spreading the wet fibres formed almost perfectly round indentations in the finished paper, discernible only when the sheet is held to the light. When these drops do appear in paper there are usually several of them, of various sizes, as a rule near the corners of the sheets. There are also in some of the old papers ruffled or blurred "chain-lines," a slight imperfection not entirely absent in handmade papers of the present day (Figure 196). This blurring of either the "chain" or "laid" wire impressions was caused by the coucher having allowed the mould to slip, with its thin deposit of pulp, just as he was in the act of couching the sheet upon the felting. Another defect, encountered only in old paper, is a peppered appearance throughout the sheet, due to the knotting of certain of the fibres (Figure 197). It would hardly be possible to examine thoroughly any fifteenth- or sixteenth-century book without finding all of these imperfections represented in the paper. It is not unusual to discover embedded in old papers hairs loosened from the felt in the pressing process; or human hairs fallen from the head of the vatman or coucher. In the Paper Museum there is a piece of paper in which has been embedded a fifteenth-century mosquito, visible only when the sheet is held to the light. To pre-
In examining early printed books it will be noticed that in many instances the deckle or rough edges (Figure 198) have been cut away. In some cases this trimming was done before the paper was printed upon, as many of the old typographers no doubt regarded the deckle edges simply as necessary imperfections in the making of the paper. When the deckle edges were left undisturbed by the printer they often suffered at the hands of the binder, so it is more usual to find early volumes with cut edges than with the original deckles. The weapon with which the binder dealt the most deadly blows was the "plough," with which he cut away the margins, placing the printing in a false position on the page of the book, and often demuding the volumes of a portion of the very text. In binding, books were often trimmed to such an extent that a folio became a quarto, or a quarto an octavo, in size. Modern bibliographers usually catalogue these old volumes by measurement instead of by the paper. If a book was printed on a once-folded sheet, it would always be a folio, no matter how much a ruthless or ignorant binder may have cut it down. In the early printed books this trimming was possible as the margins were purposely left wide for the notes of the readers, so that a folio could have been reduced several inches without interfering with the text. The only way to arrive at the original size of an old volume is to examine the paper on which it was printed. In the paper-moulds the "chain-lines" invariably ran the short way of the sheet, and the "laid-lines" the long way, or from right to left as the mould was held in the hands of the vatman. In binding a folio volume the sheets were folded in the centre, the "chain-lines" running up and down, parallel with the fold. No matter if the margins have been trimmed off, it is always possible by this means to see that the volume was originally a folio. In a quarto the paper was again folded, so that the "chain-lines" ran across the page, from left to right. With an octavo the "chain-lines" ran up and down as in a folio.

Before me is a book from the Aldine Press, dated 1522, which was catalogued as an octavo, for its actual measurements (12 by 20 cm.) would indicate this size. Originally, however, the volume was a quarto, as the "chain-lines" in the paper run across the pages. On the other hand, the edition of Arbiterus de Bello Gallico printed by Nicholas Jenson in Venice in 1471 is usually, because of its large size, set down by the cataloguers as a folio, but in this book the "chain-lines" run across the pages, so it must be a quarto. This test holds good for a great many books, between octavo and folio. It can be relied upon because it is a natural test and is applicable to all books of Occidental origin.

The size of the largest paper used by William Caxton 2 was 15½ by 22 inches. This paper was used for two books only: the first and second editions of the Golden Legend (first edition finished at Westminster the 20th of November 1483; the second edition appearing soon after, but without date; printed in double columns, containing 464 folios). This size was probably found too large for convenient printing, as for all of the other Caxton books smaller paper was used, varying in size from 11 by 16 to 13 by 18½ inches. The average size of moulds used for making paper in Europe during the fifteenth century was about 14 by 19 inches; the largest sheets measured about 15½ by 26½ inches. These were convenient sizes for the mould-makers to fabricate and also for the paper-makers to form sheets upon; the larger the moulds, the more difficult they were to handle, as their weight when laden with the wet pulp, or stock, was far greater than would be imagined.

In Great Britain even as late as 1818 it was ordained by law that no newspaper should exceed in dimensions 22 by 32 inches. "So desirous were the publishers of newspapers at that time for a larger surface," wrote Charles Cowan 2 in his reminiscences of his early days in a handmade-paper mill at St. Mary Cray, Kent, "that an order for a large quantity of paper reached us, the size to be 22 by 32 inches, and the stationer stated that he would assume all risk of passing it through the Stamp Office." This would have given a surface of 731 square inches to each sheet instead of the statutory maximum of 704 square inches. About the largest surface of the fifteenth-century papers was 470 square inches, while a surface of approximately 235 square inches was the most common. The largest size of handmade paper that is fabricated at present is made in the James Whatman, Springfield mill at Maidstone, Kent, the sheet being termed "antiquarian" and measuring 31 by 53 inches, a surface of 1,643 square inches. 4 For making sheets of this giant size the mould is hung on a mechanical lifting device and six or eight men are required in the dipping and couching processes. It was at this renowned mill that the size of handmade paper known as "medium" (17½ by 22 inches) was first made two sheets on a
Fig. 199  The divided mould thought to have been first used in Europe in 1526 in the James Whatman mill, Maidstone, Kent. Aside from being divided by a wooden section in the centre, removable with the deckle, this mould is also divided into sheets of letter-paper size by "tearing-wires." The paper stock lies thinner along these wires and therefore may be torn with an edge resembling a genuine deckle. Each sheet of the eight formed at one dipping of the mould would have two genuine and two false deckle edges. The Chinese used divided moulds centuries before their use in Europe. See Figures 51, 52, 55.

Fig. 200  Through the action of the "tearing-wire" laced to the "laid" wires, this mould is capable of forming two sheets of letter paper at each dipping. Every sheet would have three genuine deckle edges and one false deckle edge. This manner of economizing labour is used largely in the making of stationery.

Fig. 201  The engraving of the city of Nürnberg from Schedel's Liber Chronicum of 1493. The group of five buildings at the right of the woodcut, outside the wall, was Ulman Stromer's paper mill, the first in Germany.

mould, a deckle running through the mould dividing it into two equal parts so that two sheets could be dipped and couched with practically the same effort as had been previously expended in making one sheet (Figures 199, 200). This was in 1526, and the innovation caused a split among the makers belonging to "the Original Society" which lasted several years. The section of artisans who were adverse to making two sheets of medium paper simultaneously on a mould called themselves the "Deckles," while those agreeing to make the paper in the new and novel manner were known as the "Stars." After a reconciliation of the two factions Mr. Balston, the owner of the Whatman mill, summoned William Grigsby, one of his workers and the leader of the Stars, who always wore on his jacket a ten-pointed star, denoting the number of vats in the mill, and gave him a sovereign for each point, bidding the vatman and couchers spend the money in jollification.

The first organized union of papermakers in England was

* See Figures 51, 52, 55 for the use of the divided mould in China.
founded in 1800, but as early as 1784 there was a strike among the workers in this craft. The earliest recorded labour dispute in a paper mill antedated the founding of the union in England by more than four hundred years. This strike occurred in the Ulman Stromer mill, the earliest papiererending establishment in Germany (Figure 201). In the Germanic National Museum, Nürnberg, there is a manuscript diary entitled: *Püchl von mein geslecht und von abenteuer* (Figure 202). This manuscript, begun by Ulman Stromer about the year 1390, not only is the first document in Europe relating to papiererending technique, but sets down an account of the earliest controversy between capital and labour in the paper industry. Ulman Stromer was a member of the senate that governed Nürnberg, and his mill was located just outside the western wall of the city, at the point where the Pegnitz River emerges into the fields. Previous to his papiererending venture Stromer had been a merchant, and on his journeys of trade to

Italy, where paper had been made since 1276, he had seen the craft practised. He was convinced that he would be successful with an establishment of the same kind in his native Germany, especially if he could secure a monopoly in this work. No one in Nürnberg was versed in making paper, so it was necessary that the erstwhile trader procure his artisans elsewhere. He set out to find several foreigners who were skilled in the craft of papiererending, and after considerable deliberation succeeded in inducing a number of artisans to leave their positions in Lombardy.

Ulman Stromer was at this time sixty-two years of age, and his experience in trading had made him keen and of a cautious disposition. After procuring the workers he forced them to swear to be loyal to him and to guard carefully the secrets of their craft so that there would be no likelihood of other mills springing up in Germany. Accordingly, Ulman Stromer wrote in his diary that Closen Obser, the German he had engaged as foreman, “promised to be faithful unto me and declared on his oath that he would be true to me and my heirs, that he would be my overseer at the mill, keep me from harm, and that as long as he lived he would make paper for no one else save me and for my heirs and would not teach any man to make paper in any way at all. This took place on the Sunday next before St. Lawrence’s Day, in my room at the time of evening prayer in the year 1390 when my son Jörg was present.” Thus having his foreman’s faithfulness assured, Stromer proceeded to have his other German workers take the same oath. He recorded in his chronicle that, “it was on the day after St. Lawrence when Jörg Tyrmann swore on oath to the saints that he would help my progress materially and that for ten years he would make paper only for me and my heirs and would not instruct anyone except by my sanction. But when the ten years are past he may make paper for himself, but for no one else, and he may then teach those who make paper for him, but for no one else, as long as he lives.”

These men, like himself, were Germans, but with the skilled Italian workers Stromer felt there was need for extra precaution, so he took them before a procurator named Conradus, and Stromer’s sons, brother, and brother-in-law acted as witnesses to the affidavits. The contract with the Italian workmen read: “In the year 1390, Franciscus de Marchia, and Marcus, his brother, and
his manservant Bartholomeus pledged their loyalty to me and swore on oath of the holy saints that they would for ever be faithful and would not divulge the secrets of papermaking to anyone in all the German lands this side of the mountains of Normandy."

The precautions taken by Stromer to guard his own interests excited the suspicions of the Italians; they concluded that if their labours were so indispensable to the success of the paper mill, it would be more to their advantage to control the mill themselves than to permit Stromer to be their master. With this thought in view the Lombards tried to hamper the progress of the mill in every possible manner, hoping that Stromer would become weary and discouraged with the whole venture and eventually lease the mill to them so that they might operate it as they pleased. Continuing with his diary, Ulman Stromer wrote: "the Italians were most troublesome the first year and caused me many difficulties, not suffering the third water-wheel to turn at all. My first two wheels operated eighteen stampers and even these were idle a great part of the time as the foreign workers wished to produce as little paper as possible so as to force me to allow them to have the mill for a rent of 200 golden a year. This I would not agree to do and they then offered to give me an amount of paper. From this I understood that they wished to ruin me and deprive me of my paper mill."

In mediæval times the master had great authority over his workers. Stromer recorded in this diary: "In the year 1391, on the twentieth of August, I took Franz and his brother Marcus and shut them in the tower."

On the fourth day of their imprisonment the unruly Italians sent for Stromer's brother-in-law, thinking that he would be more lenient with them than Stromer himself. A reconciliation was effected and the two men were liberated on the fourth day, but not until they had sworn that they would cause no further trouble and would do their full share of work at the paper mill.

The confinement in the tower had the desired result upon the scheming Italians and they worked more in harmony thereafter. Encouraged by the improved discipline, Ulman Stromer engaged additional papermakers, who were duly sworn like the others. A carpenter was required to repair the stampers and vats, for in 1392 Stromer recorded: "In my back room Erhart Zymerman has been engaged to be my servant for one year. He is to do the carpentry work at the mill or he will polish paper, and his wife will sort rags, or hang paper on lines to dry, or count the paper. Wages will be paid them, a good house in which to live and firewood withal." Ulman Stromer operated the paper mill from 1390 to 1394, when he leased the property to Jörg Tyrmann for a period of four years. Stromer died in the year 1407 at the age of seventy-nine. This manuscript diary is the most valuable document in the entire annals of papermaking.

On June 20, 1788 Benjamin Franklin (1706-90) read before the members of the American Philosophical Society of Philadelphia a treatise on papermaking, * which was later published in 4 Benjamin Franklin's discussion of papermaking technique constitutes the only strictly American contribution to the bibliography of papermaking that appeared in the eighteenth century. Dr. Franklin was eighty-two years of age when the following was communicated to the society: "In Europe to have a large surface of paper connected together and smooth on one side, the following operations are performed. 1. A number of small sheets are to be made separately. 2. These are to be couched, one by one, between blankets. 3. When a heap is formed it must be put under a strong press, to force out the water. 4. Then the blankets are to be taken away, one by one, and the sheets hung up to dry. 5. When dry they are to be again pressed, or if to be sized, they must be dipped into size made of warm water, in which glue and alum are dissolved. 6. They must be pressed again to force out the superfuous size. 7. They must be hung up a second time to dry, which if the air happens to be damp requires some days. 8. They must then be taken down, laid together, and again pressed. 9. They must be pasted together at their edges. 10. The whole must be glazed by labour, with a flint."

"In China if they would make sheets, suppose of four and an half ells long and one and an half ells wide, they have two large vats, each five ells long and two ells wide, made of brick, lined with a plaster that holds water. In these the stuff is mixed ready to work. Between these vats is built a kiln or stove, with two inclining sides; each side somewhat larger than the sheet of paper; they are covered with a fine stucco that takes a polish, and are so contrived as to be well heated by a small fire circulating in the wall."

"The mould is made with thin but deep sides, that it may be both light and stiff. It is suspended at each end with cords that pass over pulleys fastened to the ceiling, their ends connected with a counterpoise nearly equal to the weight of the mould."

"Two men at each end of the mould, lifting it out of the water by the help of the counterpoise, turn it and apply it with the stuff for the sheet, to the smooth surface of the stove, against which they press it, to force out great part of the water through the wires. The heat of the wall soon evaporates the rest, and a boy takes off the dried sheet by rolling it up. The side next the stove receives the even polish of the stucco, and is thereby better.
the Transactions of this society. Dr. Franklin describes in his essay the laborious method used in Europe for forming large sheets of paper, and then relates the simple manner employed by the Chinese papermakers in solving the difficulty (Figure 203). The European method consisted in pasting small sheets together at the edges and burnishing the joints with an agate or flint held in a wooden handle. In China a large mould was used, operated by two workmen. The large sheets were dried upon the flat interior to receive the impressions of fine prints. If a degree of sizing is required, a decoction of rice is mixed with the stuff in the vat.

"Thus the great sheet is obtained, smooth and sized, and a number of the European operations saved.

"As the stove has two polished sides, and there are two vats, the same operation is at the same time performed by two men at the other vat; and one fire serves."

Although Dr. Franklin's observations are not too accurate, they do lead us to believe that he had far more than the layman's conception of Chinese papermaking. In mentioning "wires" Franklin, of course, means the bamboos of the mould.

Fig. 205 Chinese workers forming and drying large sheets of paper as described by Benjamin Franklin in 1788. Dr. Franklin suggested that American papermakers adopt this method. From an original watercolour painting of the latter eighteenth century.
Benjamin Franklin's interest in papermaking led him to have his own watermark, which may be seen in some of the paper upon which he printed, including copies of Poor Richard's Almanack. The watermark consists of a fleur-de-lis within a shield, surmounted by a crown, with the initials B F in single-line lettering underneath. As further evidence of Franklin's concern with paper there is a doggerel poem attributed to him in which different kinds of men are compared with various kinds of paper. Inasmuch as the verses mention ten varieties of paper in use in Franklin's time and have seldom been printed, the poetical effort of the good doctor is given in full. The following version has been taken from a little calf-bound book entitled: The Columbian Orator; containing a Variety of Original and Selected Pieces... calculated to improve Youth and Others in the Ornamental and Useful Art of Eloquence. Boston, Manning and Loring, Feb. 1807:

Some wit of old; such wits of old there were, Whose hints shov'd meaning, whose allusions, care, By one brave stroke, to mark all human kind, Call'd clear blank paper every infant mind; When still, as op'ning sense her dictates wrote, Fair virtue put a seal, or vice a blot.

The thought was happy, pertinent, and true, Methinks a genius might the plan pursue, I, (can you pardon my presumption?) I, No wit, no genius, yet for once will try.

* The original printing of this amusing poem appeared in the American Museum (Philadelphia, October 1787) when Franklin was in his eighty-first year. In this publication the poem is headed: "On paper.—Ascribed to Dr. Franklin." The poem was included without comment in the Works of the Late Dr. Benjamin Franklin, printed by G. C. J. and J. Robinson, London, 1793. It was similarly printed in the 1802 London edition, but in the 1806 London edition of Franklin's complete works the editor made the following comment: "We have been told that this poem is not Franklin's and the name of some other person was at the time mentioned to us as the author; but as we have forgotten both the name and the authority, and as the poem has been ascribed to Dr. Franklin in the American Museum, we think it not right to omit it." In Jared Sparks's edition of the works of Benjamin Franklin (Boston, 1840) the poem is reprinted on pages 161–3.

Various the papers, various wants produce, The wants of fashion, elegance, and use. Men are as various: and, if right I scan, Each sort of paper represents some man.

Pray note the fork; half powder and half lace; Nice, as a band-box was, his dwelling-place; He's the gilt paper, which apart you store, And lock from vulgar hands in the scrutinise.

Mechanics, servants, farmers, and so forth, Are copy paper of inferior worth; Less priz'd, more useful, for your desk decreed, Free to all pens, and prompt at ev'ry need.

The wretch, whom a'vice bids to pinch and spare, Starve, cheat, and pilfer, to enrich an heir, Is coarse brown paper, such as pedlars choose To wrap up wares, which better men will use.

Take next the miser's contrast, who destroys Health, fame, and fortune, in a round of joys. Will any paper match him? Yes, throughout, He's a true sinking paper,* past all doubt.

The retail politician's anxious thought Deems this side always right, and that stark naught; He foams with censure; with applause he raves, A dupe to rumours, and a tool of knaves; He'll want no type his weakness to proclaim, While such a thing as fools-cap has a name.

The hasty gentleman, whose blood runs high, Who picks a quarrel if you step astray, Who can't a jest, or hint, or look endure: What's he? What? Touch-paper † to be sure.

What are our poets, take them as they fall, Good, bad, rich, poor, much read, not read at all? Them and their works in the same class you'll find; They are the mere waste-paper of mankind.

* An old name for blotting paper.
† A kind of paper used in making fireworks; also used by prestidigitators when a quick-burning paper is desired.
Observe the maiden, innocent and sweet.
She's fair white-paper, an unsullied sheet;
On which the happy man, whom fate ordains,
May write his name, and take her for his pains.

One instance more, and only one I’ll bring;
’Tis the great man who seems a little thing;
Whose thoughts, whose deeds, whose maxims are his own,
Form’d on the feelings of his heart alone:
True genuine royal paper is his breast;
Of all the kinds most precious, purest, best.

The Oriental papermakers have never had any standard sizes for paper, and throughout China, Japan, Korea, India, Tibet, and Indo-China the dimensions of the moulds vary greatly. The largest Japanese mould (see Figure 74) would be capable of producing sheets of paper 29 by 67 inches (1,943 square inches), the bamboo laid strips or reeds running lengthwise of the mould, as in European metal wire-covered moulds. This exceptionally large mould was procured near Okayama, a town in southwestern Japan, and had been used for making a paper called shōji, used in lieu of glass in the windows of old-time Japanese houses (Figure 193). In Japan, as well as in China, sheets of paper have always been fabricated in almost every conceivable size, but in late years, owing to the exportation of paper from these countries, the paper has been to a great extent standardized. All through India, however, the sizes and methods remain much as they were hundreds of years ago. As no paper is exported from India, there is little need foriformity, the various small cottage mills producing the paper for local markets only. In the southern Shan States of Burma the largest-size moulds measure 32 by 66 inches and are of the “wave” type, being covered with woven cloth. This large size of paper is produced east of Taunggyi at Mong Kung, and the paper is termed kalats. These large sheets, like the Japanese shōji, are cut to suit the various purposes of the native population. The Shan paper is made from paper-mulberry bark (Broussonetia papyrifera). In Kashmir the sheets of paper measure about 26 by 30 inches, a surface of 780 square inches. During the sixteenth and seventeenth centuries beautiful paper for manuscripts was made in Kashmir from rag stock. A village near Srinagar has long been

the papermaking centre of Kashmir, and paper is still made in this region with clear and abundant water. In the Indian province of Bengal the paper usually measures about 21½ by 22½ inches in the uncut sheets, while in Tonkin, French Indo-China, where papermaking has been carried on undisturbed for hundreds of years, the moulds are smaller, averaging about 10 by 24 inches. The sizes of the Oriental papers have been cited for comparison with the old European sheets; the Oriental papers have not changed in size through the centuries to the same extent as the European handmade papers.

An idea of the cost of European paper in the fifteenth century may be gleaned from the prices that were paid by the directors of the Ripoli Press at Florence between 1474 and 1483. An original cost-book of this establishment is preserved in the Biblioteca Nazionale in Florence. This book shows that the nine sizes or qualities of paper would have varied in price from about two dollars a ream for the lesser size or quality to about six dollars a ream for the Bologna paper in common folio. The oldest bill that is recorded showing the price of paper is dated 1352 and reads: “To George Cosyn, for one quarter of royal paper, to make painters’ patterns, 10d.” According to this, a quire of royal paper in 1352 sold for about one third less than in the year 1483. In the contract between William Rittenhouse and William Bradford, dated 1697, the prices of paper were given, “ye writing paper at 20 shillings [the ream] and ye brown paper at 6 shillings pr. ream.” The weekly wage of a papermaker in England during the latter part of the fifteenth century was from two to three shillings. When the prices paid for paper at this time are considered, the wage of a workman seems low, but at that time labour did not hold the same important place that it did in later years. During the eighteenth and nineteenth centuries the selling price of a ream of finished paper would have offset the weekly wage of one papermaker. In England during the early part of the eighteenth century a vatman earned from fifteen to eighteen shillings a week; in America at that time the wage was a little higher than in the papermaking districts of southern England. Eighteen shillings a week was a high wage compared with that of other trades; a bookbinder at that time received but twelve shillings a week and was required to work from six in the morning until nine at night, three hours longer than a
papermaker's day. The following interesting account which appeared in a little book of trades in 1747 gives some idea of the requirements at that time of both the master and the worker: "Papermaking requires much water and a great deal of room, and therefore is altogether carried on at water-mills in the country, which undertakings are not numerous. It goes through various operations and divers hands before it is completed, and the moulding part, which is the principal, requires a nice hand and good eye. They take with an apprentice 5 to 10 pounds who work from six to six, and he ought not to be a very tender lad; they pay a journeyman moulder [vatman] 15 to 18 shillings a week; and a mill with the proper utensils (besides which there must be a reserve of at least 200 pounds, cash for a stock of rags, etc.) will stand one, minded to be a master, in 100 pounds, of which some have two or three. It is a very curious art taken as a whole, and so useful a manufacture, that it ought to be encouraged at home more than it is." From this account it will be seen that the life of a worker in an eighteenth-century paper mill was anything but indolent. He was required to be at the mill by six in the morning ready for work, and did not leave for his home until six in the evening. The noonday lunch was usually consumed while the men were working, but the more lenient masters allowed fifteen or twenty minutes for the repast. From the English book of trades of 1747 it would appear that papermakers at that time were looked upon with some degree of favour, but a hundred years earlier such was evidently not the case according to a petition dated 1636 to the Privy Council from the people of Buckinghamshire and Middlesex. These people living near the paper mills alleged that by converting corn mills into mills for the making of paper rents were advanced greatly and that the papermakers brought many poor and indigent to the parish whom they had to maintain. Also they complained that the papermakers were too highly paid and were able to save more of their wages than was possible with workers in other trades. The people further alleged that the papermakers brought plague into the country from their rags, that they killed the fish by their double water-wheels and by penning up the water flooded the countryside. They also petitioned that the paper was poorly made and would bear ink only on one side and was sold much dearer than formerly.

Many of the old German and French mills were provided with kitchens and sleeping-rooms which were used by some of the papermakers, others living in small cottages near their work. The papermaking centres were little communities in themselves, and many of the old artisans lived for one generation after another in the same spot, working at the same vat and with the same moulds that had been in use over long periods of time. In Holland it was the custom for some of the workers to live with the master of the mill where they were working, all having their meals at the same table. From time immemorial it had been considered proper for papermakers to cease eating when the master of the house, by laying down his spoon, gave evidence that he had finished. There is a tradition that many of the early Dutch masters were anything but liberal, and that in order to prevent their workmen from consuming too much food, the dishes were served steaming hot, and before they had had time to cool sufficiently to be eaten, the master would lay down his spoon and the poor papermakers would be forced to leave their master's table before their lusty appetites had been satisfied. To this day in the old papermaking districts of Holland whenever children are noticed to be gulping their food they are chided by their parents' asking them if they have been reared by the papermakers. In the summertime the old Dutch artisans began their work in the mills at three thirty in the morning and ended their tasks at ten, the remainder of the day being spent in the fields and gardens, where they continued the constant stooping that was essential in the making of paper. The old workers, especially the vatmen and couchers, had to have strong and robust constitutions, but the constant stooping posture, combined with the heat of the paper stock in the vat, caused them to grow old prematurely, and at fifty many of these hard-working craftsmen appeared to have reached the allotted threescore years and ten. During the eighteenth century a great deal of paper was produced in Holland, it being recorded that in the year 1726 there were sold at Amsterdam a hundred thousand reams in a single day. William Rittenhouse, the first papermaker in the province of Pennsylvania, had worked in Amsterdam as early as 1678, when he was thirty-four years of age, but he had learned the craft of papermaking in his native city, Mülheim on the Ruhr. Rittenhouse was forty-four when he came to Pennsylvania in 1688 and it is
interesting to surmise just how he had been influenced by the Dutch papermakers and to what extent he introduced the old Dutch customs into the pioneer paper mill of the New World.

In contrast to the custom of the old Dutch mill-owners in endeavouring to prevent the workers from satisfying their appetites at their master’s table, we have an account showing the abundance of food supplied by a master papermaker in early nineteenth-century America. In the amusing manuscript diary of Ebenezer Hiram Stedman, quoted from previously, there is an intimate description of paper-mill life in pioneer Kentucky and Ohio. Some time before the year 1820 Stedman left the mill in Kentucky and ventured across the river into Ohio, where he readily found work in the erstwhile Christian Waldschmidt mill, the second papermaking establishment to be set up in the state, about 1810. An extract from the Stedman diary relative to mill life among the German immigrant papermakers reads: “... When Matthias Kugler came to the place he was an ignorant German, could not read or write; he worked for eight dollars a month for the man (Waldschmidt) who was later to be his father-in-law. One day young Kugler was sent by his master to the barn to flail out grain and he and his master’s daughter got mixed up amongst the grain and Kugler had to marry her, that is the way it commenced. Matthias Kugler was now the master of the mill and Mrs. Kugler was head of everything. The first meal I had in the mill-house was supper and Kugler had a practice of initiating every new journeyman papermaker who came to his house by telling them that all the food on the table was cooked for the papermakers and the family and each worker was entitled to consume as much as he desired, but everything taken on the plates must be eaten as there was to be no waste; nothing was cooked to be thrown to the dogs or hogs.” This short quotation from Stedman’s interesting diary gives a little conception of the proprieties of the life of a papermaker in the “western country” during pioneer days when the craft of making paper by hand was practised in the Miami Valley, now an important paper-producing centre.

The old European papermakers, as well as the early American workers at this craft, were much too fond of their drink and could be found almost any night at the public houses which were located near the mills. The vatman and the coucher, who interchanged their work, could readily have been distinguished by their red, muscular arms and hands and by their stooping backs. This condition was brought about by their having their arms in and out of warm water constantly, and continually bending over the dipping-vat and coucher’s stool. The old mills were inadequately heated, and the vat-houses, where the moulding of the paper took place, were usually located where the light was poor, the atmosphere damp and gloomy, and the whole environment unhealthful (Figures 206, 207, 208). All through the history of papermaking by hand there was a scarcity of workers, due no doubt to the unwillingness of apprentices to learn a trade so disagreeable and arduous; only those with exceptional physical endurance could have remained long at the craft. The greatest strain was required of the vatman, owing to the four-way motion that he had to give to the mould in forming each separate sheet of paper. After work-
ing years at the vat the craftsmen sometimes lost this “stroke” and were never again able to form a sheet of paper. Sometimes this paralysis has been known to attack workmen for different periods, during which time they were unable to work at the moulding of paper; then the ability to give the “stroke” or “shake” returned. Yet with all the disagreeable features of their craft, the old papermakers were a happy and contented guild of workmen. As in other callings, there were those who disliked the monotony of living and working in one place, and these men journeyed from one mill to another, obtaining work wherever they might go. The papermakers were extremely proud of their craft, for the apprenticeship was long, the work demanded dexterity and skill, and to become a proficient moulder and coucher of fine paper required no little ability of head and hand.

Nothing remains today of the old handmade-paper industry in America, since here, though not in the Old World, the advent of the papermaking machine soon swept aside the ancient, tedious method of forming each sheet of paper separately. Just at the close of the Civil War all papermaking by hand had ceased on the North American continent. Most of the buildings that housed this important early industry have gone into decay, and not a vestige of any of the old equipment, except a few scattered moulds, remains. The original Rittenhouse mill, the first to be established in America, in 1690, near Germantown, Pennsylvania, was swept away by high water in 1700, but Rittenhouse and his son Claus built another mill, a short distance below the site of the first, which was in operation in 1702. There is no authoritative picture of the original mill or of the second structure. According to the letters of William McCulloch to Isaiah Thomas written between 1812 and 1815, the original Rittenhouse mill was of logs, the building extending over an undershot water-wheel, there being no dam or race. This Philadelphia antiquarian also states in his letters: “The Rittenhouses, one or more of them, have continued paper-
The earliest reference in any publication to the Rittenhouse mill or to papermaking in America appeared in Philadelphia (printed by William Bradford) in 1692 and was written by Richard Frame,

The following verse was written by John Holme in 1696 under the title of A True Relation of the Flourishing State of Pennsylvania, and is considered to have been the earliest metrical composition composed in Pennsylvania, but it was not published until 1847. The verse relates to William Bradford and the Rittenhouse paper mill:

Here dwelt a printer and I find
That he can both print books and bind;
He wants not paper, ink, nor skill
He's owner of a paper mill.
The paper mill is here hard by
And makes good paper frequently,
But the printer, as I do here tell,
Is gone into New York to dwell.
No doubt but he will lay up bags
If he can get good store of rags.
Kind friend, when thy old shift is rent
Let it to th’ paper mill be sent.

Another work dealing in a minor degree with Pennsylvania papermaking appeared two years after John Holme’s verse, in 1688, with the title: *An Historical and Geographical Account of the Province and Country of Pennsylvania*. This was published in London, and the reference to paper is: “All sorts of very good paper are made in German-Town, as also very fine German linen such as no person of quality need be ashamed to wear.”

The third mill, also in the province of Pennsylvania, was established by Thomas Willecox, about 1729, on the west branch of Chester Creek in that part of Chester County which in later years became Delaware County. It is recorded that as late as 1884 some of the buildings of this mill were standing, but whether or not these were part of the original structure it is not possible to say. When I visited the site of this old mill a number of years ago, nothing remained but the stone foundation, which stood in soggy ground almost covered with rank vegetation. A remnant of the old ivy vine, the original slip of which was brought to this country by Thomas Willecox from Devonshire in 1725, still clung to the ruined walls. It was on account of the abundant growth of this vine that the mill in its prosperous days was known as “Ivy Mills,” and carried the device of an ivy leaf as its watermark. At the base of one of the crumbling masonry walls, deeply embedded in the marshy ground, lay a rusty and broken screw press fallen upon its side. It had been one of the indispensable implements of the old mill, and between its platens ream after ream of paper had been pressed — paper that had been made for ante-bellum banks, for the counting houses of some of America’s oldest firms, and for the banks of the South American republics as well as those of Greece. It was not until March 1866 that the mill abandoned the manufacture of handmade paper. On the hill above the mill stands the old Willecox home, occupied by a direct descendant of this noted papermaking family. The old Wilcox family burying-ground, enclosed within an iron fence, lies up the hill behind the house, and here rest this illustrious family of papermakers. Within the enclosure, but to one side, a small gravestone with the one word CAESAR marks the tomb of an old Negro slave whom Thomas Wilcox had purchased from the captain of a slave-trading ship that had anchored in Delaware Bay. Caesar had been a faithful and intelligent papermaker in the Wilcox mill, and at his death he was privileged to share the resting-place of his masters.

About 1736 a paper mill was established on the banks of the Cocalico Creek, near Ephrata, Lancaster County, Pennsylvania, by a branch of the Pietists of Germany, who came to this country in the early eighteenth century. This was the fourth paper mill in Pennsylvania. When the site of this mill was visited more than a quarter century ago, there was nothing of the old buildings remaining; not even the foundations could be traced, for a woollen factory had been built upon the spot where the mill once stood. The building usually pictured in histories as the original Papiermühle of this German religious colony was never a mill of any sort, but the home of one of the leaders of the cult. Not the oldest citizens of Ephrata could remember seeing the paper mill; it had been demolished many years before and no authentic picture exists.

Another locality visited, with the hope of finding at least a remnant of an early American paper mill, was the site of an early papermaking establishment in New York, which was set up in 1773 on what is now Silver Lake, a peaceful body of water that flows into the head of Hempstead Harbour, at Roslyn, Long Island. This enterprise was founded by Hendrick Onderdonk and two associates encouraged thereto by Hugh Gaine, a bookseller and printer of New York. The mill was prosperous and Onderdonk became a wealthy and influential man, living in a correspondingly handsome style. Whenever a noted personage came to the village, the master of the paper mill was invariably called upon to entertain him, as Onderdonk was the leader in the small community. On the morning of April 24, 1790 word came suddenly to the village, and to the Onderdonk household in particular, that the President of the United States was on his way through the island, and that he would stop with the papermill owner for
breakfast. The Onderdonk family was around the table eating roasted clams when the message was received, and a great commotion arose among the women to get things in readiness for the honoured guest. They sprang from their benches, and in haste swept into their aprons the clam shells and cups and saucers, soon having the table cleared for a more formal repast for General Washington. After breakfast the President and Hendrick Onderdonk strolled to the hill west of the pond, and the General remarked that the locality would make an excellent place for a fort.

They then visited the paper mill, Washington seeming much interested in the process of forming sheets of paper and asking many questions in regard to the methods employed. He was much absorbed in watching the men dip and couch the thin sheets, one at a time, and the vatman summoned sufficient courage politely to request that the President try his hand at the work. This Washington did, dipping the "laid" mould into the vat and bringing it to the surface laden with the snowy-white fibrous liquid. He then couched the sheet, the workman taking care to slip a small bit of paper between the felts that covered the sheet the noted visitor had made. Perhaps this means of identification was later found unnecessary, as the paper formed by a novice is generally distinguishable by its own characteristics. It is said that this sheet was a cherished possession of the mill for many years, but no trace of it can now be found. To be sure, there is no authentic record to support the story that George Washington actually made a sheet of paper when he visited the Onderdonk mill, but the situation is sufficiently picturesque for one at least to wish that it might have been true. One historian of Long Island has advanced the opinion that such a performance never took place, the only reason given being that it would have been beneath the dignity of the Father of Our Country to stoop to such a workaday task; but, it would seem, Washington could have made just one sheet of paper without losing his rank as a gentleman! There have been several authentic instances of European nobility visiting paper mills and trying their skill in forming paper upon a mould. Charles Cowan in his Reminiscences relates that the Duke of Bordeaux, better known as Count de Chambord (1820–83), once visited the Valleyfield mill and with his own royal hands made several sheets of paper upon a small mould. After the sheets had dried they were forwarded to His Royal Highness at Holyrood Palace and were graciously acknowledged. Surely if it were not beneath the dignity of a nobleman in imperialistic Europe to stand at a vat and make a few sheets of paper, our own George Washington could have performed the same task in democratic America without the loss of too much prestige.

General Washington was evidently much impressed by his visit to the Onderdonk mill, for in his diary under the date of his sojourn he had this to say: "I left Mr. Young’s, Oyster Bay, before 6 o’clock on Saturday morning and passing through Mosquito Cove, breakfasted at a Mr. Onderdonk’s at the head of a little bay where we were kindly received and well entertained. This gentleman works a grist and two paper mills, the last of which he seems to carry on with spirit and profit." George Washington was the possessor of his own watermarked correspondence paper and at least a few of his letters are inscribed in his own hand upon this form of stationery. The watermark is in the form of a circle with the lettering "GEORGE WASHINGTON" in outline running within the frame, the circle surmounted by a griffin or eagle. In the centre of the watermark a figure of Liberty sits somewhat uncomfortably upon a plough. It is not known where the paper was made, but it is likely that an American mill kept the General supplied as a favour.

The old stone foundations of the Onderdonk mill are all that now remain of Long Island’s first paper mill. Within the low foundation a great tree grows which clearly shows how long ago the wooden mill had fallen into ruin.

Of the old American paper mills, the best-preserved structure is one that was erected in the late eighteenth century. It stands in Bunnville, Connecticut, on the outskirts of Hartford, appearing most dignified and substantial amid its shabby modern surroundings. Originally it stood in the country, beside a stream, but houses and factories have pressed closer and closer until now the fine old structure must be demolished. The impressive building is about 90 by 40 feet, two storeys in height, and built of red sandstone, each block beautifully squared, and all laid together faultlessly in massive walls. By contrast the neigh-
bouring present-day buildings look mean and poor. The first floor of this old stone mill is divided into two rooms; one served as the vat-house, the other for the beating of rags. The second floor was used for drying and finishing; the original sliding shutters that had been used to introduce or exclude the air for the drying of paper are still intact and in fairly good working order. By going over this small building it is possible to picture every phase of the old hand process and to determine just how the artisans operated. The limitations of light and space and the crude appliances did not seem to deter the early workers, and not only did the paper they fabricated serve its purpose at the time, but much of it has lasted throughout the years and given to us the records of the past.

It has not been intended to give here complete historical accounts of these few early American mills, since this has been ably done in other volumes, but to set down brief descriptions of them as they now exist, so that a student of the history of papermaking in this country will know what to expect when he visits the sites of these pioneer paper mills. Papermaking in America grew early into a flourishing industry. At the close of the eighteenth century there were numerous small paper mills, and by the year 1810 there were no fewer than one hundred and eighty-five establishments where paper was made (Figure 209).

Previous to the first World War England had six mills devoted to this craft. Of the 1,043 vats that existed in Germany in 1846, only two or three remained in 1938; while in Holland, a great papermaking country, there were at this same period only three or four vats in operation. In 1938 Italy had a number of handmade-paper mills, and in France at this time two small establishments were still making paper by the old hand methods. In Sweden there was one lone mill (Figure 210).

In Asia the number of small cottage mills where paper is formed by hand is amazing, but these establishments would not be comparable to those of Europe. Between thirteen and fourteen hun-