used, the favorite skin being stag-hide; common parchment and vellum were also employed. Roughly-dressed deerskin or calfskin was sometimes drawn over the boards, with the hair left on the cover, enough of the hair being removed to give space for an inscription. The corners were protected with large bosses of brass.

The covers were often embellished with ivory carvings of figures in relief, and garnished with gold, silver, and precious stones; they were generally fastened with a strong clasp of brass, on which the arms of the owner were sometimes engraved.

In monastic bindings the sheets were sewed on pieces of skin or parchment; each sheet was protected internally and externally with a slip of parchment, to prevent the thread, used in the sewing, from cutting the paper, and to protect the back from injury.

During the middle ages there were in most European cities secular craftsmen, such as the leather-worker, the goldsmith, the sculptor, and the worker in enamel; the labors of all these workmen were sometimes combined in the production of a single cover; the bookbinder probably labored at other trades similar to his own. At a later period the bookbinders became members of various trade guilds; the monasteries, however, still exercised a fostering care over all the arts.

Of these books of the monks, very few examples remain. The boards which formed the basis of the binding, instead of protecting the manuscripts often led to their destruction; they became a lodgment place for worms, and the grubs in process of time found their way to the pages and riddled them with holes. The revolutions and reformations which at different periods have convulsed Europe have, besides, swept away the greater number of such volumes as had withstood the ravages of time; those that remain are priceless as relics and are, with few exceptions, deposited in the great libraries of Europe.

For a long time, velvet was used to cover the best works; colored cloth was also so employed. During this early period great progress was being made in the art of working on leather, especially in Germany. The Germans produced many beautiful stamped-leather bindings, ornamented with metal clasps, corner-pieces, and bosses. Augsburg and Nuremberg were famed for this kind of work. It was brought to such a high degree of excellence by the German artists that in richness it rivaled the goldsmith's work.

Stamped-leather bindings.

In Spain and Italy bookbinding also flourished before the fifteenth century. The city of Siena has a magnificent collection of bindings, extending from about the thirteenth to the seventeenth century. The covers of the Treasury books there preserved, and which have been framed, are adorned with paintings by famous artists. The binders of Italy excelled in beautiful ivory, gold, and jeweled covers, also in fine leather work.

In France, during this period, nothing remarkable seems to have been achieved in the way of bookbinding. From the inventories of libraries and of goods and jewels belonging to kings and nobles of the fourteenth and fifteenth centuries, we glean some information as to the bindings of their books. The covers were of velvet, silk, embroidery, and leather, and were adorned with ornaments of metal and sometimes with precious stones.

Enameled covers.

In the eleventh century enameling begins to appear in the decoration of covers. In the Cluny Museum at Paris, are two magnificent plates of Limoges enamel, which have evidently been taken from the cover of a book.

CHAPTER II

MEDIEVAL BINDINGS

Patronage given to bookbinding.

IT was chiefly owing to the patronage of the wealthy and of lovers of books that progress was made in the art of bookbinding. Patrons of literature existed not only in Italy, but in Western Europe and England. Bookbinding as a fine art began in Italy during the Renaissance, but was most highly cultivated in France.

Hungary—Mathias Corvinus.

Mathias Corvinus, King of Hungary, who died in 1490, ranks among the first patrons of the art during this early period. He had a library of fifty thousand manuscripts and books, encased in the most costly and magnificent bindings. This library was destroyed in 1526, when Solyman II. laid siege to Buda. Only a few volumes escaped the ravages of the Turks, and the greater number of these were placed in the Imperial Library at Vienna.

Italy—The Medici family.

In Italy literature flourished under the patronage of the Medici family. Their books seem to have been embellished without regard to expense.

The works collected by Piero de' Medici (1464–1469) are decorated with miniatures, gilding, and other ornamentation, and are distinguished by the fleur-de-lis. Those acquired by Lorenzo (1469–1492), called the "father of literature," are also encased in bindings of great elegance; they are stamped with the Medicean arms and with a laurel branch, in allusion to his name *Laurentius*, and bear the motto "Semper."

The lavish use of ornament in the binding of books was carried into the sixteenth century. One of the most famous libraries of the time was that of Cardinal Mazarin, in his palace on the Quirinal Hill at Rome; it contained five thousand volumes, "bound by artists who came express from Paris."

Cardinal Mazarin.

In Spain encouragement was given to the art by Cardinal Ximenes, Confessor to Queen Isabella, and Philip II. (1556–1598). Saragossa and Seville produced many beautiful bindings, but few have been preserved to the present day.

Spain—Cardinal Ximenes and Philip II.

The libraries of Germany contain bindings of almost every age and description.

After the introduction of the printing-press, the work of the binder increased and became more important, hence arose a distinction which remains

Trade bindings and special bindings.

to the present day,—trade bindings and special bindings. The special bindings were made for great collectors, or for presentation purposes.

During the first hundred years in the history of typography, the printer was generally a stationer and also a binder, and if he had registered as a bookseller, he sold the volumes he had bound. These early productions are distinguished alike for beauty of typography and thoroughness of workmanship. Many books bound from four to six hundred years ago are now in almost as good condition as when first issued.

In France, Germany, and the Netherlands, the bookbinders enrolled themselves in guilds; they were constantly training new workmen and raising the standard of their art.

During the fifteenth and sixteenth centuries leather bindings appeared in great numbers. As early as the twelfth century there was a distinct English school of binding which produced beautiful tooled-leather work. The sides of the covers were ornamented with small dies cut in intaglio, so that the impression on the leather was in cameo, or in relief. Some of the early designs represent men, birds, beasts, and fishes; the figures, though grotesque, are full of expression and ani-

Leather bindings.

mation. The die-sinker often copied the wild creatures inhabiting the woods and wastes, with whose habits he had long been familiar. Among other subjects were angels, ecclesiastics, knights on horseback, fabulous beasts, and conventional leaf and flower ornaments.

The panel-stamp.

In the Netherlands large panel-stamps appeared about the middle of the fourteenth century. It is not known, however, to whom they owe their origin. By means of the panel-stamp the whole of the side of a small book could be decorated from one, or at most from two blocks. A century later, when many books of small size began to issue from the printing-press, this quick and easy method of ornamentation was generally adopted in the Netherlands, France, and England.

William Caxton's bindings.

William Caxton, who returned from Bruges to England in 1477, combined the art of binding with the printer's craft. The greater number of his books which have come down to us have been rebound, but a few still retain their original covers of brown stamped leather.

In French bindings we find many panel-stamps of great beauty.

The heraldic stamp.

Early in the sixteenth century the bookbinders of London adopted a pair of heraldic panels for their covers. One contained the royal arms supported by a greyhound and a dragon; the other a large Tudor rose, supported by angels, and a motto. Under the rose or royal shield, the binder sometimes placed his initials. All volumes bearing the arms of kings and queens have not, however, at some time belonged to the royal library. The arms probably represented some privilege or were the sign of some guild. John Reynes, a famous London printer and bookbinder, employed two varieties of heraldic panels, and in his case they represented special privileges.

The pictorial stamp.

The pictorial stamp is not so often found in English books as the heraldic stamp; it is probable that the greater number of pictorial stamps used in England were imported from the Continent. The service-books brought from France and the Netherlands into England, early in the sixteenth century, bear the figures of certain saints, the most usual being St. Catherine, St. Barbara, St. Nicholas, and St. John the Baptist; St. Michael and St. George also occur in these early panels.

The roll-stamp.

Books of large size, which could not be readily decorated with panel-stamps, were ornamented with roll-stamps. With the introduction of the roll, began the rapid decline of stamped binding. At first the rolls were broad, measuring about an inch across, and produced a handsome effect; this ornamentation, however, gradually became smaller, until at the end of the sixteenth century it was little more than a scroll; in the seventeenth century it appeared indented as in gold-tooling.

Embroidered book-covers.

Many examples of embroidered book-covers are found during the middle ages; the greater number of the embroidered bindings in the British Museum, however, are of the seventeenth century; in the sixteenth century they were often used for books of devotion and for presentation copies. The embroidery was worked on a foundation of velvet, satin, silk, linen, or canvas; the materials used were colored silks, wool, worsted, thread, gold and silver wire, seed pearls, and metallic spangles. The ladies of England produced embroidered covers of remarkable beauty, and those of France, Spain, and the Netherlands also did excellent work.

Tooling.

By tooling is meant impressions made on leather by hot metal dies. When gold is thus impressed, the work is termed gold-tooling; when leather is stamped without the use of metal, it is called blind-tooling.

In Europe gold-tooled binding was first known in Italy, where it had been introduced from the East by means of Venetian commerce, probably during the latter part of the fifteenth century. It afterwards became distinctively a French art. This method of ornamentation seems to have been introduced into England in the sixteenth century, in the reign of Henry VIII. (1509–1547), by Thomas Berthelet or Bartlet.

Aldus Manutius.

In Italy Aldus Manutius (1449–1515) did much to reform European bookbinding. He began to organize his printing-office in Venice about 1489, and afterwards gathered around him artists and learned men both from the Levant and from Western Europe. To the Academy that he established came Hans Holbein, Geoffroy Tory, and other artists, who carried back to Germany, France, and England the methods they had learned in Italy. Among the friends of Aldus were Tommaso Maioli and Jean Grolier, the famous booklovers. Aldus covered his volumes with vellum or leather, usually without decoration; his earliest bindings and those intended as gifts to friends and patrons were ornamented with gold-tooling. This great printer died in 1515, but the press was continued by his family for some time afterwards.

Two of the most distinguished book-collectors the world has ever known were TOMMASO MAIOLI and JEAN GROLIER.

Maioli lived in Italy in the first half of the sixteenth century (*c.* 1500–1549). He belonged to a family of book collectors; Michele Maioli, supposed to be either his father or his uncle, was a scientific writer and also a collector. The Maioli bindings are generally in good taste. The leading features of the ornament are broad lines edged with gold, either curiously interlaced, or running in graceful curves; slender sprays of conventional foliage and numerous dots of gold lend elegance to the designs. The scrolls and foliage are often in white, edged with gold, placed on a dark background of leather. **Tommaso Maioli.**

Jean Grolier de Servin, Vicomte d'Aiguise, the great French bibliophile, lived from 1479 to 1565. His library was noted for its beautiful bindings. It is said that many of his books were bound in his own house, under his own eye, and that he often put his own hand to them. It is probable that some of his volumes were bound for him in Italy, during his residence there. Grolier became Minister of Finance to the kings of France, and spent much time in Italy, either in military com- **Jean Grolier.**

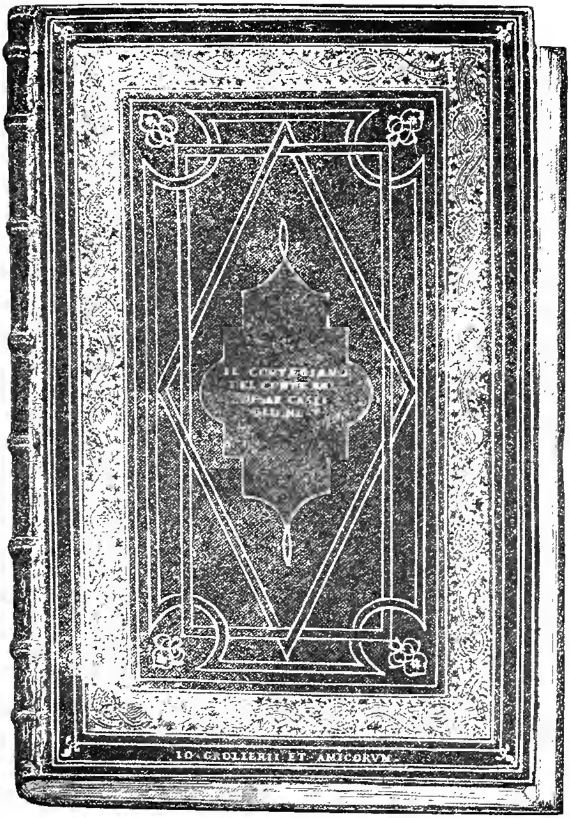
mand or as an ambassador. In Venice he made the acquaintance of Aldus and of the artists and learned men of his Academy; he continued to patronize the Aldine press during the remainder of his life. In the leisure of his official functions, he sought out new combinations and interlacings for his bindings. Grolier, however, was not a binder but an amateur possessed of exquisite taste and with abundant wealth to indulge it.

It was the practice of book-lovers to offer the enjoyment of their libraries to their friends. Both Maioli and Grolier placed inscriptions or mottoes upon their books. One of the most usual employed by Grolier was "Io Grolierii et Amicorum."

To Grolier is ascribed the introduction of lettering-pieces on the backs of books and placing volumes on the shelves with the backs outwards. He is credited also with having been the first to use morocco leather for binding.

Cameo bindings.

Cameo bindings originated in Italy, in the early part of the sixteenth century. The real cameos were copies of antique gems and medals, made of a sort of lacquered paste, and were glued into a depression on the side of the cover; the French imitated this mode of decoration by simply



GROLIER BINDING.

[From "Bookbindings Old and New," Brander Matthews. By permission of Mr. Matthews and the Macmillan Company.]

stamping the leather in relief. Examples of Italian cameos are those found on the books once belonging to the library of Demetrio Canevari; the subject of the central oval stamp, which is in gold, silver, and colors, being invariably Apollo driving his chariot over the waves.

CHAPTER III

MEDIEVAL BINDINGS—MODERN BINDINGS

The Eves.

THE Eves were a family of binders who worked for the kings of France from about 1578 to 1631. Nicholas, the first, is said to have bound books about 1565, for the famous mistress of Henry II., Diane de Poitiers, who possessed some of the most beautiful bindings ever produced. In the Eve style of work the compartments of the geometrical designs are surrounded by scrolls or spirals and branches of palm and olive. In their earlier work the designs were graceful, but the compartments were not filled in; after a time their binding became very elaborate, and they finally abandoned the geometrical designs altogether, using only the wreaths and palm branches. The name *fanfare* was afterwards given to this flourishing style of ornament.

Oxford and Cambridge Universities.

The bindings of Oxford and Cambridge Universities were distinguished for superior workmanship, although they were not noticeably artistic.

The materials adopted by Sir Thomas Bodley for the Oxford bindings were leather, vellum, and occasionally velvet. The later bindings of these universities are marked by improved taste and are prized by some modern collectors.

Fifteenth and sixteenth centuries.

In the fifteenth and sixteenth centuries binders continued to beat their books on a stone with a wooden hammer, to give them the proper solidity. They often made use of a slip of parchment around the end-papers and the first and last sheets, to protect the backs from injury and to strengthen the joint. Parchment or stout paper was used to strengthen the last leaf, as the inside lining of the boards, and sometimes for the entire binding of ordinary books; it is owing to this practice that, in later times, fragments of early manuscripts, before unknown, have been discovered; but many valuable works, thus applied to binding purposes, must have entirely disappeared. The sheets were sewed on strong slips of white leather, placed equally distant from each other, which form the four, five, or six raised cords or bands seen on the backs of volumes encased in these early bindings. In these two centuries board covers of wood were still used, generally of oak or beech, but thinner than those of the preceding period. Three kinds of commercial bindings were known,—board, leather, and parchment. For the use of the noble and the rich, books were bound in more costly materials; for volumes of special interest or value, velvet was generally employed.

Sixteenth century.

In the sixteenth century wooden boards were finally discarded for pads of paper and sheets of cardboard. In this century the "plough," used to cut the leaves even, made its appearance.

In the sixteenth century bookbinding attained its highest degree of development on the Continent. For artistic taste and thoroughness of workmanship, it has never since been equaled. Beautiful covers were produced not only in Italy, Germany, and France, but in Spain and even in the Slavonic provinces of the East.

In the seventeenth century the French produced many fine bindings; in the eighteenth century their work retrograded. In Italy, during this period, the art was rapidly declining.

Jacques Auguste de Thou.

A famous collector, whose labors extended into the seventeenth century, was Jacques Auguste de Thou (1553–1617), who became keeper of the royal library under Henry IV. of France. His bindings were generally plain and substantial, the only ornament being a gold armorial stamp in the centre; for choice volumes he used an elaborate gold ornament in the fanfare style. His materials were red, green, and lemon morocco, fawn-colored calf, and white vellum.

Doublures.

The National Library of Paris possesses the earliest known example of a *doublure*, or inside lining of the cover of a book; it is an Italian binding of 1550. Florimond Badier, one of the binders of Louis XIV., is said to have been the first to make any extensive use of this innovation. Macé Ruette, who bound books for Louis XIII. between 1606 and 1638, is credited with the introduction into France of yellow marbled morocco and marbled paper. This marbled paper was sometimes used for the inner leaves of books, and almost universally for the *doublures*. The inside lining, as well as the cover, of fine volumes is often of leather, which is artistically decorated.

Le Gascon.

Le Gascon is regarded as one of the foremost of bookbinders. M. Marius-Michel thinks he may have been a pupil or an apprentice of the binders who worked for De Thou. He made use of graceful curved lines, formed by the repetition of countless gold dots or points, which produced a brilliant effect on the scarlet morocco ground.

Seventeenth century—England.

In England, in the seventeenth century, little encouragement could be given to the art because of the unsettled condition of the country, owing to the civil wars of Charles I., the influence of the Puritans, and the profligacy of the reign of Charles II., whereby the patronage of the wealthy was removed. Oaken boards were discarded, a thick but flimsy pasteboard being now used for covers; the bands of hempen cord were drawn through holes pierced through the boards. The process of beating books to produce solidity was still continued, and the sewing and backing were well done.

Eighteenth century—France.

In the eighteenth century bookbinding flourished in France, and we find a long array of names of those who practised the art. Among the distinguished binders were Padeloup, Derome, Le Monnier, Boyet, Du Seuil, Douceur, Anguerrand, and Dubuisson. The first two names represent each a dynasty; it is said that there were twelve Padeloups and fourteen Deromes, all booksellers and bookbinders. The most noted were Nicholas and Antoine Michel Padeloup and James Anthony Derome.

During the time of the Revolution and the First Republic, the art naturally sank to a low ebb. This period of degradation lasted until about 1830, when binders began to be inspired with higher ideals. Modern French work is characterized by perfect forwarding and finishing, but is lacking in originality of design. Among the names of celebrated modern binders may be mentioned Trautz, Bauzonnet, Purgold, Capé, Duru, Lortic, Hardy-Meunil, Belz-Niédrée, Thibaron, Thouvenin, Cuzin, Marius-Michel, and Léon Gruel; the latter two have written valuable works upon the history of bookbinding in France.

Eighteenth century—England.

In the beginning of the eighteenth century large and valuable libraries began to be established in England. As a consequence of the increased demand for books, more attention was given to their bindings. Morocco, russia, and brown calf were the chief materials used. The improvements seem to have been made more in the forwarding than in the finishing of the work. The subjects of the ornamentation of the covers frequently bore no relation whatever to the contents of the volume, and the tools were of the poorest design, without an attempt at conventionality.

Robert Harley.

The most distinguished collector of this century was Robert Harley, Earl of Oxford, whose library, known as the Harleian Collection, is now in the British Museum. The books are bound chiefly in red morocco, with a broad border of gold round the sides, some having also a centre ornament.

The sawn back.

The sawn back is considered to have been introduced in the middle of the eighteenth century, but there is evidence of the use of something of this kind in the middle of the sixteenth century. By this method the bands are let into a groove in the backs of the sheets, and no projecting cords are seen, but the back is not flexible. It is not known just where this process was first employed, but the idea seems to have been derived from the Dutch bindings, the method was reluctantly adopted by the French and English binders. Raised cords were soon relegated to school-books. From the time of the introduction of the sawn back until the end of the eighteenth century, calf-gilt was generally employed for binding. The covers usually conformed to one pattern, having marbled sides, brown backs, and colored lettering-pieces. The open or hollow back was rarely used, and the back was made sufficiently stiff to prevent the leather from wrinkling when the book was opened.

Towards the close of the eighteenth century, bindings assumed an entirely different appearance, owing to the efforts of Roger Payne. He was the first binder who attempted to harmonize the decoration with the character of the volumes themselves. Payne worked upon straight-grained morocco, stained dark blue or bright red, and also upon russia leather; his favorite color seems to have been olive. His ornaments were chaste, beautiful, and classical. So far as possible, Payne did all the various processes of the work with his own hands. Unfortunately he was intemperate, but was given constant employment by the noble and the wealthy. Payne's best work went to the Spencer Library. His superior workmanship proved a stimulus to the trade, and introduced a chastened style of ornamentation among the binders of London.

Roger Payne.

Charles Lewis, who ranks among the best of English binders, was at the head of his profession between 1802 and 1840. Dr. Dibdin thus speaks of him: "The particular talent of Lewis consists in uniting the taste of Roger Payne with a freedom of forwarding and squareness of finishing peculiarly his own. His books appear to move on silken hinges."

Charles Lewis.

Francis Bedford, born in London in 1800, was considered the greatest binder of his time. His bindings are substantial and sober, but possess little originality or artistic merit.

Francis Bedford.

About 1830 the materials used in bindings of the fifteenth and sixteenth centuries began to be revived. Velvet and silk became fashionable for drawing-room table books. Modern bindings of velvet were adopted for many large libraries, among which were the collection of King George III. and the libraries of Earl Spencer, York Minster, and Ripon Cathedral.

Peculiarities in bindings.

Some peculiarities in bookbindings deserve special notice. In some instances the material of the cover was made to coincide with the nature of the book. Foxe's historical work was bound in *fox's* skin, and "Tuberville on Hunting," in *deerskin*, the cover being ornamented with a stag in silver. Eccentricities were carried even to the use of human leather for binding. It is said that M. Camille Flammarion, the great French astronomer, had a volume bound in the skin of a countess whose white shoulders he once admired, and who, on dying, made him the strange bequest of her integument, to be used as a cover for his work describing the world of stars. There are a number of other books in existence, said to be encased in this "human covering," so repugnant to every person of refined taste.

Improvements in machinery.

In England bookbinding has many patrons who have contributed much to the improvement of the art, and the number of master binders in London has, in consequence, greatly increased. Much of the success is due to the improvements in the machinery used, among which are the hydraulic press, the rolling-machine, the arming- or embossing-press, and numerous appliances heated by gas or propelled by steam.

Robert Leighton.

Robert Leighton was the first to adopt nearly all the machinery now employed in large binderies. He invented the backing- and trimming-machines, and was the first to employ aluminium and black and colored inks for cloth covers; he also introduced steam-power for embossing in gold. Many improvements to facilitate the work of binding have since been invented.

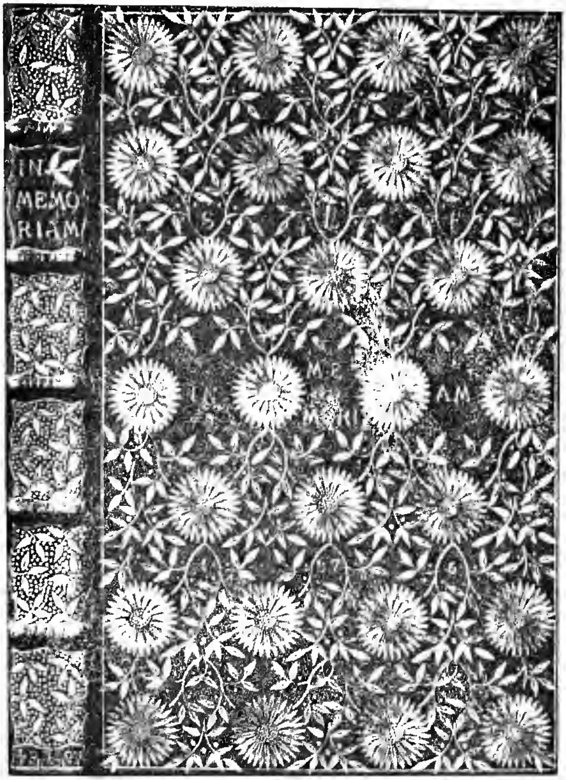
The Doves bindery.

On the Thames, between Chelsea and Chiswick, in a modest two-and-a-half-story house, is situated the famous Doves Bindery of Mr. Cobden-Sanderson.

Mr. Cobden-Sanderson.

Mr. Cobden-Sanderson is the most distinguished binder of his time. Believing handicraft to be the salvation of humanity and that a man should toil with his hands, he abandoned the bar, which he had chosen as his profession, and studied the trade of bookbinding. At first he did all the work with his own hands, the only aid being given by his wife, a daughter of Mr. Richard Cobden, who took charge of the sewing. He designs his own tools, which are cut especially for his use.

This master binder does not care to produce many covers, but it is needless to say that his best effort goes to each. Each design is thought out for the book itself, the decorative scheme being at times suggested by some representative passage of the author. Believing that "beauty is the aim of decoration, and not illustration or the expression of ideas," his bindings are decorative in character and not illustrative. Although the scheme of ornamentation may have been suggested by some passage in the book, we find on his covers no childish symbolism or mere labeling, which have no decorative value. His bindings are generally ornamented with conventionalized flowers which occur in geometrical precision. He studied the methods of Le Gascon, and probably from him derived the idea of imparting brilliancy to his designs by the free use of gold



COBDEN-SANDERSON BINDING.

[From "Bookbindings Old and New," Brander Matthews. By permission of Mr. Matthews and the Macmillan Company.]

points, stars, single leaves, and like ornamentation.

The work of the Doves Bindery is all done by hand on leather tooled in gold. Every detail is carefully thought out and executed in the most painstaking manner; nothing is slighted or hurried over. The decoration is put on, not by the single impression of a stamp, but is built up step by step; the books, therefore, bear the impress of mind and not of mechanism. Mr. Cobden-Sanderson no longer himself binds, but still designs; his assistants attend to the execution of the designs and the actual binding.

CHAPTER IV

COMMERCIAL BINDINGS

ALTHOUGH in edition work, many volumes have been decorated without regard to the principles of art, there has been an improvement in this direction of late years, and the designs occasionally attain a high degree of excellence. There must always be a difference between what is made by hand and what is produced by a machine; but a book-cover stamped by steam becomes pleasing to the cultivated taste when it bears the impress of a design which is truly artistic. Cloth binding, although originating in Great Britain, has been carried to much greater mechanical excellence by machines invented or improved in the United States.

The distinction between special bindings and commercial or trade bindings arose soon after the introduction of the printing-press. The early printers were binders as well as publishers; their books which have come down to us attest to the thoroughness with which they did their work. When every touch of gold on a cover had to be made by the separate impression of a tool, the process was necessarily laborious and expensive; consequently, very early in the history of the art attempts were made to simplify the work of the decorator.

The roulette.

Among the first tools adopted was the roulette, or roll. This contained a complete pattern engraved on the circumference of a wheel, the pattern reproducing itself as the wheel was rolled across the cover. The roulette was used for borders and frameworks.

Combination of engraved blocks.

The next device was the combination of engraved blocks to form a pattern in some degree appropriate to the contents of the volume. The binder kept in stock a variety of blocks of different sizes and subjects, sometimes related in pairs or in sets of fours; these he rearranged to form corners, centre-pieces, and panels, to suit his books as they were successively issued. He was obliged, however, at times to make use of the roulette and of handwork.

The engraved plate.

In order to dispense altogether with handwork, and thus quicken the production of books, one design was engraved for the whole side of a volume, and was stamped on the cover at a single stroke of the press. The Tory plate was complete in itself, but some plaques still left details to be filled in by the hand of the workman.

The roulette, the combination of blocks, and the engraved plate, were employed simultaneously for several centuries.

The early commercial binding was an attempt to reproduce artistic work done entirely by hand; modern commercial binding is no longer a mere imitation of handwork and is developing along its own lines.

Half-binding and three-quarter binding.

Half-binding had its origin in Germany, and is a money-saving device. In this method leather is used only for the back, with its necessary hinge, and the corners of the cover; a very deep back of leather with larger corners is termed three-quarter binding.

The English binders carried this economy still farther, and, dispensing altogether with the leather, covered with paper both the sides and the backs of their books. A volume thus sheathed in boards was not desirable, as the back was liable to crack and come off and the sides to break away. This method proving unsatisfactory, plain glazed calico was substituted for the paper; this was the beginning of cloth binding. At first there was no attempt at decoration; the title was still printed on a white paper label, which was pasted on the back of the book.

Cloth binding.

Cloth binding arose in England, and is said to have been introduced by Archibald Leighton in 1822. At first the binding had a "smooth-washed" surface, but about 1831 or 1832 embossed cloth came into use. The first volume of "Lord Byron's Life and Works," published in 1832, was bound in green cloth, and had a green paper label on the back, with the title and coronet printed on it in gold. When, in the same year, the second volume appeared, the title and coronet were stamped in gold upon the cloth, the label being omitted altogether. This is supposed to be the first work issued with the title printed in gold directly on the cloth. It is thought, however, that some volumes of a series of "Oxford English Classics" may have been so stamped before this "Byron."

Improvements in machinery.

Stamping, at first, must have been done by a hand-press, or an "arming-press," as it was called. The cloth was dyed to any desired color, and was run through rollers to give it the grain or texture that was wanted. Steam was soon used instead of foot-power, and other improvements enabled the binder to imprint the pattern on the cover in as many colors as could be employed to produce good work. Binding is now done with great speed; a modern bindery can turn out several thousand copies of a cover in twenty-four hours.

In artistic handwork the leather case is attached to the book, after which the ornamentation is added. In cloth binding, or edition work, the cover is made and decorated before it is affixed to the volume. In edition work the process is wholly mechanical, with the exception of the designing of the stamp.

Commercial bindings in the United States and Great Britain.

Although countless numbers of volumes have been clothed in undesirable covers, still much machine binding has been done which is chaste and beautiful. In the decoration of commercial bindings the United States seems to surpass Great Britain. For the higher class of books, the English still regard the cloth cover as a mere temporary case, each collector binding his books according to his own taste. In America, on the contrary, the cloth cover is more generally retained, and more attention is therefore given to the tasteful decoration of bindings. Among distinguished

American binders.

American binders may be mentioned Mr. William Matthews, the Bradstreets, Mr. Stikeman, and Mr. Otto Zahn.

CHAPTER V

FORWARDING

THE various processes employed in the binding of a book are known by the general term of *forwarding*. The decoration of the cover is called the *finishing*. In artistic leather binding, the book is covered and embellished by hand, each volume being treated individually. The method outlined in the following paragraphs is that employed in cloth binding, or edition work.

When the flat, dry sheets arrive from the printer, they are first folded by machinery, one fold giving four pages, two folds eight pages, three folds sixteen pages, and four folds thirty-two pages. Folding is seldom carried farther than this, as the constant doubling of the paper causes the sheets to be of unequal size.

Folding.

On the gathering table, the sheets are arranged in piles, in the order of the signatures, which are the figures or letters found at the foot of the first page of each sheet or section of the book. The girl who gathers begins at the last pile, and placing a sheet on her left arm, takes in due order one

Gathering.

sheet from each pile until she has formed one complete book. By another method, the girls sit around a revolving table, and as the piles pass, each girl takes one sheet from each pile. The book is then collated, or examined, to see that only the proper sheets have been taken and that none have been misplaced. Great care is required in collating books with insets, such as plates, maps, or a part of a sheet inserted when the whole sheet has been divided into multiples of threes, as in twelves, eighteens, and twenty-fours.

Collating.

Solidity was formerly given to books by beating them with a hammer on a stone or piece of iron; they are now rendered compact by the use of the hydraulic press or the signature press. When screwed down tightly, a volume is sometimes reduced to one-half its original size.

Pressing.

The next step is to prepare the book for sewing. If the sawn back is to be employed, grooves are made in the backs of the sheets. In flexible binding the cords are placed on the outside of the sheets; in the sawn back they are sunk into the grooves, and the book, consequently, will not be entirely flat when opened. The back is generally marked off by a pencil into six parts which are equal, with the exception of the lowest; this is made a little

Preparation for sewing.

longer than the others, because if it were of the same length, an optical delusion would cause it to appear shorter. The depth of the groove and the thickness of the cords depend upon the size of the book; if the cords are too large the book will not open well. The sawing is done by a machine.

Sewing.

A sewing-press is used to attach the sheets to the bands or cords. The sewer places the back edge of the sheet in contact with the cords, opens the sheet in the middle, and a needle and thread passing to and fro sews it to the cords. The thread passes twice as many times through the back of each sheet as there are cords, in order to twist the thread around each cord and to unite the cords and the sheet. The threads are all fastened to the cords and to each other. The stitch by which the thread passes from one sheet to another is known as "kettle-stitch."

Trimming.

After the end papers, or the papers which are to form the inside of the cover, are attached, the book is passed through the trimming-machine, to make the edges true. Many books are now left with uncut edges; in others the sheets are trimmed only at the top.

Gluing.

The backs are then glued. The glue holds the sections together, increases the strength of the volume, and keeps the back true during the processes of rounding and backing. The book, placed between two pieces of binders' board, is put into a press, with the back exposed; hot glue is applied to the back with a brush. The volume is then left to dry, no artificial heat being used.

Rounding.

Rounding is the next operation. The back is made convex, the front edges concave, the curve of the front corresponding exactly with that of the back. To round a book, it is hammered, and is changed from one side to the other until it has acquired the proper form. Books made with a flat back have a tendency to spring forward.

Backing.

A thin bevel-edged board is laid on each side of the volume, parallel with the edge of the back. The book is then put into the backing-machine, and receives the two ledges against which the sides of the case are to rest.

The hollow back.

To give a book a hollow back, a double layer of paper or cloth is inserted between the back of the cover and the back of the sheets, the outer layer being glued to the cover, the inner layer to the back of the sheets. As these layers are connected only at their edges, they form a hollow when the book is opened.

To strengthen the cover of a volume and also to give it a neat appearance, a headband is placed at the top of the back of the book. This may be of silk or cotton cord, or a strip of vellum or pasteboard. A similar band is often placed at the bottom of the volume.

The headband.

When books are to be either whole or half bound, that is when the outer surfaces are to be entirely covered or partly covered with leather, the boards are first attached to the book and the covers are put on afterwards. In cloth binding, or edition work, the boards are covered before they are added to the volume. The cloth is a special kind of cotton, woven for the use of bookbinders. By binders, the pasteboards which form the sides are known as the *boards*, the leather or cloth as the *cover*, and the two together as the *case*.

Whole binding.

Cloth binding.

In cloth binding, after the headband is attached and the lining paper put on the back, the case is pasted to the end papers placed at the beginning and end of the volume. In leather binding, either whole, half, or three-quarter, the cords or strings which are left to hang loose a little distance beyond the sides of the volume, are scraped thin and passed through holes pierced through the boards, and are fastened to the inner surface of the boards.

Fastening the book to the case.

Drying.

After the books are attached to the cases, they are laid in the press and left to dry. This requires from eight to ten hours. When dry, they are taken out, examined, and wrapped.

Case-making.

In case-making, the boards are first cut a little larger than the size of the sheets; the cloth is cut the proper size, somewhat larger than the boards, sufficient space being left between the boards to allow for the thickness of the book. Glue is applied to the inner surface of the cloth, which is turned over the edges of the boards; the case is then run through rubber rollers to make it smooth. To stamp the case, it is first sized, if this is necessary, after which gold-leaf is laid upon it. A workman, known as a stamper, feeds the cases into the embossing-press, which contains the die heated with live steam-heat. After the impression has been thus embossed, the loose gold is cleaned off, leaving the design in gold upon the case. Printing-ink is also used for stamping covers, the impression being given by a powerful steam job-press.

Stamping.

To decorate leather-bound books with lines of gold-tooling, the leather is first moistened with a mixture of white of egg and water; the gold-leaf is applied with a hot metal wheel, which leaves a line of gold as it moves across the cover.

The brass stamp containing the design for the side of the book sometimes consists of only one piece, the design having been made especially for the volume; but a pattern is often made up by combining a number of small dies.

Finishing the edges. The edges of books are sometimes cut smooth and left white. They are also finished in various ways, either by coloring or by gilding. To color the edges, a brush is dipped into a liquid containing some pigment, such as Venetian red or umber, and is struck lightly against a stick held over the unbound volumes. This is the sprinkling process, which causes a shower of spots to fall on the edges of the book. An even tint is given by dipping a sponge into the liquid and passing it lightly over the edges. Marbling is produced by a floating mixture of colors in a vat.

Coloring.

Gilding. In gilding, thin gold-leaf is applied to the edges before the case is fastened to the volume. The front edges, which have been made flat instead of concave, are first scraped perfectly even; they are then moistened with a mixture of white of egg and water; when the gold-leaf touches these damp edges, it adheres to them immediately. The mixture is sometimes made of black lead and thin glair. To burnish the edges, they are rubbed with a hard stone.

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