Reconstucting a Senefelder pole press

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Over the last few years, probably inspired by the bicentenary of the invention of lithography, several replicas have been made of Senefelder's 'Stangenpresse' or 'pole press'. This was the first press Senefelder found that met his requirements for printing from stone and was invented, he tells us, in 1796.[1] On such presses he printed music from relief-etched stones for a couple of years before inventing the planographic branch of lithography in 1798 or 1799.[2]

The pole press introduced a new idea into press design and construction by using a scraper to apply pressure consecutively across the printing surface.[3] It was different from the common press of the letterpress printer, which applied pressure over the entire area of the printing forme at one pull. It was also different from the rolling press of the copperplate printer in that it could be modified (by using scrapers of different sizes) to apply pressure only to those parts of the printing surface that carried the image to be printed. The scraper has remained central to the lithographic hand press, though instead of moving a scraper across a stationary stone, most later presses involved moving a bed with the stone on it beneath a stationary scraper.

One original Senefelder pole press survives in the Deutsches Museum in Munich.[4] Its provenance is unclear, though it was transferred from the Munich Court & State Library some time in or before 1905.[5] An old photograph of the press in the St Bride Printing Library[6] shows it standing beside one of Senefelder's portable presses; on the top of the press there is a garlanded bust of Senefelder, and on the wall behind it a caption in German that is too indistinct to read. The likelihood is that the photograph dates from the end of the nineteenth century, and more particularly from around the time that the centenary of lithography was being celebrated. There is anecdotal evidence that it was Senefelder' first press,[7] and that it came from his workshop after his death in 1834. Nevertheless, it appears to have undergone some alterations over the years.

At least three replicas of this single surviving pole press were made in the second half of the twentieth century. All are in German museums, two of them not more than 50 kilometres apart in the Gutenberg Museum in Mainz and the Stadtmuseum in Offenbach.

1. See A. Senefelder, *Vollständiges Lehrbuch der Steindruckerey* (Munich and Vienna, 1818), p. 26, and his *A complete course of lithography* (London, 1819), p. 22.

2. For a discussion of the date of the invention of lithography, see M. Twyman, *Lithography 1800–1850* (London, 1970), pp. 11–12.

3. For an overview of the development of lithographic handpresses, see M. Twyman, 'The lithographic hand press 1796–1850', *Journal of the Printing Historical Society*, no. 3, 1967, pp. 3–50.

4. Twyman, 'Lithographic hand press', pp. 13–14 and pl. 2. See also M. Twyman, 'Senefelder's pole press' in the Book Club of California, *The bicentennial of lithography* (San Francisco, 1999), pp. 27–36.

5. *Modern lithographer*, August 1905, vol. 1, no. 8, p. 186.

6. See figure 49 in M. Twyman, *Early lithographed music* (London, 1996). The illustration is similar to the one reproduced by C. Wagner, *Alois Senefelder sein Leben und Wirken: ein Beitrag zur Geschichte der Lithographie* (Leipzig, 1914), figure 8, where the press is shown with a set of scrapers.

7. Wagner, *Alois Senefelder*, p. 26, n. 1, writing as early as 1914, stated that it was thought to have been Senefelder's first lithographic press.

The Offenbach replica was used as the basis for the press made for the Gutenberg Museum in 1967.[8] The third press, in the Museum auf dem Maxberg in the Solnhofen region of Bavaria, was made in 1968 by a local carpenter in Weissenburg.[9]

Well over one hundred years ago, however, a reconstruction of a Senefelder's pole press—rather than a replica of an existing example—was made for the London printing firm of Blades, East, and Blades of Abchurch Lane and put on show at the Caxton Celebration Exhibition in 1877. It is described in the catalogue of the exhibition as 'made from the original Patent Specification taken out in England by Alois Senefelder, . . . and actually at work'.[10] A keepsake was printed on this press at the exhibition. It featured a portrait of Senefelder by N. H. Jacob that had been transferred from an old stone found in Senefelder's Paris printing office (Fig. 1). The additional text below the print states that 'The Litho Press, on which this is printed, is a facsimile of the first Press made in England'. Unfortunately no pictorial record of this press has yet been found, and it is not known what became of it.[11]

To these four replicas or reconstructions of Senefelder's pole press, one of which cannot be traced, we can now add at least three others, all of which date from recent years around the time of the bicentenary of the invention of lithography. In addition to the one discussed in detail here, there is another in the newly established Nederlands Steendrukmuseum, near Eindhoven, which was made for it by Modellbau Rost of Markranstädt, Germany, in 2001.[12] A further replica, now in the Printing History Museum in Houston, Texas, was made around 2000 by Stephen Pratt and his son Ben at the Pratt Press Workshop, Fort Cove, Utah (who have also made two reconstructions of the Senefelder portable press in the Deutsches Museum).[13] Both these replica pole presses were based on the 'original' example in the Deutsches Museum, though in the case of the Pratt press the initial brief was to follow the illustration of the pole press that Senefelder included in his *Vollständiges Lehrbuch der Steindruckerey* (Munich and Vienna, 1818).[14]

Background to the reconstruction

Our approach to the making of a replica Senefelder pole press was made without knowledge of the two projects referred to above, and there is no evidence that any of the three parties knew of the activities of the others at the time. It seems that the bicentenary of the invention of lithography prompted all these projects independently, though for different reasons. Our original idea, formulated as long ago as 1996 and briefly referred to in an article on Senefelder's pole

8. Information kindly supplied by the Director, Dr Eva Hanebutt-Benz, in a letter of 17 July 2002.

9. We are grateful to Drs Mathieu Wetemans for drawing this replica to our attention and to Dr Theo Kress, Freunde des Museums beim Solenhofer Aktien-Verein e. V., for providing us with further information about it.

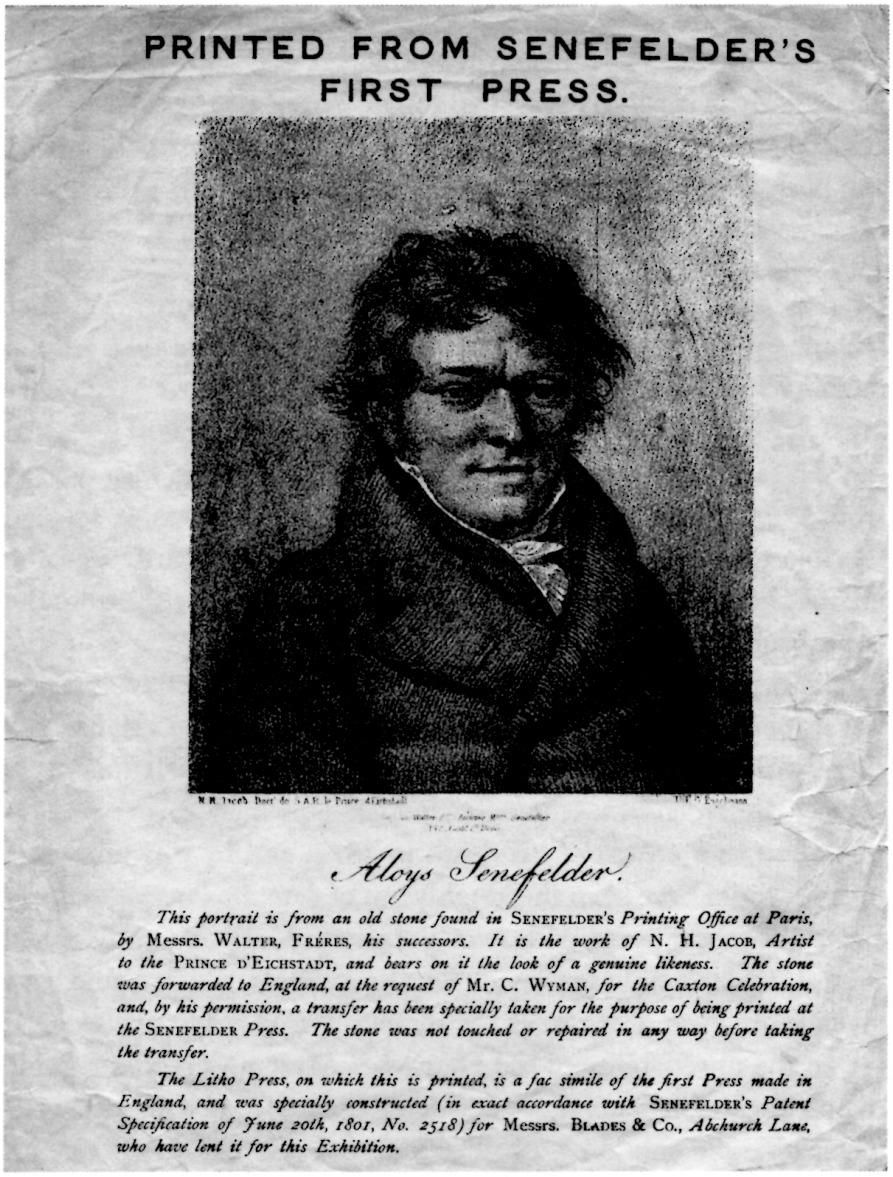
10. George Bullen (ed.), *Caxton celebration, 1877. Catalogue of the loan collection of antiquities, curiosities, and appliances connected with the art of printing, South Kensington* (London, 1877), item 4687, p. 469. A review of the exhibition in *L'Imprimerie: journal de la typographie et de la lithographie*, vol. 4, no. 152, July 1877, p. 113, claimed that the press was made at the expense of William Blades to show lithographers of the day what their fathers worked with.

11. A record of the exhibition, which William Blades compiled in eight volumes shortly after it was over (British Library C.61.e.8), adds little more to our knowledge of the press. It is referred to briefly in a few press reviews, and a copy of the keepsake illustrated in Fig. 1 is to be found in vol. VII.

12. Information kindly supplied by Drs Mathieu Wetemans, who is Librarian of the Nederlands Steendrukmuseum.

13. Correspondence with Stephen Pratt, 2002.

14. Letter from Stephen Pratt, 18 September 2002



1. Keepsake printed on a reconstructed pole press at the Caxton Celebration Exhibition in South Kensington, 1877. The press, no longer in existence, was based on the drawings and description in Senefelder's English patent specification of 1801. The print features a portrait of Senefelder by N. H. Jacob that had been transferred from an old stone found in Senefelder's Paris workshop.

press in the 1998 keepsake of the Book Club of California,[15] was to construct a press for the Rare Book School at the University of Virginia, where one of us (MT) had offered courses on the history of lithography for some years. This project fell through, largely because the Library was being re-organized and available rooms were not high enough to take the press. At this stage the project lost momentum for want of a sponsor and location. In the end, we decided to go ahead and finance the making of the press ourselves simply in order to discover what might be learned from the exercise. This explains the long delay in the project, the first products of which came off the press in the summer of 2002.

Though both of us regularly made lithographs on stone many years ago, there was a clear demarcation of responsibilities within the project. One of us (AM) undertook the work of the construction

15. Twyman, 'Senefelder's pole press', pp. 31–2.

of the press and made decisions about the kind of wood and other materials to use, the other (MT) provided the historical context, particularly in relation to original source material. Together we discussed at length which of several available sources we should follow, and both of us have subsequently taken prints from the press.

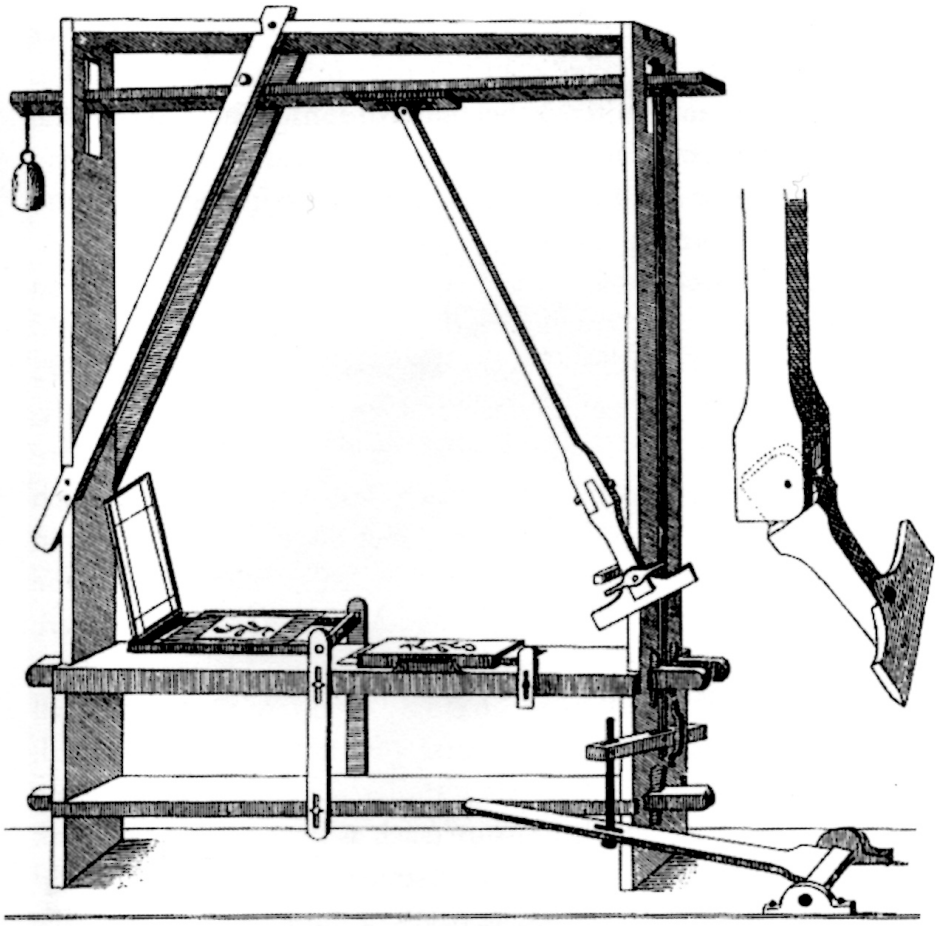
Sources used

In arriving at our decision to follow the illustration Senefelder included in the first edition of his treatise in 1818 we took several factors into account. We decided not to use the 'original' Senefelder press as our model, as we already knew that two replicas of it existed (in Mainz and Offenbach). Since one of our objectives was to learn from the experience of making and using a pole press, it seemed sensible to turn to another legitimate source, and particularly so because both of us had been privileged to take a few prints from the Offenbach press. There was also the consideration that both the date and provenance of the pole press in the Deutsches Museum were open to question. Even if such things could be established, there would remain a question mark over its status. It may have been a discarded press that Senefelder happened to have in his workshop at the time of his death in 1834; and by this time pole presses would have been thoroughly out of date. In any event, it had clearly been tampered with over the years. Most obviously it had been altered in height to provide for a longer pole, which would have given more even pressure as the scraper passed across the stone.[16] Given the unreliability of the Deutsches Museum press as a guide to pole presses in general, we decided to turn to a verifiable drawing instead.

The most reliable early drawings of pole presses are the ones described in the English and French patent specifications (English 1801, French 1802).[17] Both included illustrations to clarify their verbal descriptions, though the English version is substantially fuller and more helpful in every respect. All the same, both accounts and sets of drawings were made in the very early days of lithography, and some years before it got off the ground either artistically or commercially. On the other hand, the illustration of a pole press printed in the first two German-language editions of Senefelder's treatise provides a considered view of the press after it had been in use for the best part of twenty years. It is reasonable to assume therefore that this drawing, coupled with Senefelder's own account of the manufacture and use of the pole press, provides a reliable source of information for a reconstructed press. In the light of all these factors, we decided to use the illustration provided by Senefelder

16. Twyman, 'Lithographic hand press'. p. 14.

17. J. A. Senefelder, 'A new method and process for performing the various branches of the art of printing on paper, linen, cotton, woollen, and other articles' (no. 2518, 20 June / 18 July 1801); F. André, 'Pour une nouvelle méthode de graver et d'imprimer' (no. 250, 11 February 1802).



2. Illustration of a pole press in A. Senefelder, *Vollständiges Lehrbuch der Steindruckerey* (Munich and Vienna, 1818).

in his *Vollständiges Lehrbuch der Steindruckerey* (Munich and Vienna, 1818, 1821) as our primary source (Fig. 2).

Problems over dimensions

Almost inevitably there were problems with this approach too. Whereas the pole press in the Deutsches Museum could be measured, and the drawings in the English patent specification were provided with a scale, the 1818 and 1821 illustrations were given no precise dimensions. The only indication of the size of the press illustrated in Senefelder's book is to be found in its text, which refers—not particularly helpfully—to the pole being between six and ten feet long (excluding, it seems, the scraper).[18] The English translation of 1819 simply translates the word 'Schuh' of the German 1818 edition as 'foot', without reference to the differences between the Bavarian and English systems of measurement at the time. In 1826, however, the Bavarian foot was calculated to be the equivalent of '11,375 English Inches, or 0,289 Metres'.[19] The Bavarian foot was therefore approximately 0.95 of an English foot.

By applying the dimensions of the 1801 specification (which are broadly supported by the very flexible interpretation of the length

18. Senefelder, *Vollständiges Lehrbuch*, p. 236; *Complete course*, p. 192. The translation of the 1821 edition of Senefelder's treatise, J.W. Muller, *The invention of lithography* (New York, 1911), refers to the lever as being 'six to twelve feet long' (p. 160).

19. P. Kelly, *The universal cambist and commercial instructor, being a full and accurate treatise on the exchanges, monies, weights, and measures, of all the trading nations and their colonies*, 2nd edn (London, 1826), p. 262.

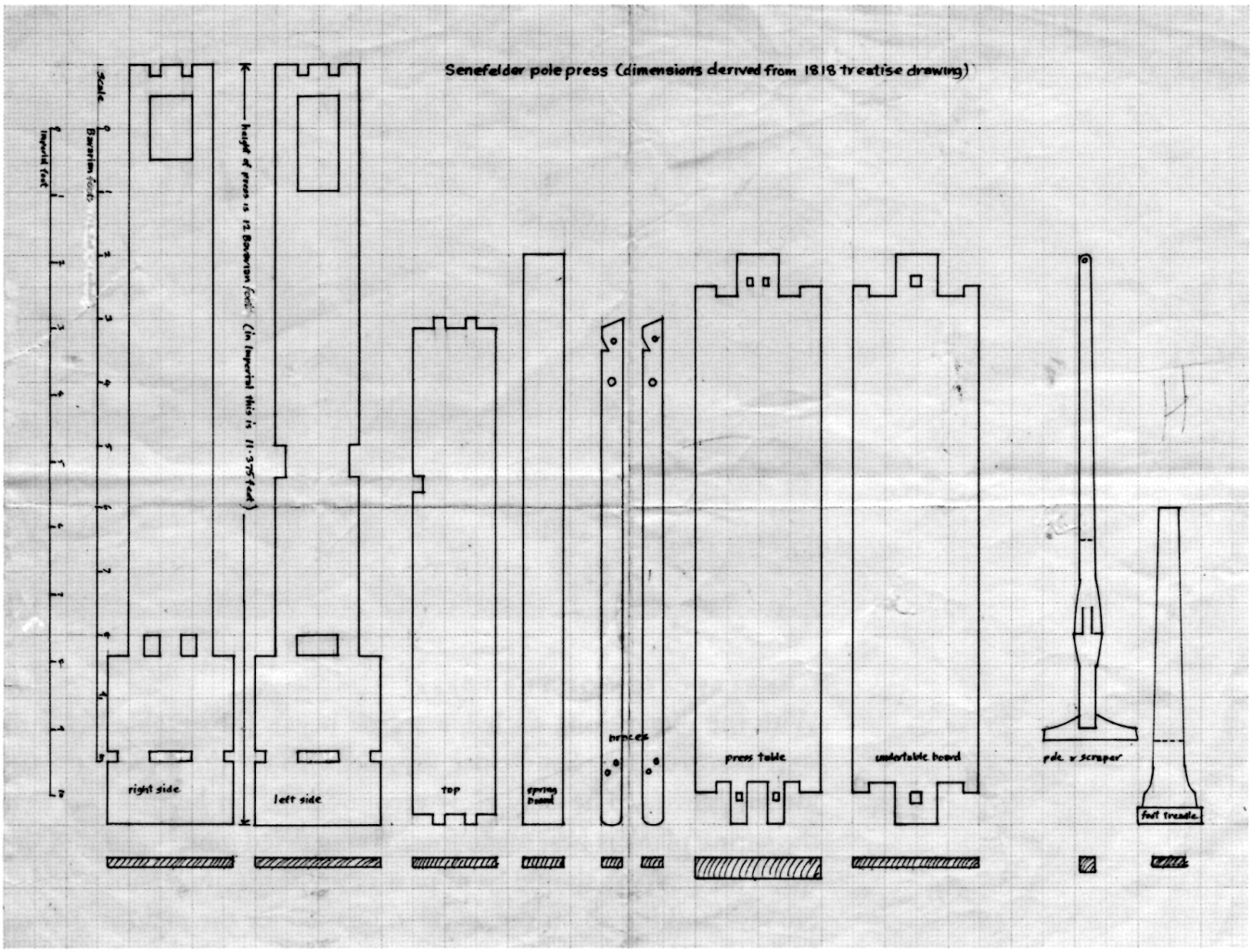
of the pole in the text of Senefelder's treatise), we arrive at a press which is very much taller than the pole press in the Deutsches Museum, even in its altered (heightened) form. There are several possible explanations for this discrepancy, the most obvious being that pole presses came in different sizes to fit different rooms and meet different printing needs.

Given the need for a bed with a working height no lower than around 30 inches, poles of the length described by Senefelder would lead to an overall press height somewhere between around 9 and 12 Bavarian or Imperial feet. In general, German rooms appear to be higher than British ones of the same period. They may therefore have accommodated the tallest such press without too much difficulty, though it must be assumed that there were situations in which smaller (lower) presses were essential. The taller the press, the longer the pole could be, and the easier it would be to describe an arc that was flat enough to give even pressure across the surface of the stone. For this reason, stones would have been easier to print on tall presses than on short ones. Tall presses would have been essential, however, when printing from large stones and from work on stone that required considerable pressure (such as large solid areas of ink work and crayon drawings on grained stones). Shorter presses would have sufficed for circulars, single pages of music, and other small-scale jobbing work. These thoughts confirmed the view that it was worth constructing a press that would come out significantly larger than the one surviving pole press in the Deutsches Museum and the replicas based on it.

Though there are no actual dimensions on the drawing of the press in the 1818 and 1821 editions of Senefelder's treatise, the illustration is carefully considered and presents some dimensional clues. The front elevation is isometric, but the depth of the press is drawn in perspective. By comparing the thickness of the various parts and their relationship to one another, it seems likely that a modular approach was adopted for dimensions (presumably based on the Bavarian foot/inch). Working on this assumption, the thickness of the bed shown in the drawing came out as 4 Bavarian inches, and that of the other main planks as 2 Bavarian inches.

Calculation of depth measurement from the parts of the drawing that are in perspective is more problematic. But Senefelder's texts provide useful clues when they state that the spring plank should be about 8 (Bavarian) inches wide.[20] This gives an approximate scale and allows us to suggest that the side planks of the press are about twice this dimension in width. A drawing of all the separate components of the press framework was therefore prepared (by AM) on

20. Senefelder, *Vollständiges Lehrbuch*, p. 237; *Complete course*, p. 192; Muller, *Invention of lithography*, p. 160.



3. Revision of a working drawing made by Alan May for the reconstruction of Senefelder's pole press shown in Fig. 2. The drawing is scaled in Bavarian feet (Schuhe), Imperial feet, and metres.

the basis of such deductions and calculations (Fig. 3) and this was used as a basis for the construction. It is scaled in Bavarian feet, and gives a press height of 12 Bavarian feet (3.47 m). During the reconstruction of the press, the thickness of the bench top was reduced from 4 to 3 Bavarian inches in order to reduce its weight for ease of handling. For simplicity, measurements in Bavarian feet and inches were then converted to their metric equivalent (and are given in this form henceforth).

There appears to be a minor error in Senefelder's 1818 drawing (Fig. 2), though it is not one that would have affected the operation of the press. The two 'windows' cut through the side planks, one of which is larger than the other, and through which the spring plank passes, have been transposed. The position of the fulcrum on which the spring plank pivots makes it clear that the resulting vertical movement of the plank to its left would have been about half of that to its right.

4. Construction of one side of the press using dowels as a means of joining two planks.

Construction of the press

With the dimensions settled, a search began for suitable wood to start construction. Senefelder says little about the wood he used for his presses. The only clear recommendation he makes is that the spring plank is best made from young dried pine,[21] and that the wood for scrapers should be of pear or an unspecified hard wood.[22] He says nothing about the wood to be used for the main structure. However, the Senefelder pole press in Munich is made almost entirely from pine, as are the two replicas of it in Mainz and Offenbach. European pine therefore became the preferred wood for our reconstruction.

Senefelder's 1818 drawing shows no joins in the planks, some of which are 600 mm wide and 100 mm thick. These days it would be unusual to find wood of such dimensions in a normal wood-yard. Attempts to find pine trees of sufficient girth that could be specially felled and cut were not successful; in any case, planks of the necessary width would have to be cut through the centre of the tree and would therefore probably not remain flat. Although it is likely that large pine trees were more readily available in the early nineteenth century than they are now, edge jointing may have been necessary even then. This method of joining planks can be seen on the under bench portion of both sides of Senefelder's pole press in Munich. In the end, Scandinavian pine planks were ordered, all of them 200 mm wide and either 50 mm or 75 mm thick. They were then lightly planed on both faces to finish approximately 2 and 3 Bavarian inches

21. Senefelder, *Vollständiges Lehrbuch*, p. 237 (ausgetrocknetem Tannenholz); *Complete course*, p. 192; Muller, *Invention of lithography*, p. 160.

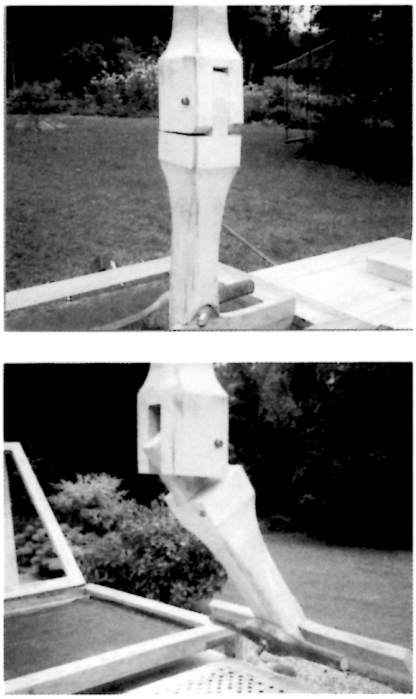
22. Senefelder, *Vollständiges Lehrbuch*, p. 240 (Birnbaumholz);*Complete course*, p. 195 (hard wood); Muller, *Invention of lithography*, p. 162 (pear wood).

thick, and were edge jointed where necessary using the traditional method of joining by means of dowels (tree nails) (Fig. 4).

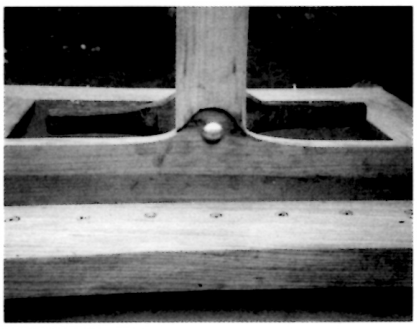
The construction of the main parts of the press took about six days, most of this time being spent on drilling and dowelling the edges of the planks. If wider planks had been used, or if the planks had simply been joined by nailing battens across them, the main framework could have been completed in a day and a half. One of the aims of the reconstruction was to make a press that resembled Senefelder's drawing as closely as possible, so the extra time spent making the plank joins unobtrusive (without resorting to modern gluing techniques) was felt to be justified.

The making, fitting, and testing of the smaller parts of the press took a further week. The pole was made from pine that was 100 mm square at the knee joint, but was reduced and tapered over most of its length to make it lighter. This joint, which is about 400 mm from the base of the pole, was initially cut square. But, on being tested, it became clear that it was dangerously unstable under pressure. It therefore had to be re-cut so that the bottom section of the pole came forward a few degrees (Fig. 5). Before the joint was cut it was known that Senefelder had referred to a problem of this kind, but it was not clear precisely what it was until after the joint had been made. In the 1819 edition of his treatise, Senefelder wrote that it was '. . . therefore, advisable so to unite the parts that they may deviate rather from the straight line, and incline a little to the inside.'[23]

The scraper, which is attached to the base of the pole by a bolt (Fig. 6), was made from cherry wood in the absence of pear (which Senefelder recommended). Cherry seemed to work satisfactorily and four scrapers were provided for use with stones of different sizes. Scrapers need to be wide enough to print the whole image on a stone, but ideally should not overlap its edges as this might lead to stone impression marks on printed sheets and could also damage the leather of the tympan. In addition, minimising the width of scrapers reduces the efforts of the pressman. The four scrapers were made in varied widths from 300 to 450 mm, all of them being 25 mm thick and approximately 100 mm deep. The bottom edge of each of these scrapers was reduced from 25 mm to 2 mm by planing from both sides (Senefelder recommended one twelfth of an inch[24]). Finally, the base of each scraper was planed true and rounded slightly. The curved portion at the top of the scraper fits tightly into a similar shaped recess at the bottom of the pole. The scraper can thus adjust itself to the surface of the stone by pivoting on an attachment bolt. A double handle is fixed to the back of the



5. The knee joint at the end of the pole shown locked in a vertical position (top), and relaxed (above).



6. The scraper, which is fastened to the base of the pole by a bolt. The double handle behind the scraper, which the 'puller' holds, is fastened by the same bolt.

23. Senefelder, *Complete course*, p. 194.
24. Senefelder, *Vollständiges Lehrbuch*, p. 240; *Complete course*, p. 195; Muller, *Invention of lithography*, p. 162.

scraper by means of this same bolt, so that the printer can pull the scraper across the stone under load.

Most of the other parts of the press—the tympan, frisket frame, tympan supports, tympan stop, treadle, and all the linkages and levers associated with pulling down the spring plank—were made from oak or ash. The tympan frame was made from stout hardwood and was recessed on its underside to accommodate a much more lightly constructed frisket frame. The two were hinged together so that, when turned down over the stone, the frisket was on the underside. Strong leather was used for the tympan itself, which was clamped to the frame on the end furthest from the 'puller'; the near side was attached to threaded hooks, which were passed through the tympan frame so that the leather could be tensioned by means of wing nuts. Senefelder states that this leather should be 'strong calf skin, or young ox hide'.[25] The left and right edges of the leather tympan remain free, which means that the leather is always tensioned in the direction of the pass of the scraper. The arrangement of the tympan and frisket had to be based to some extent on that of Senefelder's Munich press, because there is insufficient information about it in the 1818 drawing. The tympan frame was hinged by means of dowels to the tympan supports (the vertical wooden strips attached to the middle of the bench on both sides of the press). They can be adjusted in height by means of wing nuts. This feature, which is shown in the 1818 drawing but is not present on the Munich press, was introduced to accommodate stones of different thickness.

Once all these parts had been made, everything was taken outside the workshop because the framework was far too large to assemble indoors. It was put together on its side so that the dovetailing of the press top and the fitting of the bracing pieces could be completed. These would have been out of reach once the press was made upright. Finally, the various parts were brought together and the press was photographed (Fig. 7) and re-assembled ready for a first trial. Several people saw the press at the time that it was first put up; all were surprised by its size and astonished that so large a structure was necessary to print such a small stone. The reconstruction commissioned by William Blades for the Caxton exhibition of 1877 (see above p. 6), which was based on the drawings in Senefelder's patent specification, prompted a similar reaction in the *Printing Times and Lithographer* of 15 August 1877. The journal's brief account of the press ran: 'We have seen a similar press figured in several works, but our imagination never conceived it to be of the size exhibited. We have no doubt that Mr. Blades has faithfully followed Senefelder's specification, but it is quite certain that such a press could not be got

25. Senefelder, *Vollständiges Lehrbuch*, p. 240; *Complete course*, p. 196; Muller, *Invention of lithography*, p. 162.

7. The reconstructed press showing the tympan and frisket lying open and the pole 'parked' on its hook.

into many of the workshops usually occupied as lithographic printing-offices.'[26] This may explain why the Blades press has not survived.

Printing trials

For the first trial (undertaken by AM), an old drawing on stone done some years previously was washed out and re-inked. It included both crayon and ink work. The stone measured 300 × 375 mm and had an image area of about 200 × 250 mm. It was positioned directly under the pole of the press, with its long side parallel to and in the middle of the bench. The leather of the tympan was coated with tallow on its upper surface to reduce the friction of the scraper when pulled across it under pressure. After tallowing, the tympan and frisket were laid open to the left of the stone (all descriptions here assume that the press is being viewed from the treadle side of the press, as in Fig. 7). A sheet of printing paper was put on the underside of the tympan and the frisket was closed to hold it in place. The tympan/

26. *Printing Times and Lithographer*, vol. III, no. 32 NS, 15 August 1877, p. 167.

frisket height was then adjusted so that, when turned over the stone, the paper was held about 10 mm above the printing surface.

The pole, which is normally 'parked' on a peg on the right-hand upright of the press, was taken up and its knee joint flexed so that the scraper could be positioned over the far edge of the stone. After straightening the knee joint, which has the effect of making the scraper press lightly on the tympan, the treadle was depressed. This movement causes the right-hand end of the horizontal spring plank at the top of the press to descend, and forces the pole with its scraper to bear down hard on the tympan. At first, the scraper was immovable because the pressure being applied was too great. However, the link between the treadle and the mechanism for pulling down the spring plank was designed by Senefelder to be adjusted by means of a series of holes and pegs (shown in Fig. 3), and pressure was relaxed by fitting the pivot pin into a different hole. As soon as this was done, the scraper was pulled across the tympan with comparative ease, though it was still necessary to brace one's body against the press bench in order to get sufficient purchase.

In his original patent specification of 1801 Senefelder writes of this operation in the following way: 'The pressure and force is increased by putting the foot on the pedal or treadle . . . in the moment that the motion forwards is begun.'[27] The choice of the words 'in the moment' suggests that the action of pulling on the scraper and operating the treadle were co-ordinated in a similar way to that of the clutch and gear lever when driving a car. Neither of us found this at all easy, and nor did Stephen Pratt when trying out his press.[28] After the pole had been pulled across the tympan, pressure was relaxed and the knee joint flexed again so that the pole could be parked on its peg. The printing cycle is completed after turning back the tympan, raising the frisket, and removing the printed sheet. Initially, the printed image looked weak, as was to be expected in the normal course of events when beginning a print run, but after four or five impressions had been taken it strengthened. It was then found possible to print an edition of about twenty prints without further adjustment. Furthermore, when these prints were compared with ones taken from the same stone using a powered scraper press, they were found to be in no way inferior. They also seem to have been printed in a much shorter time.

Once it was clear that the press was workable, we met to carry out additional tests (Fig. 8). A new and larger stone was drawn that combined solid areas of ink work, crayon hatching, fine pen and ink work, and ink washes. The stone measured 330 × 460 mm and its image area 250 × 370 mm. The drawing was prepared in the normal

27. Senefelder, 'A new method', p. 8
28. Letter of 18 September 2002.

8. Alan May rolls up a stone during the second set of tests.

way and a series of prints taken. Each impression was numbered and any variables and faults in inking, paper damping, and printing pressure noted. Even though the press was unable to deliver the same pressure as lithographic presses with a movable bed and stationary scraper, it was capable of printing quite large solid areas, in addition to crayon hatching and fine ink work. The printing of the washes was less successful, though this probably had more to do with our inking and damping of the stone than the capability of the press.

Initially we found that pressure was not being applied evenly across the stone, and assumed that this could be put right by applying more pressure overall, but we later discovered that the unevenness was caused by irregularities in the scraper. This last proved to be critical, and the scraper was later made more even. The only other problem we encountered was a tendency for the scraper to embed itself into the soft, tallowed leather of the tympan and become immovable. This happened when the treadle was initially depressed and also when there was a pause in the movement of the scraper across the tympan. This problem was later entirely solved by reversing the leather of the tympan so that the skin side was uppermost.

Those who have learned to print from lithographic stones using geared or electrically powered scraper presses almost certainly tend to use more pressure than is strictly necessary. The use of too much pressure in lithography is not usually as evident in the resulting

print as it is in letterpress printing. In many ways, getting the pressure right when printing on a pole press is easier than it is on presses with fixed scrapers and moving stones. This is partly because of the considerable effort needed when working on a pole press and partly because the 'puller' is acutely aware of the change in pressure as the scraper describes an arc. Sufficient pressure at the beginning and end of the pull is always more than enough in the middle.

Speed of output

The next test was designed to find out how many prints could be taken in an hour when two people worked at the press. The size of the stone used for this test was again 330 × 460 mm, and the image drawn on it consisted of a pattern of evenly spaced dots. The various tasks involved in taking a print were divided up in the following way. The inker charged the roller, damped the stone, applied ink to the stone and cleaned its surface when necessary. The 'puller' opened the tympan and frisket, positioned the paper, closed the frisket and folded down the tympan/frisket over the stone, positioned and operated the pole and its joint, pulled the impression, parked the pole, folded back the tympan and frisket, and removed the printed sheet. Although from the description of the two sets of tasks it appears that the 'puller' had much more to do than the inker, we found that this was not the case. In practice, both sets of tasks took roughly twenty seconds to perform.[29] Furthermore, because the inker and 'puller' worked from opposite sides of the press, and a part of each set of tasks was done away from the stone, the two workers dovetailed their duties. The total time spent taking a print was therefore not much more than the time taken by either worker: the inker charged the roller at the inking slab while the 'puller' operated the pole, parked it and turned back the tympan; the inker then damped the stone and rolled it up while the 'puller' fitted a fresh sheet of paper to the tympan; finally, while the inker returned to the inking slab to recharge the roller, the 'puller' turned down the frisket and repeated the printing operation.

On the basis of this arrangement, a half-hour trial produced 45 impressions. This compares with an output described by Senefelder as follows: 'For pen and ink drawings, of the size of a common folio sheet, . . . and with two workmen, one to put on ink, the other to work the press, twelve hundred impressions may be taken by means of it in one day.'[30] A working day at the time was commonly ten hours, which gives an hourly rate of 120 impressions. In our trials we experienced some difficulty with the stone scumming up, which we attributed to using an ink that was too greasy. In addition, the stone

29. Godefroy Engelmann, *Traité théorique et pratique de lithographie* (Mulhouse, 1840), p. 163, made an assessment of the time it took a lithographer to take a print on common scraper presses of the day. He calculated that the damping and inking of a pen-drawn quarto-size stone took 15 seconds, laying the paper on the stone and removing it 7 seconds, and pulling the stone through the press a further 14 seconds, making a total of 36 seconds.

30. Senefelder, *Complete course*, p. 192.

and print area were substantially larger than the common folio sheet referred to by Senefelder. Bearing in mind these differences, the trials seem to suggest that Senefelder's claim for producing 120 prints an hour on a pole press was not an exaggeration.

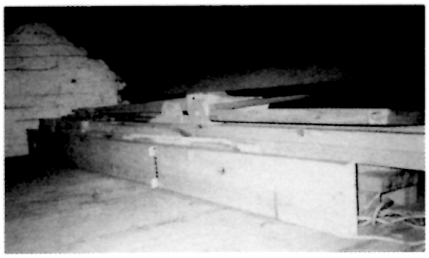
Senefelder's 1818 drawing shows what can best be described as a shelf some 290 mm from the base of the press. The pole press in the Deutsches Museum has no such shelf, though it has a narrow strengthening plank in a slightly higher position. The primary purpose of the shelf in the 1818 drawing may well have been to give greater stability to the construction, but in the course of working at the press it was found to be of great value for keeping paper and other materials needed when printing. It also seems likely that lithographic stones would have been housed there temporarily, partly for convenience, and partly to provide added weight to the base of such a tall press.

The mechanics of the pole press

In his treatise Senefelder writes of his press that 'It would be the most perfect press of all, if its pressure could be raised to more than six hundred weight [300 kg], without exposing the printer to immoderate exertion; and for that reason it is not easily applicable to very large stones, or such as require a great pressure'.[31] In order to test this assertion and gain some knowledge of the pressure necessary to print on a pole press, the test stone (measuring 330 × 460 mm) was placed on the bed of the press with 12 mm of packing beneath it. It was then inked and the pressure adjusted to the minimum necessary for a satisfactory impression. The packing was then removed and replaced by a strain gauge of the same thickness, which was positioned to measure the pressure directly under the scraper. The pressure reading under the edges of the stone was found to be around 200 kg, and in the middle of the stone 270 kg.

When the stone was rotated so that its short side was parallel to the bed of the press, the pressure setting had to be increased. This was necessary because the scraper and pole had to describe a wider arc in its sweep across the tympan. This adjustment increased the pressure in the middle of the stone to almost 300 kg. The minimum printing pressure on the stone across the length of the scraper was 200 kg, which is about 22 kg per square centimetre (about 300 pounds per square inch). The pressure on the press was then increased to six hundredweight (300 kg) at the edges of the stone in order to test Senefelder's hypothesis. The strain gauge was removed, the packing replaced, and an attempt was made to pull the scraper

31. Senefelder, *Complete course*, pp. 191–2.



9. The press after dismantling. It occupies a space of about 3500 × 650 × 650 mm.

across the tympan. It was found possible for one person to do this, but it required considerable effort.

Some measurements of the amount of bend induced in the spring plank and bench top were made with the printing pressure set at 200 kg. The measurements were made with the pole and scraper positioned in two positions and with the treadle depressed. The stone was placed with its longer side parallel to the bench top. It was found that the bend in the spring plank was almost 7 mm with the pole and scraper at the edge of the stone, and 11 mm when they were at its centre. The bend of the bench top was 3 mm in both positions (but would have been less had it been 100 mm rather than 75 mm thick). The total deflection is therefore between around 10 and 14 mm. These values seem surprisingly small, particularly as Senefelder suggests that the spring plank needs to be able to bend by at least 1 inch (25 mm).[32] They are probably an indication that the plank in this replica is too stiff and should be planed thinner (which was later done). The bend in the spring plank is caused by two forces: the pressure imparted by the treadle, and the extra pressure caused by pulling the scraper to the middle of the stone. Measurements of the spring plank on the reconstructed press when the treadle is depressed suggest that its bend would need to be increased by between 14 and 18 mm to match Senefelder's figures.

Other considerations

The most important part of the experiment has been the manufacture of the press itself and what was learned from this. It is now clear that any capable carpenter would have been able to construct a pole press along the lines Senefelder described, and could have done so cheaply and relatively quickly using local materials. It is also clear that much of the detail of Senefelder's pole press is not especially design critical, and that a workable version could be produced with only an approximate adherence to Senefelder's dimensions.

How much care would have gone into the carpentry of such presses at the time is impossible to establish. In the making of the reconstruction described here, no attempt was made to produce an elegant museum piece, or to age the press prematurely in any way. It will be left to mature naturally and will, we hope, be used in a museum setting to reveal more about the practice of printing from stone in the early decades of the nineteenth century.

Among questions that need to be addressed—and might well be better answered in the future by the use of this and other pole presses—are the following:

32. Senefelder, *Vollständiges Lehrbuch*, p. 238; *Complete course*, p. 193.

1. How successfully could such a press print from large stones with a high ink to paper ratio, bearing in mind that all lithographs are likely to have been printed on pole presses before the invention of the fixed scraper press by Hermann Mitterer in 1805?[33]
2. Could one person take prints from a pole press efficiently? What factors would have determined the use of two workmen, other than the need to increase the force applied to the pole when great pressure was needed?[34]
3. Were the frisket and tympan really needed for all jobs? And to what extent might they have slowed down production?
4. How would work for multi-page publications (such as sheet music) have been printed from stones bearing an image for one page only?[35]
5. Why is it that stone impression marks appear on some early lithographs, given that scrapers varied in size and could be changed easily?

Conclusion

Anyone thinking of constructing a pole press is faced with a range of options. Some of them are referred to in this article, others in accounts of different kinds of pole press that were published in early nineteenth-century lithographic manuals.[36] In many respects it is easier and less challenging to reconstruct an early lithographic press than a common press. It is to be hoped, therefore, that we shall see more reconstructions of early lithographic presses, whether based on those designed by Senefelder or by other pioneer lithographers. In a museum context they would help to explain the nature of early lithographic printing to lay people. In a more specialist field, manufacturing such presses and printing editions from them would probably reveal things about the work of early lithographic printers that would otherwise remain obscure.

33. Twyman, 'Lithographic hand press', pp. 16–17 and Fig. 11.

34. Senefelder assumes that two workmen were the norm, *Vollständiges Lehrbuch*, pp. 80, 237, 240; *Complete course*, p. 192, 194 .

35. Surviving stones and evidence from his own music printing suggests that Johann André normally printed music from single stones. See Twyman, *Early lithographed music*, pp. 64–6.

36. Twyman, 'Lithographic hand press', pp. 15–16 and Figs. 5, 9,10.