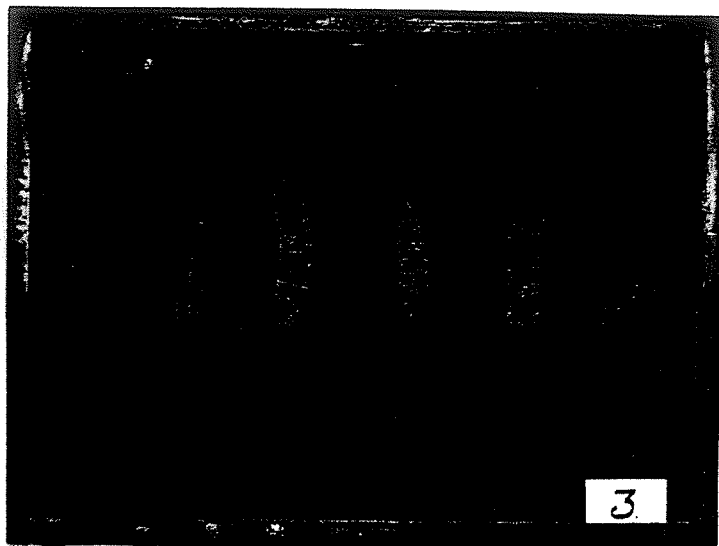


Papermaking Moulds

Simon Barcham Green



Made in March 1919 by Amies for the "Banque d'Outremers Bruxelles". Wove single-sheet 32" x 23.3" (Whole Imperial or Large Imperial), 2 rods and crossed stays. The sheet folded in half to 23.3" x 16", which could have been a large ledger or register.

On learning that Barcham Green & Company Limited owned one of the most interesting collections of European hand papermaking moulds in the world, we were eager to present information about these finely-crafted, utilitarian objects. We asked Simon Barcham Green, of Hayle Mill, to provide some insights into these moulds and the influences they had on standard paper sizes.

Functional, precise, durable and light are some of the characteristics that papermakers look for in the moulds that are their key tools. Over the centuries, moulds have evolved into the elegant but simple devices that we know so well. In different parts of the world they have developed in different ways; this article looks primarily at the European type of mould, especially the English variant.

Moulds and Paper Sizes

E. J. Labarre, in his excellent Encyclopaedia,¹ lists over three hundred named sizes of paper but concludes these are all variations of only fifteen names and only half a dozen actual sizes. Some of these variations are quite bizarre, like "Double double small hand" (40" x 30", which is the same as Quad Crown) and "Pinched Post" (18 1/2" x 14 1/2"). Yet we have plenty of moulds in stock whose sizes do not correspond to anything in Labarre's list. What practical reason can there be for this?

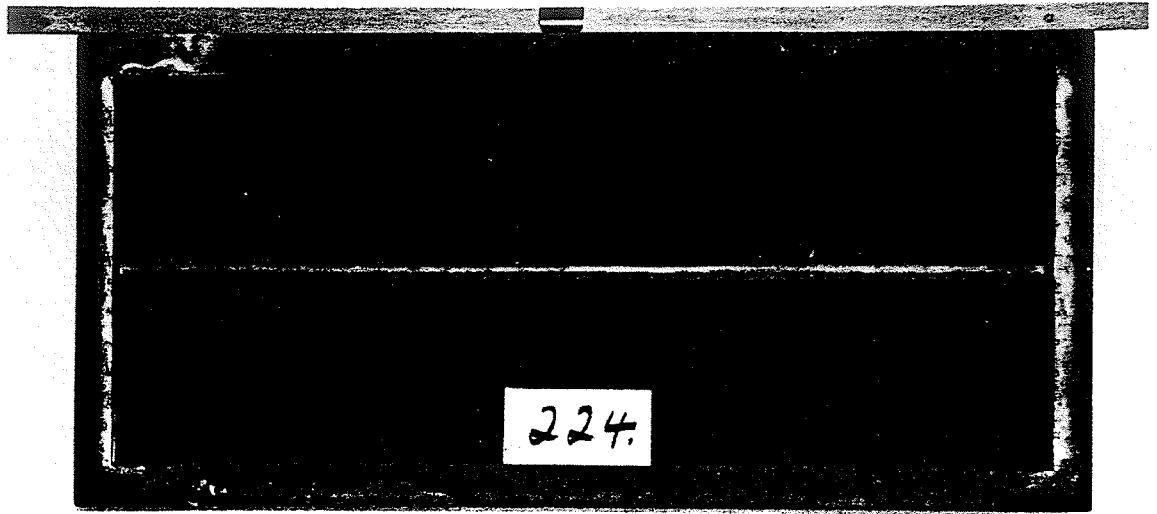
There is none, because the driving factor behind paper sizes must surely be market forces with which, somehow, the papermaker had to comply. Practical factors do, however, affect the sizes of paper moulds and this may account for the common sizes Labarre refers to. In his analysis, he points out that most paper

sizes have a length to width (or more often a width to half the length) ratio of about 1.6, which is similar to the Golden Section. This can be partly explained by market requirements, in that books and letters would tend to be sought in familiar and aesthetically pleasing proportions. However the shapes and sizes of handmade paper that can be produced depend on what a vatman can handle, which, in turn, is influenced by the span of his arms and, to go by many old photographs, the size of his beer belly!

Anyone who has made paper on square or nearly square moulds will know that they do not feel quite right. This is partly because a square mould does not seem to balance as well as a more extended shape. In addition, any mould width of more than about 25 inches is difficult to hold away from the body, which is necessary while forming sheets.

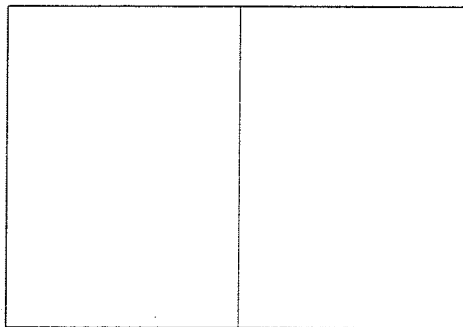
One of the largest English sizes made by hand (but not at Hayle Mill) was Grand Eagle (42" x 28"). Double Elephant (40" x 27") was more common. Small moulds could be a problem because to make small sheets one at a time was grossly uneconomic. The answer was to use two, three, or four sheet moulds with divided deckles or to subdivide the sheets with tearing wires (which formed heavy watermarks) to facilitate the tearing down of the sheets when dry.

Dard Hunter² states that two-sheet (or double) moulds were introduced in Europe by the Whatman Mill in 1826 but this is refuted by Schulte³ who ascribes the invention to Holland, although he is not specific about the date. Because of their considerable width and weight, two-sheet moulds were strongly resisted by the workers at first and indeed were never accepted in some countries.



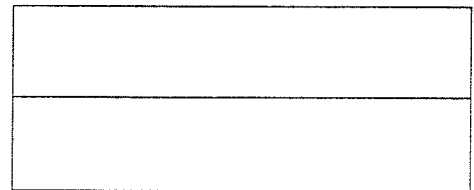
Made by Amies, date unknown, probably pre-1913 and maybe 19th century. Wove two-sheet 25.4" x 5". An unusual pair of moulds with the dividing deckle bar running from hand to hand. This would have tended to cause problems when the wave jumped over the divider. The wooden divider is covered with a brass strip, perhaps an attempt to reduce the problem. The moulds were clearly for bills and at the end of each sheet there are traces of an old watermark. Frustratingly the only legible word is "Bank." Folded in two the sheet becomes 12.7" x 5" which is still very elongated. The watermarks took up 9", leaving about 4" for a counterfoil. It appears that we may have purchased these second hand (but hardly used) in 1913 and removed the watermarks, perhaps never finding any use for them. (In the Hayle Mill historic collection.)

Our collection of 258 sets of moulds included 82 pairs of two-sheet moulds of which only two had sheets abutting on their long sides, like this—

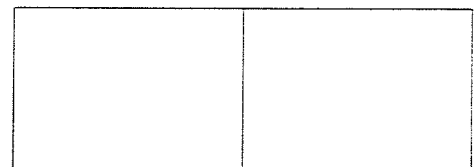


—making nearly square moulds, with the deckle divider running away from the vatman. Of these, one was quite small and clearly experimental. The other measured 34 1/4" x 27" overall, producing two sheets of 25" x 15 3/8". These moulds were made in 1986 and not only did we find them very awkward to handle, but also the 25" long deckle divider did not cut well.

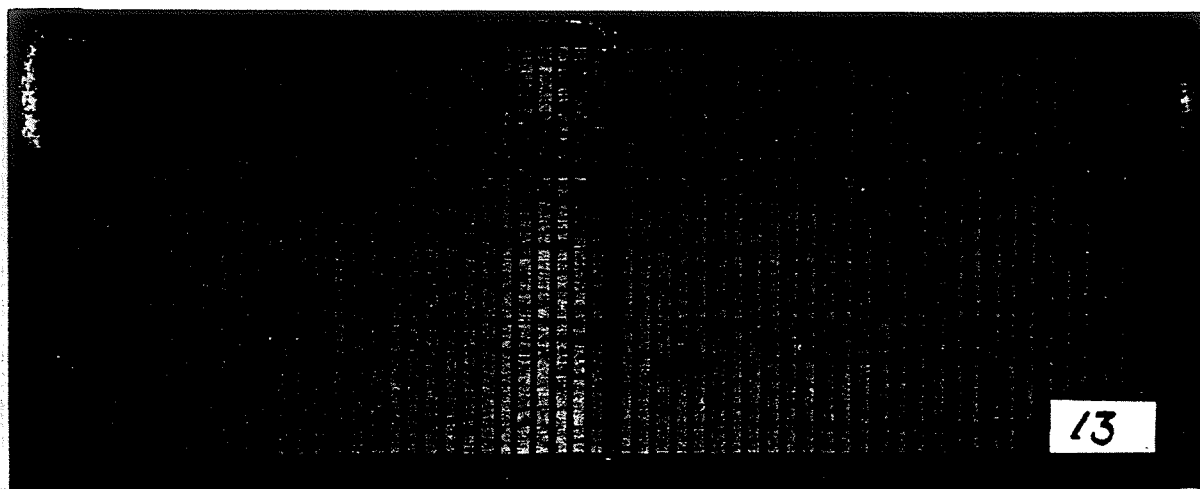
A third two-sheet mould was divided from hand to hand, which almost certainly gave problems as the wave crossed it.



Most of the other two sheet moulds were very long, the largest measuring 49 3/8" x 20 1/2", producing two sheets of 23 1/4" x 18 1/4" ("Medium"). In later years we found these moulds very difficult to use and inevitably, without decades of experience, it was hard not to make wedgy paper (thicker at one end than the other).



We had only two pairs of three-sheet moulds and three four-sheet moulds, the sheets meeting at their long edges in all cases.



Made in 1927 by Amies for Joseph Batchelor & Son of Little Chart, Kent. Fine single faced laid two-sheet 20.6" x 15.2" (Demy), 2 rods, no stays. Used to make "Crown and Sceptre", one of the "Kelmescott" papers derived from those made by Batchelors for William Morris. The watermarks illustrate the crown and sceptre resting on a book and the oval device of the Original Society of Papermakers, showing four hands gripping each other by the wrist. Forty-five pairs of moulds and the rights to make Batchelor's papers were acquired by J. Barcham Green Limited in 1945. (Now in the Takeo Collection, Tokyo, Japan.)

Most paper produced at Hayle Mill until the late 19th century was made to customers' specifications and a lot of it was for security papers. These often required sizes that might seem unusual until you realize that they were to be folded and might include a counterfoil. However, there is an indication that we used mostly standard sizes. In the archives we have a handwritten list of prices from Edwin Amies and Son, mould-makers, dating from 1878, which reads as follows:

	Size in Inches [†]	Without watermarks	With watermarks
<i>ONE-SHEET MOULDS</i>			
Medium	23 x 18	£ 5-5-0 [§]	£ 5-10-6
Royal	25 x 20	£ 5-5-0	£ 5-10-6
Double Foolscap	27 x 17	£ 5-5-0	£ 5-17-6
Super Royal	27 x 19	£ 5-7-6	£ 6-2-6
Imperial	30 x 22	£ 6-6-0	£ 7-0-0
<i>TWO-SHEET MOULD</i>			
Foolscap	17 x 13 ½	£ 6-0-0	£ 7-5-0
Small Post	18 x 14 ½	£ 6-17-6	£ 8-3-0
Large Post	21 x 16 ½	£ 7-15-0	£ 9-0-0
Demy	22 ½ x 17 ½	£ 7-5-0	£ 8-10-0
Copy	20 x 16	£ 7-10-0	£ 8-0-0
Medium	23 x 18	£ 8-8-0	£ 10-0-0

Other sizes were quoted by area; e.g., 150-200 square inches for £ 2-15-0 and 450-500 square inches for £ 5-10-0, both without watermarks.

It is interesting to note not only the fairly small difference between large and small moulds but also how cheap watermarks were and that there did not seem to be any limitation on their complexity. Also they did not bother to quote for one-sheet moulds for the small sizes.

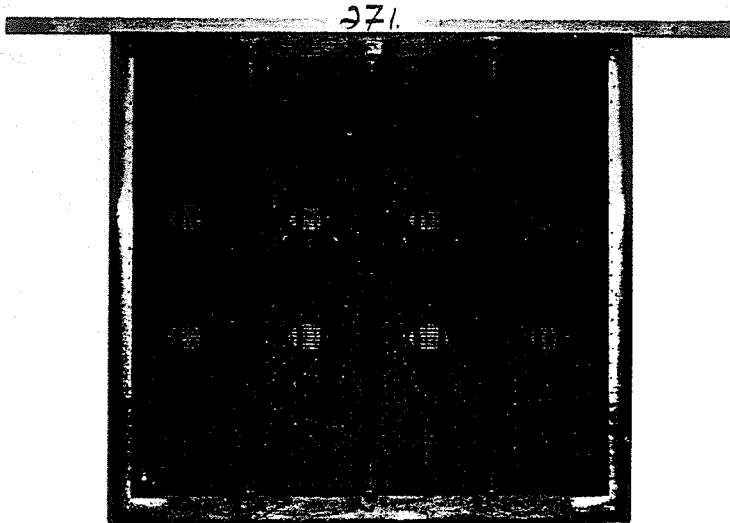
Mould Construction and Quality

Other authors have dealt with details of mould construction (Coleman⁶ and Moore⁷), and Loeber⁸ not only covered this in great detail but also set out important design criteria. At one time I would have thought that the features they describe were all absolutely essential to making good paper. As I was brought up with beautifully crafted moulds, I always assumed that nothing else would do. At Hayle Mill this was certainly the case and we became very unhappy at any deficiencies in moulds, old or new. Now I would have my doubts, at least about some details in some circumstances.

Having visited many papermills, workshops, and small factories in the last few years, I could not fail to notice the variation in mould design and quality. Most British moulds aim for the same standard, although there are many interesting variations in details.⁹

Moulds in other European mills differ significantly from British moulds. They are often much lighter, with quite slender deckles, softer wood and sometimes of fairly loose fit between deckle and mould. The differences are certainly not obvious in the papers, however.

In many parts of India, European-style, rigid, wire-covered, wove moulds are used, albeit with a different dipping technique. Generally the construction is simpler and deckles usually have a plain rectangular cross section and are held on to the mould rather than fitting around it. As deckle edges are trimmed off in India and quality targets are not as high as in Europe, the moulds seem more than adequate for the paper-makers' needs.



Made by Amies in June 1890. Wove four-sheet 18.8" x 4.6".
 Coutts are well known bankers and these were presumably bills of exchange for dealing with Francophone countries. The lozenges are debossed and unwatermarked, perhaps so that the thicker area of paper can be die-stamped. They appear light in the photograph because the rest of the mould has three layers; a laid backing wire, a coarse wove secondary backing; and a fine wove cover. This is necessary so that all parts of the cover are properly supported despite the differences in height. There is very little space between each pair of bills for a counterfoil. The oddly placed "propeller" and angled lines may have been intended as a security mark which would be relocated from make to make. There is no sign of them having been moved or indeed that the moulds were ever used. The moulds are nearly square — 22.6" x 21.2". (In the Hayle Mill historic collection.)

Closely linked to functionality is precision. There are various aspects of this. The deckle needs to fit well, not too tightly or loosely and without allowing pulp to seep under the edge and make unduly feathery edges. It needs to start off with exactly right angled corners and stay that way for perhaps hundreds of thousands of sheets. Printers in particular are rightly fussy that sheets be precisely rectangular. Lack of squareness can be especially obvious in folio books which are not trimmed. Paper can be out of square for many reasons, but to have any chance of success in making paper with right angles the deckle must be as close to perfect as possible.

Watermarks must also be precise in their location, shape, and weight. Laid moulds can present a problem as the watermark sometimes slides along the laid lines to which it is sewn. Andrew Hoyem was very unhappy when this happened with the whale watermark in the paper we made for his Arion Press edition of Moby Dick, as the whale's mouth is gaping open in an unduly large number of sheets. Hoyem was not mollified when I pointed to medieval examples, so I did not add that paper historians and descriptive bibliographers are always thrilled with these little peculiarities.

Moulds have a hard life and, considering this, it is remarkable how long they last. It is always interesting to look at well-used moulds and see where they are suffering. The bottom left hand corner of the deckle is worn, being the first point of contact with the mould. Cracks appear in the corners and the joints work loose (leading to loss of squareness). Brass and copper reinforcements crack and wear and are sometimes replaced. Laid lines are fragile, especially near to the parallel deckle edges. For this reason there is additional sewing when new and it is not uncommon to have to replace parts of the twist wires and several laid wires. Brass wires become brittle so that sewing comes undone. For this reason, phosphor-bronze is preferable.

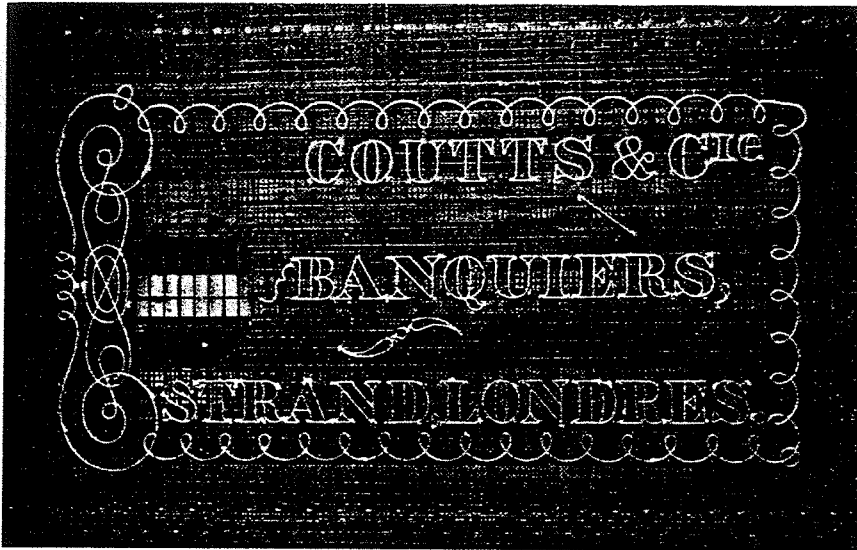
Ribs are vulnerable to damage. It is common for them to be broken where the pin goes into the mould frame. This is sometimes rectified by binding with wire. The coucher's finger nails and the ass can damage ribs in the middle of the long edges and the moulds have reinforcing wire panels fitted near the bottom of a few ribs.

Mould Materials

It must have been tempting for mouldmakers to use harder wood to resist damage, but the timber must also be dimensionally stable and light. Mahogany has been the timber of choice for the last century or more. Its abrasion resistance is not very high and boxwood inserts on the bottom of the frame help compensate for this. We experimented with nylon to replace the boxwood, but found that these moulds slid too much on the bridge and stay.

We also varied the metal parts, using stainless steel instead of brass for reinforcing the deckles and stainless steel, Monel metal¹⁰, and aluminium mesh for wove covers. We returned to brass, phosphor-bronze, and copper, finding little advantage in the alternatives.

There would seem to be plenty of opportunity to experiment with other new materials for wearing surfaces, cover fabric, and the like. To date, synthetic textile covers seem to either sag or slacken with time but it may well be the choice of exactly the right material that counts. Of course such materials, alloy flyscreen, and many other types of mesh work very well when production quantities are small or with smaller moulds. The Filipino paper industry uses such materials almost exclusively and, although I have given much advice there on mould construction, in many cases they are more than adequate. If you are selling abaca paper for 25 or 50 cents a sheet, you cannot readily justify expensive moulds.



Detail of mould shown at left.

Conclusion

One of the curious aspects of mouldmaking is that its history is so undocumented, especially prior to 1800. Papermakers and mouldmakers were not only secretive but seemed disinclined to write anything down about their tools. Often the constructional details would have seemed obvious to them and many of the early craftsmen were illiterate anyway. Furthermore, very few papermill records have been kept over the centuries. There are limits to what can be inferred by studying paper, although that has not hampered some self-styled filigranologists.

This brief article may shed some light from a twentieth century papermaker's perspective on European moulds that have changed little in a hundred years. Perhaps a reader with access to eighteenth or seventeenth century or even earlier moulds and records can add to our knowledge in the future.

Glossary of Mould-Related Terms

- Ass.** A curved, sometimes notched, adjustable prop on which the coucher rests the mould to drain for a few seconds.
- Backing Wire.** A wide spaced mesh, usually laid, which supports the cover wire above the ribs, helping eliminate any trace of the rib in the lookthrough. Used for double-faced laid and for wove moulds.
- Bridge.** A plank of wood fitted across the vat for the coucher to pass the mould to the vatman.
- Cover.** The upper layer of wove or laid mesh on which the sheet is actually formed.
- Double-faced.** A laid mould having a cover wire and a backing wire. The look through shows no shadow mark from the ribs, just the "chain lines" caused by the twist wires.
- Guide Wires.** Thin wires stretched parallel to the ribs and between the backing and cover wires. The cover is sewn down to the junctions of the laid backing and guide wires. There are usually two (sometimes three) guide wires between each pair of ribs.
- Ribs.** The rounded off triangular pieces of softwood (often parana pine, yellow pine, or silver spruce) which join the long sides of the mould at intervals of 1"-2" and which support the backing and cover wires.
- Rods.** Metal (usually brass or phosphor-bronze) rods, about 1/8" in diameter, which pass from one short side of a mould to the other, intersecting and reinforcing the ribs. Most moulds have one rod, centrally placed. Some have two, one each at the one third and two thirds positions.
- Single-faced.** Laid moulds where there is no backing wire. A shadow mark appears in the paper around the chain lines because of the hydraulic effects of the ribs.
- Slip.** A strip of wood attached to the vatman's side of the deckle and projecting below it. It both prevents stuff forcing its way under the deckle as the mould is dipped and can be adjusted so that the deckle is a snug fit. Mould makers supply the slip separately and it is fitted after the moulds have been in use for a few thousand sheets (i.e., a few days).
- Stay.** 1) A wooden (or occasionally brass or phosphor-bronze) stiffening support inside the base of the mould. Stays can be a single diagonal or two crossed diagonals. Sometimes small stays are used to strengthen corners. Not usually fitted to small to medium size moulds but can be added later as the mould weakens.
2) A plank of wood fitted across the vat for the vatman to pass the mould to the coucher. Fits into the bridge.
- Water Bars.** Small ribs (about two thirds the normal height and width) attached to the underside of the wire adjacent to the short sides and to each side of any rib supporting a deckle divider. Their purpose is to help drain away the water and not to support the wire.



Made by Amies, date unknown (but before 1951). A single wove single-sheet mould 30.2" x 25.4" (Quad Pott or Index) with one rod and no stays. An exceptionally attractive and interesting mould about which little is known. The Star and Crescent suggest that the paper was made for the Turkish government and as only one half is watermarked and it is a single mould it may have been a trial. The watermarks are sewn to a separate wove panel which has been sewn in (flush, it is not debossed). However, as the watermark sewing wires go round the backing wire they were fitted after the panel was put in. Some of the twist wires have been removed. Maybe these moulds had had a previous use but this would not normally require a whole section of cover to be replaced, especially as the mould is in excellent and nearly unused condition. (In the Hayle Mill historic collection.)

Notes on the Photographs

The accompanying captions may give some idea of what various moulds were for and why they are certain sizes. The photographs have been taken so as to show the underlying rib structure of the moulds as well as surface details. The number labels all measure 4" x 2" and give an indication of scale. Where names are shown for the sizes, they are either the names we would have used or the nearest sizes in Labarre's Table of Dimensions. The watermarks are not necessarily the name of our customer. For example, a bank might buy from a printer who purchased through a paper merchant. For two-sheet moulds, the size given is that of the sheet rather than the mould.

Photographs of over 250 moulds in the Barcham Green collection and detailed catalogs may be examined at the National Paper Museum Archives, Greater Manchester Museum of Science & Industry, Liverpool Road Station, Manchester, M3 4JP, England (tel: 061-832-2244) and at the American Museum of Papermaking, IPST, 500 10th Street NW, Atlanta, GA 30318-5714, USA. Visitors to the museums should make prior appointments. The collection at Hayle Mill cannot be visited but a full list of moulds for sale will be sent in exchange for two international reply coupons; write to: Barcham Green & Company Limited, Hayle Mill, Maidstone, Kent, ME15 6XQ, England. All photos were taken by Gordon Woodroffe-Hill and are copyright Barcham Green & Co Ltd.

Endnotes

1. Labarre, E. J., *Dictionary and Encyclopaedia of Paper and Papermaking*, Swets & Zeitlinger, Amsterdam, 1952.
2. Hunter, Dard, *Papermaking Through Eighteen Centuries*, New York, 1930, p. 236; repeated in *Papermaking: The History and Technique of an Ancient Craft*, Alfred A. Knopf, Inc., New York, 1947, (republished by Dover Publications, 1978), p. 229.
3. Schulte, A., *Gutenberg Jahrbuch*, 1934, p. 20.
4. Sizes were not given by Amies in inches. By way of comparison, I have taken the most common sizes quoted by Labarre. Demy is particularly variable from 18" x 14.5" to 24" x 18".
5. Prices are in pounds, shillings ($\frac{1}{20}$ th of a pound), and pence ($\frac{1}{12}$ th of a shilling). In 1878, £1 was US \$4.80.
6. Coleman, S. A., "The Craft of Making Moulds for Hand-Made Papers," *Papermaking by Hand in 1967*, J. Barcham Green, Maidstone, Kent.
7. Moore, Tim, "Western Mold Making," *Hand Papermaking*, Volume 2, Number 1, 1987.
8. Loeber, E. G., *Paper Mould and Mouldmaker*, The Paper Publications Society, Amsterdam, 1983.
9. We have moulds from at least twelve British mouldmakers, although all of the moulds shown here were made by Amies, whose moulds make up about two-thirds of our collection. The other mouldmakers represented in our collection are: Bacon & Wayman, Brewer & Co., W. Green, W. Green Son & Waite, Knowles Trotman, R. Larner, J. Marshall, T. J. Marshall, Sinclair, G. Tovey, and W. & R. Balston Ltd. We also have a mould from Tumba, in Sweden, and Tadao Endo, of Shiroishi, Miyagi, Japan.
10. This is an alloy containing 67% nickel, 30% copper, and small amounts of iron, manganese, carbon, silicon, and sulphur. It is stronger and more expensive than phosphor-bronze and may have been used because of wartime shortages of bronze.