Fig. 95  The back of the “laid” mould shown in Figure 94. It will be noticed in this mould that the “chain-lines” do not follow along the ribs, but this is unusual and probably due to the mould-frame being re-covered.

And John Tate the younger love mote he broke
Whiche late hath in Englonde doo make this paper thynne
That now in our englysshe this boke is pryncted Inn

While this book is not dated, it may be assumed that it appeared in 1496. The watermark of the Tate mill is an eight-pointed star within two circles, somewhat resembling a cart-wheel. Paper of the same type is also found in the Golden Legend, printed by de Worde. This work is dated 1498.

John Tate was a mercer in London, the son of John Tate, who was Lord Mayor in 1473. Tate the younger died in 1527, and his will contains several references to the paper mill. In the first place he bequeathed to Thomas Bolls of Hertford “as moche whit paper as shal extende to the summe of xxvi s. viij d. . . . owte of my paper mill at Hertford.” Then he directed his executors to dispose of the paper mill, “with all the goods, woodes, pastures, medes, with all the commodities concerning said myll to the most advantage.” Finally, in leaving to his eldest son, Robert, all the lands in Hertfordshire and Essex, the paper mill was excluded: “My paper myll with the appartenances to be always excepted and to be sold.” The John Tate paper mill was evidently shortlived, as there is no evidence of its existence before 1494 or after 1498. The paper fabricated in the Tate mill was remarkably fine, as is attested by Thomas Dibdin, who has the following to say in his Bibliotheca Spenceriana: “The paper, press-work and embellishments of the Bartholomaeus are perhaps unrivalled by the efforts of any other artist in our country within the period.” The Tate mill was no doubt forced to cease operations because of the strong competition of the papermakers from abroad.

Fig. 96  The metal “laid” mould of Europe. This type of mould came into use during the twelfth century and was directly patterned after the “laid” transfer mould of China as shown in Figures 51, 52, 53.

The paper used by Erhart Ratdoldt at Augsburg, in 1490–2, shows from 32 to 38 lines to the inch, while the paper printed on by Berthold Ruppel in Basel has but 20. The “chain-lines” or sewing-wires varied greatly also and are found spaced from half an inch to fully two inches apart. From this it will be seen that location or period has little bearing on the number of lines found in old papers, and that therefore there is no possible way of cataloguing or indexing these impressions in paper so that a particular time or place of origin may be determined. Ancient paper, both Oriental and Occidental, must be placed by its general characteristics and not by any list of rules that can be given as infallible.

Metal wire was originally made in Europe by beating the material into thin plates, and then cutting it into strips and rounding them with a hammer. The earliest Occidental moulds must have been made with wires fashioned in this manner, as the first water-
mark, dating from about 1282, was no doubt formed of metal and not of bamboo. Wire-making by use of the draw-plate was probably known in Nürnberg early in the fourteenth century; the History of Augsburg (1351) and that of Nürnberg (1500) mention the "wiredrawers" (Drahtzieher). The draw-plate was imported into France by Richard Archal, and first made its appearance in England in 1565, having been taken to that country by a German workman named Schultz. An English patent by Brockedon, dated 1819, specifies the use of diamonds, rubies, sapphires, and other gems, drilled for draw-eyes and mounted in iron, to be used in the drawing of wire. The draw-plate, made of metal or of hard precious stones, like most other appliances thought to have had their origin in Europe, was without doubt first used in the Orient many centuries before it was conceived in the Occident.

In France a company or guild of wiredrawers existed previous to 1583, and in London there was an incorporated company under

Fig. 97 A back view of the Van Gelder Zonen mould shown in Figure 96. In this mould the "chain-lines" follow the ribs of the mould in the proper manner.

the title of "The Art and Mystery of Drawing and Flattening of Wire." The motto of these artisans was Love draws friendship, and they had their workshops in Crooked Lane before the alterations in London Bridge. It is thought that iron wire was used first as a mould-covering at the introduction of papermaking into Spain, but the use of brass was centuries old at this time and brass soon took the place of iron as a more suitable metal for the purpose.

In European moulds the wires were permanently fastened to the wooden frames, and in this way differed from the Oriental method of using detached covers. The European moulds were rigid, so that the wet sheets of paper formed thereon were couched in a manner different from the Chinese or Persian fashion. This change constituted, in early centuries as at present, the greatest deviation between Oriental and Occidental methods of operation. In forming sheets of paper in the East the paper stock was kept from flowing over the mould by the use of loose sticks, while in the West the wet fibrous mass was kept within bounds by a fence joined permanently at the corners and placed on the mould when a sheet of paper was to be formed, and removed so that the sheet might be couched. This narrow rim or fence was called a "deckle" and it not only prevented the macerated fibre from flowing over the sides of the mould, but determined the size of the sheet of paper as well. The term "deckle" had its origin in either the German word "Deckel" or the old Dutch "dekfeel," meaning "cover." As the word was not used in England before the day of John Spilmann, the German who established a paper mill

* Of the old papermakers of England, John Spilmann is today the best known, this being due to a poem compiled by Thomas Churcheyard (1520-1604) in 1588, and also to the fact that it is thought Spilmann's mill was referred to by Shakespeare in II King Henry VI, IV, vili. Spilmann was a German, a native of the town of Lindau on Lake Constance, and after moving to England he became one of Queen Elizabeth's goldsmiths. He leased a mill on the Darent in the royal manor of Bicknors at Dartford, Kent, which he converted into a paper mill, known to have been making paper in 1588. Early in the year 1589 Spilmann obtained a patent which gave him a monopoly of papermaking and the collecting of rags in the Kingdom. After holding the patent for eight years he surrendered it, and in its place another patent covering a period of fourteen years was given to his mill. This patent embraced the privilege of making white writing paper and paper to be used for other purposes as well. It appears that there were several infringements of Spilmann's patent, but they were evidently settled peacefully, as the papermaker-goldsmith was knighted in 1605, upon a visit to the paper mill in Dartford by King James.

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in Dartford, Kent, in 1588, he in all probability introduced the term into English paper mills.

Until the latter part of the eighteenth century the "chain" wires had been laced or sewed directly to the wooden ribs, or supports.

Shakespeare’s reference to a paper mill occurs in a speech of Jack Cade to Lord Say: "Thou hast most traitorously corrupted the youth of the realm in erecting a grammar-school; and whereas, before, our forefathers had no other books but the score and the tally, thou hast caused printing to be used; and contrary to the king, his crown and dignity, thou hast built a paper-mill.

This play was first published in 1594, and it may be that Shakespeare had this mill and its monopoly in mind when he wrote the lines. Jack Cade's rebellion took place in 1450, and certainly Lord Say had nothing whatever to do with paper mills. His son, however, acquired by marriage a property at North Newton, Oxfordshire, and it is known that North Newton mill was at one time used for manufacturing paper; this has led some writers to advance Shakespeare's words as evidence establishing this North Newton mill as the first paper mill in England.

The poem by Thomas Chureyward relative to the John Spilman paper mill first appeared in 1588, under the title of: A Description and plaine discouer of paper, and the whole benefits that Paper bringes, with reherasall, and setting foorth in verse a Paper myll bilt neere Dartford, by a High Germaine, called Master Spilman, Jewellour to the Queenes Maiestie. The complete poem consists of 355 lines printed in a quarto volume of fifteen pages with bordered title-page. While these verses throw no light on the technical history of papermaking, they are, nevertheless, of interest as the first description of the craft to appear in English. The work was prefaced by a dedicatory epistle addressed: "To my honourable friend Sir Walter Raleigh," under the title: A Sparke of Friendship and Warne Goodwill, etc." The composition is much too long to reprint in its entirety; a few salient verses that deal particularly with the subject of paper will suffice:

I prayse the man, that first did Paper make,
the onely thing that sets all vertues forth:
It shoes new bookees, and keeps old works awake,
much more of price than all this world is worth;
Though parchmetne dure, a greater time and space,
yet can it not, put paper out of place:
For paper still from man to man doth go,
when parchmetne comes in few men's hands, you knowe.

Then he that made, for us a Paper mill,
is worthy well, of love and wordes good will,
And though his name, be Spilman by degree,
yet Help-man nowe, he shall be cokle by mee.
Six hundred men, are set a worke by him,
that else might starve, or seeke abroad their bread,
Who nowe lives well, and goes full brave and trim,
and who may boast they are with paper fed.

The hammers thump, and make as lowde a noyse,
as Fuller doth, that beates his woolen cloth,

Fig. 98 A sheet of "laid" paper showing the "antique" pattern—the dark streaks at either side of the "laid" lines.

Fig. 99 A sheet of "laid" paper showing the "modern" pattern—the elimination of the dark streaks.

of the moulds, which caused the pulp to lie heavier along each side of every "chain-line" in the sheets of paper. European paper made before about 1800 may oftentimes be distinguished by this peculiarity. Paper of this kind is rightly called "antique laid" (Figure 98). Modern papermakers do not use this term correctly, but

In open shewe, then sundry secrete toyse,
makes rotten ragges, to yekkle a thickend froth:
Then is it stampt, and washt as white as snowe,
then flong on frame, and hang'd to dry I trowe:
Thus paper straignt, it is to write upon,
as it were rude, and smoothlie with slickeing stone.

Sir John Spilman's tomb may be seen in the Dartford parish church, Dartford, Kent. The monument consists of two effigies in colour, one of Sir John, who died in November 1626, the other of his wife, Elizabeth, who died in May 1607. The tomb was restored and placed in its present situation in the church before 1878 by the Fraternity of Papermakers.

apply it to any rough-surfaced "laid" paper. Old paper with pronounced irregularities in the "laid-lines" is known as "medieval laid." The heaviness along the ribs or "chain-lines," noticeable in both antique and medieval "laid" papers, was eliminated by holding the covering away from the ribs of the mould by the use of wires running parallel with, and under, the "laid" wires. This prevented the paper stock from settling at each side of the "chain-lines," a tendency caused by a peculiar suction of the wedge-shaped ribs as the mould was lifted from the vat (Figure 99). Slight variations are found in great varieties in old paper and give some clue as to period and locality. Very few Oriental moulds had rib supports under each "chain-line" and therefore the paper made upon them does not show the peculiar characteristics that are apparent in European "medieval" or "antique laid" papers.

The mould-making (Figure 100) required great skill, as these implements were constantly in and out of warm water, and if the wooden frames had not been joined properly at the corners, they would soon have warped and become useless. When paper was being made, two moulds and one deckle were required at each vat, so it was essential that the deckle fit each mould perfectly.

The wood used for European mould-making was prepared by cutting the straight-grained, well-seasoned material into narrow boards, free from all knots and blemishes. These boards were boiled in water, again and again, and finally slowly dried. The process was repeated many times before the material was considered ready for use. The finest present-day moulds are composed of at least three varieties of wood, including maple and mahogany, while the old paper-moulds were usually made of but one species -- for the most part oak.

When the art of papermaking was introduced into the American colonies in the late seventeenth century, there were no wire-drawers or wireworkers in this country, so that the few moulds required by the pioneer mill were imported from Europe, possibly from Holland. It was not many years, however, before moulds were being fashioned in their entirety in this country. The first American mould-maker, Isaac Langle, was a resident of Germantown, not far distant from the Rittenhouse paper mill. It is not known whether he learned the craft of drawing and weaving.
wire in Germany, or acquired the trade so that he might supply the Pennsylvania papermakers with the much-needed moulds. In any event, he was making moulds for the Ephrata mill in Lancaster County as early as 1740. Aside from this, little is known of this pioneer craftsman. After Langle's death, in 1744, there appeared an advertisement for the sale of a Siebmachertreebe: stuhl mit einen dazu gehörigen eisern Schienen-zug und anders zugehör (a wire-weaver's frame with an iron apparatus for wire-drawing and other belongings). These were the simple and unpretentious tools that had been used by this early paper-mouldmaker in all of his work.

Nathan Sellers, who is usually given the credit of having been the pioneer worker in paper-moulds, did not commence his operations until about 1770. A few years later he abandoned his calling so that he could join the Continental Army, but his work was considered of such importance to the papermakers of the country that he was requested to return home and resume his trade. Sellers was an expert artisan and executed considerable work for the government, many of his moulds being used for forming sheets of paper at the Wilcox mill in Pennsylvania, where much of the government paper was fabricated. Many of the tools that had been made and used by Sellers, comprising straightening-boards, wire-drawing blocks of lignum-vite wood, wire-plates, and pincers, were in the possession of one of his descendants until his removal to the West in 1841. One of the most important implements employed by wireworkers was a straightening-board. Sellers had fashioned one of these, after his own ideas and inclinations, which embodied the principles of the ones then used in France and England, but much improved; so much so as to have been reinvented and patented in France as late as 1800. The tool consisted of a series of stout wood or metal pins securely fixed in a board; the wire being drawn between this row of pegs was first bent in one direction and then the other, in a wavy line, the bends gradually diminishing or shortening until the wire became perfectly straight.

Mark Wilcox of Ivy Mills, Chester, Pennsylvania, was obliged to import some moulds from England, and the following bill for them is still preserved:

**THE MOULD: THE PAPERMAKERS’ CHIEF TOOL**

*London, August 2d 1783*

Capt^a Falconer Bot of Peter Wynne

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<th>Description</th>
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<td>2 fine Brass wire washers 24 Inch by 20</td>
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£12

An original bill from Nathan Sellers for the making of moulds is also in existence, and reads:

June 18th 1791

Tench Francis Esq. to N^a & D^o Sellers Dr

for a fine paper mould for Bank paper with box £4. 10. 0
for 88 watermark letter at 1.10½ 8. 5. 0
for 14 do figures 15. 0
for 8 do private 8. 0

Reed Paymt Oct 5. 1791

N^a & D^o Sellers

The “wove” mould-covering (Figure 101) is thought to have been originated in Europe by John Baskerville (1706-75), and the date of his rediscovery is usually given as about 1750. John Baskerville has long held the honour of having invented and used for the first time in Europe paper of the “wove” type. In late years, however, this distinction tendered the great Birmingham printer has been disputed in favour of the Baskerville Virgil, Maidstone, Kent, an establishment originally purchased by James Whatman and a Mr. Brookes in the year 1731. In 1759, two years after the Baskerville Virgil was issued, the Whatman mill manufactured genuine “wove” paper for a book by Edward Capell entitled: *Prolusions; or Select Pieces of Ancient Poetry*. In this book the “W” of the Whatman watermark has been found; also, in the edition of £Esop printed by Baskerville in 1761 this same watermark appears. In a thorough examination of various copies of the Baskerville Virgil of 1757 it has not been possible to discover any watermark whatever, but the paper may have been made in the Whatman mill, as it is now generally accepted that
John Baskerville did not operate a paper mill of his own. It was probably Baskerville who suggested the use of woven wire moulds and the paper was actually fabricated in the Whatman mill. The histories of the Whatman mill lay no claim to the invention having taken place in that establishment, but employees of the mill have stated that the credit for the manufacture of the first European “wove” paper should go to the Turkey paper mill (Whatman-Balston), Maidstone, rather than to John Baskerville, the famed typefounder and printer of Birmingham. Baskerville’s effort was to produce paper for his book-printing which would afford a smoother surface than paper of the “laid” pattern, in use in Europe ever since the introduction of the craft into Spain in the twelfth century. The “wove” covering was made of fine brass screening and received its name from being woven on a loom in about the same manner as cloth. It left in the paper an indistinct impression resembling a fabric. Baskerville had been in the japaanning and metal-working trades before becoming a printer, so that he was naturally familiar with this material, metal screening having been used in England for other purposes a number of years before it was put to use as a material upon which to form sheets of paper. While this printer of Birmingham was the first European to adopt the “wove” type of mould, paper of this kind had been fabricated in the Orient for many years, the Orientals having used coarsely woven cloth as a means of retaining the macerated fibre, which, when dry, was paper. The first book to be printed on European “wove” paper was Baskerville’s magnificent quarto edition of Publius Virgilius Maronis Bucolica, Georgica, et Æneis, which was published in Birmingham in 1757. Another edition of Virgil was issued by the same printer in 1771, under the earlier date of 1757. It is the first printing of the 1757 edition that is of interest on account of the paper upon which it was printed. The 1757 edition of Virgil immediately created a furor in English and Continental literary circles and Baskerville received no end of praise and commendation for his work. The new style of smooth paper was acclaimed universally. William Shenstone, the noted English poet, wrote of this work in 1757: “My neighbour, Baskerville, at the close of this month (March, 1757) will publish his fine edition of Virgil; it will for type and paper be a perfect curiosity.” Baskerville’s Virgil of 1757 was the first European book in which “wove” paper was used, and as late as 1790 paper of this kind was common in England. In the copy of Virgil before me there are but 186 of the entire 432 pages on “wove” paper, the re-
remaining pages, 246, being on very fine antique "laid" paper. In the first "wove" or *papier vélin* sheets the ribs of the moulds appear distinct and pronounced when the paper is held to the light. This defect was caused by the woven wire mould covering having been sewed directly to the ribs, or supports, of the mould. Perhaps the "wove" cover that was used in making the paper for the *Virgil* had been stretched directly over a mould of the "laid" type. These imperfections appeared in paper until about 1800, when they were eliminated by placing a coarsely woven metal screen under the top "wove" covering. It is not known whether Baskerville made his own paper or had it fabricated in a neighbouring mill. In a letter to Horace Walpole, fourth Earl of Orford (1717-97), written in 1762, Baskerville wrote: "The ink, presses, chases, moulds for casting, and all apparatus for printing were made in my own shops," but he did not state that he possessed any papermaking appliances. From this it may be assumed that he did not operate a paper mill, and it is reasonable to believe that he was kept occupied with typefounding and printing without adding to his labours the making of paper.

In the preface to Baskerville’s edition of *Paradise Lost* (1758) the printer expressed his gratification that the “improvement” in the paper which had been used in the *Virgil* in the preceding year had been recognized by the public. "I must own," he wrote, "it gives me great satisfaction to find that my edition of Virgil has been so favourably received. The improvement in the manufacture of the paper, the colour, and firmness of the ink were not overlooked." Although the "wove" paper was acclaimed by Baskerville and the literary public in general, it does not appear that he made exclusive use of paper of this type, for a number of editions appeared after 1757 imprinted upon paper of the old style; even the Baskerville folio Bible of 1769 is printed entirely upon antique "laid" paper.

It was "wove" paper of English fabrication that Benjamin Franklin exhibited in Paris about the year 1777. The novel paper made a favourable impression upon the papermakers and printers of France, and they desired to procure moulds for duplicating this type of paper which did not show any "laid-lines" and which had a smooth surface like a piece of woven silk. In 1779 M. Didot, the noted Parisian printer and publisher, having seen the *papier*
THE MOULD: THE PAPERMAKERS' CHIEF TOOL

It is thought that the term "wove" in connection with papermaking was first used in the patent granted to Henry Fournier and dated July 24, 1806 (No. 2931). This specification reads in part: "The method of making a machine for manufacturing paper of an indefinite length, laid and wove with separate moulds...a number of moulds of the description called laid or wove, are hooked or fastened together to form one long mould." This term is again mentioned in the English patent of Léger Didot, dated June 2, 1812 (No. 3868), where the specification begins: "Certain other improvements upon the said machine for making both wove and laid paper, etc." The definition given in Rees's Cyclopaedia (1819) is as follows: "By a modern improvement, these marks ['laid-' and 'chain-lines'] are avoided, and the paper has a smooth, even surface. For this purpose the wire is wove in a loom, exactly like cloth, and stretched over the frame of the mould. The wove paper, as it is called when made on these moulds, is a very superior article to the old paper, particularly for books; but a prejudice still prevails in favour of the old paper with lines, which obliges manufacturers still to make it, though by no means so fine or good as wove."

John Baskerville was born in 1706, in Wolverley, Worcestershire. In the year 1745 he entered the japanning trade, where a liking for things of a mechanical nature was developed. While still occupied at his first calling, he started in the printing trade and in this work became one of the most renowned craftsmen in the annals of English typography. He cut the punches for his type and did much to elevate type design in England. The books printed by him are known for their neatness, the brilliancy of the ink, and the smoothness of the paper. This he accomplished by placing each printed sheet as it came from the press, while the paper was still damp and the ink undried, between hot plates of polished copper and subjected them to a slight pressure. Baskerville died in 1775, and from his will, which he had written in 1773, it would appear that he had a mill of some kind on his estate in Birmingham, for it directs that his body is "to be buried in a conical building in my own premises heretofore used as a mill, which I have lately raised higher and painted, and in a vault which I have prepared for it." It may be that Baskerville carried on the craft of papermaking, as several writers suggest, in the building mentioned in his will, but it is probable that this structure was not of sufficient size for this purpose. According to Thomas Hansard in his Typographia (1825), the mill mentioned in the Baskerville will was nothing more than a tomb of masonry in the shape of a cone, under a windmill. Baskerville's house was destroyed in the riots of 1791, but his remains continued undisturbed until 1821, when a canal was cut through the estate and his leaden coffin was exhumed and reburied in a spot that is now a question of debate.

I do not care for "wove" handmade paper for book-printing, unless it be of Oriental origin; the European type lacks character and possesses not nearly the quality and beauty of the original "laid" paper. It is hardly proper to use old-style type in printing a book upon "wove" paper, and it is perhaps an anachronism to mark machine-made paper with "laid-lines," for paper formed on a machine is naturally of the "wove" variety and any "laid-line" watermarking applied by use of a "dandy-roll" is an imitation.

In 1790 John Phipps, an Englishman, patented a method for teaching writing and drawing by means of watermarked lines in paper. The specification is dated August 21, 1790, and reads: "A method to facilitate the acquirement of several of the useful and polite arts by an easy, effectual, and expeditious manner of teaching writing and drawing, which is done by fabricating the moulds, wove or washing wires, or other wire on which sheets of paper are made, so that every sheet shall come out of or from them properly adapted for the purposes, when finished by the maker in the usual manner, by having the lines made and the copies set for writing, and the outlines and sketch for drawing, by what is called the watermark, for the learner to trace over." This absurd method for the teaching of writing and drawing was but little used, and the interest in the novel idea lies chiefly in the fact that this was the first English patent pertaining to moulds for papermaking. The earliest American patent relating to paper-moulds was granted on April 11, 1793 to John Carnes, Jr., of Delaware; the original patent was destroyed by fire in the Patent Office and no record of it is available. The first English patent to
deal with the actual making of moulds followed the American patent by about three months, being dated June 27, 1798 and granted to Joseph Moseley Elliot. The abridged description reads: "A machine or engine for working and binding of wire, and making of moulds used by papermakers, and for the more correct and expeditious method of working and binding wire for sieves, screens, etc."

While there are no rules for distinguishing the paper of one century or country from another, it is possible by making a study of the texture and fibre of the paper and of the "laid-" and "chainlines" and the character of their impressions to arrive at the approximate date and determine in what country and under what conditions the paper was made. With European "wove" paper, it is not easy to attach a date to the sheets, but paper of this type was usually watermarked with the year in which it was made and as wire-wove paper of the Baskerville style has been in use only since about 1750, it has not sufficient age to excite much curiosity from a historical point of view. As the first paper made in the Orient was formed on crudely made moulds covered with loosely woven cloth, we must accept the "wove" as the original type of paper. The "laid" bamboo mould came into use a number of years later, and as it was the first style of mould from which a sheet of paper could be taken while wet, this invention must, as I have said, be considered the most important step in the development of Oriental papermaking. Long after the advent of the bamboo "laid" mould came the wire "laid" mould of Europe first fashioned with iron wire and later with the more durable and non-rusting brass. In the middle of the eighteenth century the vélin type of mould was reinvented, but instead of using the woven fabric of the East, from which a moist sheet of paper could not be taken, a woven brass screen was employed which formed a firm and rigid surface. At the close of the eighteenth and the beginning of the nineteenth centuries came inventions for making paper by machine. These inventions used the original idea of the transfer, or Oriental, mould, except that in the machine the mould was continuous, and formed the paper, not in single sheets as by hand, but in any desired length. The great paper industry of today is built upon the original Oriental bamboo mould which came into being almost two thousand years ago.

MODERN HANDMADE PAPER—MOULDS OF EUROPE

The ordinary moulds (Figure 102) in use in commercial hand-made paper mills of today are usually made of mahogany, the material being about five twelfths of an inch in thickness and constructed like a very shallow rectangular box, without top or bottom. The corners are joined as shown in (c) and (d) of Figure
centre lines are perpendicular to the faces of the frame, the wide edge being down. This makes the opening between the ribs smaller at the bottom than at the top; and when the frame is raised vertically upward through the liquid stock, this construction causes more of the liquid to be lifted than flows immediately through the opening, the result being that a partial vacuum is left behind, which causes a slight suction. The ribs are braced by two heavy brass wires running through them lengthwise of the frame (from one short side to the other), as shown in Figure 103b (c).

After the wooden parts of the mould have been completed, with frame, ribs, and fastenings in place, the wire covering is added. This covering may be either “laid” or “wove,” since the woodwork is the same in either case. For making a “laid” mould, the first covering added is a series of wires that act as a backing. These backing wires average about nine to the inch. The heavier wires of this backing run the long way of the mould (from left to right as the mould is held in the hands of the papermaker). However, before this backing is added to the wooden frame, it is stitched together with finer wires running in a direction at right angles to that of the heavier wires running lengthwise; and these finer wires are so spaced that each falls directly over one of the wooden ribs. After the backing wires are applied, the “laid” wires are added. These wires are woven in the same manner as the backing, but the “laid,” or outside, wires are spaced closer together, averaging about twenty-two to the inch in an ordinary mould. The two coverings, the latter on top of the former, are stitched or sewed to the ribs with fine wire, the ribs being pierced for the purpose, as indicated in Figure 103a (e). The ends of these wires are fastened with small copper nails along the mahogany frame, the entire four edges being bound with a narrow strip of copper, thus securing all of the free ends of the wires. A finished mould is shown in Figure 103b (b). In comparing the European mould “laid” covering (Figures 94, 96, 102) with that of the Orient (Figures 51, 52, 54, 55, 72, 75), the similarity will be noted, as the “laid” brass wire mould of the Occident has been founded and patterned directly on the Oriental “laid” bamboo mould of ancient times.

In a European “wove” mould (Figure 101), the covering is finely woven brass wire, made in the same manner as window
screening, only more compact, the average number of wires, both ways, being about fifty-two to the inch. The “wove” covering is applied to the wooden frame of the mould over a backing of coarser woven wire, and is stitched to the ribs of the mould so as to lie flat. It is then tacked and bound with strips of copper in the same manner as the “laid” covering. Along the four edges of the “wove” covering the wire gauze is pierced with holes to help drainage. These holes are about three eighths of an inch apart and placed so that they come under the deckle when it is placed on the mould.

Over the mould, whether it be “laid” or “wove,” is fitted a deckle, shown on the larger mould in Figure 102. It is the deckle that determines the size of the sheet to be made on the mould, but it has little to do with the thickness of the sheet of paper. In commercial papermaking by hand there must be two moulds and one deckle for every size of sheet that is to be moulded. The deckle, or fence, must fit each mould equally well and should slip on and off easily. A sectional view of the deckle, taken on the line ab, is shown in Figure 103a (a). Figure 103a (b) shows a corner of the deckle as viewed from underneath; that is, when looking at the side which lies next to the mould.

The making of moulds and deckles for commercial handmade paper mills is extremely difficult work; it requires not only great skill, but also a good knowledge of materials. The wood must be seasoned with care, since it has to withstand the constant strain of being in and out of warm water, as I have said before. There are no firms in America making wood moulds for handmade paper, but in England there are several artisans engaged in work of this kind.

More than 240 different sizes of paper are manufactured at the present time. Handmade paper can be formed in any desired size, depending upon the dimensions of the moulds. The best-known sizes of European papers are the following:

Antiquarian, 31 by 53 inches. The largest paper made by hand in Europe, manufactured only by the James Whatman mill, Maidstone, Kent, England. The paper is used for drawing and for printing large books, maps, etc.

Atlas, 26 by 34. Drawing and printing paper originally made for maps and atlases printed from engraved plates and coloured by hand.

Billet Note, 6 by 8. An old-style size of correspondence paper.

Colombier, 23% by 34%. A writing and drawing paper originally watermarked with a dove, the emblem of the Holy Spirit. The dove watermark was common in American papermaking during the eighteenth and early nineteenth centuries. It was extensively used by the Pennsylvania papermakers.

Crown, 15 by 20. A standard size of printing paper watermarked with a regal crown. Papers are also known by Half Crown, Double Crown, Extra Double Crown, etc. C. M. Briquet in his four-volume work Les Filigranes (1907) depicts more than 275 different versions of the crown watermark in use previous to A.D. 1600.

Demy, 17% by 22% printing paper; 15% by 20 writing paper and drawing paper. The term demy is from the French demi, half.

Elephant, 23 by 28. Also Double Elephant, a plate printing and drawing paper measuring 26% by 40 inches. This paper was originally watermarked with a crudely executed figure of an elephant.

Emperor, 48 by 72 inches. The largest paper ever to be made by hand in Europe. (See: Antiquarian) The Chinese have made paper in a hand-mould measuring 48 by 84 inches.

Foolscape, 13% by 17 printing paper; 13% by 16% writing paper. The name is taken from the ancient watermarked emblem of a court jester and dates from the middle of the fifteenth century. In England the foolscape watermark was replaced by the figure of Britannia.

Grand Eagle, 28% by 42. A standard size of drawing paper. The term was taken from an ancient watermark of the eagle dating as early as the beginning of the fourteenth century.

Hand, 16 by 22 Middle-hand; 20 by 25 Royal-hand. The ancient hand watermark has ceased to denote a special size, but was originally derived from the watermark of a hand or glove. Briquet pictures upward of one thousand different hand devices used by European papermakers previous to the year 1600.

Imperial, 22 by 30 writing and printing paper. Also Double Imperial, Large Imperial, Small Half Imperial, etc.

Post, 14% by 19 writing paper; 15% by 19% printing paper. The watermark was derived from the ancient emblem of the post-horn. The horn watermark dates from the fourteenth century and was used by Pennsylvania papermakers in the eighteenth century.

Pott, 12% by 15% with slight variations. The name was originally derived from an emblem representing the Sun-god, a pot or chalice.
thought to have been divided into different compartments for holding food or drink. Briquet illustrates almost one thousand variations of the pott watermark previous to the year 1600, the earliest being from 1322.

Royal, 19 by 24 writing paper; 20 by 25 printing paper. Also Double Royal, Half Royal, Super Royal, Extra Royal, etc. Formerly watermarked with an ornamental shield surmounted by a fleur-de-lis.

V
The Maceration of Materials for Papermaking
FROM THE PRIMITIVE MORTAR AND PESTLE OF ANCIENT CHINA TO THE IMPROVED HOLLANDER OF EUROPE

The earliest papermakers, the Chinese, may at first have used silk, both raw and woven, as material for their paper; in later years mulberry bark, hemp, bamboo, and other fibres were used. Certainly it is significant that the two prominent Chinese characters, of ancient origin, denoting “paper” embody the meanings of both silk and cloth. In the most common character for “paper” (紙, chih), we find radical 120 (糸), of six strokes, meaning “silk.” The other, less common character for “paper” (描) embodies the radical 90 (巾), of three strokes, meaning “napkin” or “cloth.” The remaining parts of these two characters are made up of radical 80 (勹), of four strokes, meaning a surname.1

The original Chinese method of beating or macerating the cloth or bark to a pulp was by placing the material, with water, in stone mortars and pounding the mass to fibres by means of pestles, or mallets, operated by hand (Figure 104).

The Arabs learned the craft of papermaking, A.D. 751, from Chinese prisoners in Samarkand. In their own country the Chinese at this date used the bark of mulberry trees for their paper, but, this material not being readily available in Samarkand, the Arabs employed linen as a substitute.

The Arabs probably disintegrated linen rags by placing them in heaps, saturating them with water, and allowing a fermentation
to take place, then boiling the mass in wood ashes. The boiled rags were then placed in cloth bags and suspended in a running stream, the action of which removed a great part of the alkaline residue and much of the dirt (Figure 105). The original method of beating the cleansed rags to a pulp was doubtless an imitation of the Chinese manner, but later in the development of papermaking by both the Chinese and the Arabs a trip-hammer was put into use. The workers treading upon the end of the horizontal tilt-bar of this implement caused the hammer to fall heavily upon the substance to be beaten (Figures 110, 111, 114). This required far less labour than the mortar and pestle of the ancient Chinese, yet for hundreds of years after the improved method of maceration had been invented by the Arabs and adopted in various parts of Asia, the hand beating of the bark for papermaking was employed in China and Japan. The cleansed bark was wetted, laid on a heavy stone, and pounded with wooden clubs or mallets. To this day many of the more remote handmade-paper mills in China, Korea, Siam, and Japan (Figures 106, 107, 108, 109, 115, 116, 117) employ this centuries-old method of reducing the barks to usable fibre. In the paper-villages of Tonkin, Indo-China, some of the workers in paper are using at the present time the old mortar with pestle wielded by hand, the most ancient Chinese method (Figure 112). The raw material of Indo-China is mulberry and bamboo, which after being boiled in lime may be readily beaten in this manner (Figure 113). The ancient Samarkand method of beating is still in use in many of the modern handmade-paper mills of India. The native papermakers of India use as their raw materials jute, discarded gunny sacks, and old papers. These substances are cut to bits, and placed in stone or wooden troughs, where the material is allowed to soak in lime for a period of sev-
eral days. After this mildly disintegrating process has been completed, the material is thrown into rough stone mortars sunk in the ground, where it is beaten by heavy pestles, like huge hammers, balanced on pivots. Men and boys stand on the long horizontal beams, letting the hammers fall upon the jute or other material over and over again until the substance is beaten to a pulp suitable for forming into sheets of paper (Figures 118, 119, 120).

This process is practically identical with that of Samarkand in use a thousand years ago. In several of the old papermaking villages in central Korea and southern India there remain remnants of a former method of beating by means of stone rolls that had been actuated by animal power. Owing to the scarcity of grass and food for the beasts, however, this method of macerating papermaking material in both Korea and India has long since given way to manual labour (Figures 121, 122, 123).

In the present-day handmade paper mills of Japan the beating is carried on in some of the larger establishments with modern equipment, but in many of the smaller mills this work is performed in a most primitive manner, by action of hand-wielded mallets. In the government mill, Tōkyō, where the superb "vellum" papers are made, the barks of the mitsumata, mulberry, and gampi undergo careful cleaning processes, all done by hand in the most painstaking manner (Figure 124); the barks are finally boiled in cauldrons that suggest the appliances of past generations (Fig-
Fig. 108 Mrs. Plung Niltong-kum preparing the bark of the khoi (Streblus asper) for the hand beating process. Since this photograph was made, in Bangkok, southern Siam, the old lady has died and the daughter (Figure 109) has ceased making paper, a family craft for many past generations.

Fig. 109 The beating of the inner bark of the khoi tree of Siam is done by pounding the material with a wooden mallet as the moistened bark is spread upon a heavy plank or stone. Several of the long, narrow "wove" moulds may be seen behind Luolin Niltong-kum, the young lady who is doing the beating.

Fig. 110 Maceration of papermaking material in China, by means of the trip-hammer actuated by foot power. (From Arts, métiers et cultures de la Chine, Paris, 1814.)

Fig. 111 The interior of a Chinese paper mill, showing at extreme right the huge hammer employed in the maceration of papermaking materials.

Fig. 112 The most ancient method of beating paper stock, as practised at the present time in the Paper Villages, near Hanoi, Tonkin, Indo-China.

In my visits to the Imperial paper mill I was amazed to see the dilapidated condition of the buildings and the muddy, unkempt surroundings of the premises. Few of the glass windows in the buildings remained intact and the entire structure gave the appearance of poverty and lassitude. To somewhat lesser degree the same could be said of the Imperial printing office, where the exquisitely watermarked paper from the Imperial mill is printed in the most elaborate and delicate engraving on American-built presses. The Japanese paper money is the most difficult to counterfeit of any currency issued in the world, owing more, perhaps, to the paper than to the fine engraving. In talking to a boastful director of one of the large paper mills of Japan I was given to understand that Japanese artisans could duplicate the United States paper money with ease, but, much to my informant's delight, I was told that no government of the Western world could successfully imitate the Japanese money. This is not only due to the fine water-