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# *Academy of Art and Design, Stuttgart: The Book and Paper Conservation Program and Current Research*
# 1. Board Slotting: A Machine-Supported Book Conservation Method

ABSTRACT

This research project was carried out as a senior thesis at the Book and Paper Conservation Program at the Academy of Art and Design in Stuttgart. It deals with a problem that frequently arises with nineteenth-century books, the detachment of the boards. One of several conservation methods used to reattach book boards is the board slotting technique developed by Christopher Clarkson. To improve the method, the focus of this project was the design and construction of a new board slotting machine in co-operation with an engineering company. This paper will give an overview of the treatment of the text block, the slotting of the boards, and their reattachment. In addition experiments have been carried out to prove the efficiency of the method. Folding endurance tests, which simulate the movement of boards, showed the difference in the durability between cotton and linen fabrics. For attaching the fabric tongue into the slot of the board three different adhesives were compared by a tensile-strength test. A dyeing procedure for toning the fabric with reactive dyes was modified and is applicable in small conservation workshops.

## INTRODUCTION

Broken joints and loose or detached boards and/or spines (fig. 1) are the most common problems a book conservator encounters. This damage occurs most often with books of the nineteenth century, when their manufacture became mechanized and new industrial products of lesser quality began to be used (Biesalski 1994; Silverman 1996; Thomson 1996). In addition the type of binding and frequent handling cause spines and boards to completely fall apart. Different conservation methods can be employed to preserve the original book cover. One of these is the board slotting method. This technique was invented by Christopher Clarkson in the late 1970s when he worked at the Library of Congress. In 1992 he first published an article on board slotting in the postprints of the Institute of Paper Conservation conference in Manchester, U.K. (Clarkson 1992). The method was established at the Bodleian Library in Oxford under the guidance of Edward Simpson in 1994 (Simpson 1994a).

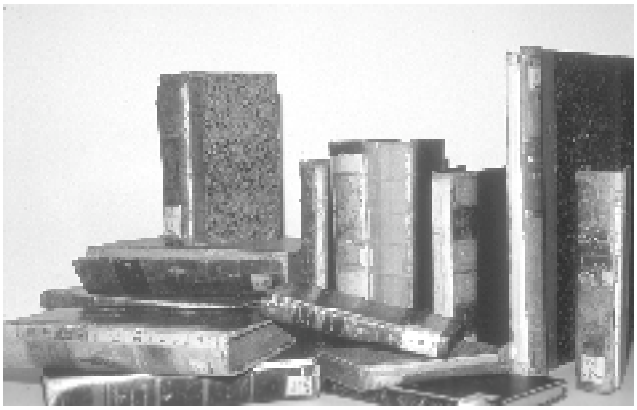

Fig. 1. Several books from the Württembergischen Landesbibliothek. Detached spines and loose or detached boards are a common problem a book conservator encounters.

## THE BOARD SLOTTING METHOD

The treatment of the board slotting method is divided into three steps:
1. Treatment of text block
2. Treatment of boards
3. Reattachment of text block and boards

Figures 2–4 illustrate these steps.

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Fig. 2. Schematic diagram of the text block. The boards are removed and two separate pieces of cotton fabric are mounted onto the spine and pasted together only at their flaps to form a tongue on either side.

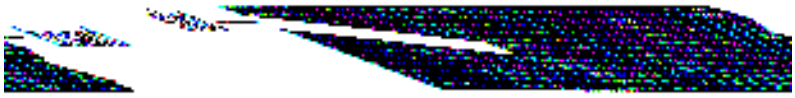

Fig. 3. Schematic diagram of a slotted board. The slot starts nearly directly underneath the leather and continues to the middle of the board's thickness. Its depth can vary between 5 and 8 mm.

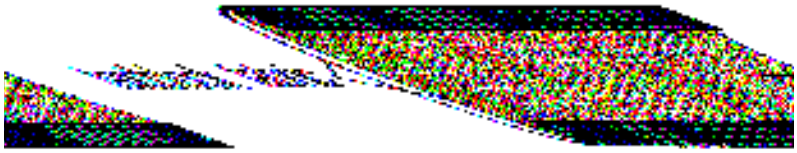

Fig. 4. Schematic diagram of a book treated with the board slotting method. The boards are reattached by pasting the fabric into the slot.

## THE TREATMENT OF THE TEXT BLOCK

The first step is the detachment of the original spine, if it has not become separated already. Damaged or loose spine linings should be removed. A prewashed cotton fabric is pasted onto the spine of the text block. It should have the same height as the text block's spine, but should overlap either side. Additionally the cotton can be mechanically secured with a thread through the first and last sections. At this point a hollow can be pasted on the spine. This depends on how the book opens. If the spine construction is very weak a spine lining and/or hollow might be suitable. If the spine is quite tight already no additional spine linings or hollows should be used. If a hollow is used (which has the height of the boards) a second, appropriately dyed cotton fabric is then pasted on top of it. The fabric should be turned into the hollow at the head and tail and then allowed to dry. After drying the two fabrics will be pasted together at their flaps. If no hollow is used the second fabric is turned in at head and tail but pasted to the first fabric only on the flaps (fig. 2). Pasting the flaps of the two layers together forms two tongues—they are taped down temporarily on strips of cardboard in order to remain flat after drying.

## THE TREATMENT OF THE BOARDS

For the treatment of the boards a milling machine is needed. With its help a slot is created into the spine edge of the board. The depth of the slot depends on the size and the strength of the boards. It can be between five and eight millimeters deep. The slot is only as long as the height of the boards and does not damage the head and tail edges of the covering material. The slot has to be made at an angle. It begins almost directly underneath the leather and reaches to the middle of the board thickness. Because of the angle the function of the boards will not be changed and they will open well later on. The degree of the angle depends of the board thickness. It can be easily calculated from the thickness of the board and the depth of the slot. Figure 3 shows a schematic diagram of a slotted book board.

## THE REATTACHMENT OF TEXT BLOCK AND BOARDS

The cotton fabric will connect text block and cover. The pasted tongue is cut to the depth of the slot. Because of the paste the tongue becomes quite stiff so that it is easy to insert it into the slot. The slot can be opened a bit with a spatula and starch paste is fed into it with a syringe and then smoothed. The tongue is placed into the slot with the help of a spatula. The book is pressed carefully and left to dry. The original spine is freed from its old linings and then attached to the new cotton spine with paste (fig. 4).

## THE BOARD SLOTTING MACHINE

The board slotting method requires a machine. At the Bodleian Library in Oxford, a normal milling machine was used. While working with this machine some handling disadvantages became obvious. The entire process proved to be relatively complicated and time-consuming. The board needs to be positioned in a special jig. This jig has to be assembled on the machine table. To achieve the correct angle, a wooden stick needs to be inserted underneath the jig and the angle has to be checked. If the angle is wrong the wooden stick has to be exchanged with a smaller or bigger one. Therefore the jig has to be taken off the machine table and the procedure has to start over again. The slot itself is made by passing the machine table with the assembled jig along the rotating sawblade. For one revolution of the machine crank the table moves only 0.25 mm to the right or to the left. Therefore to slot two boards would take about thirty to forty-five minutes.

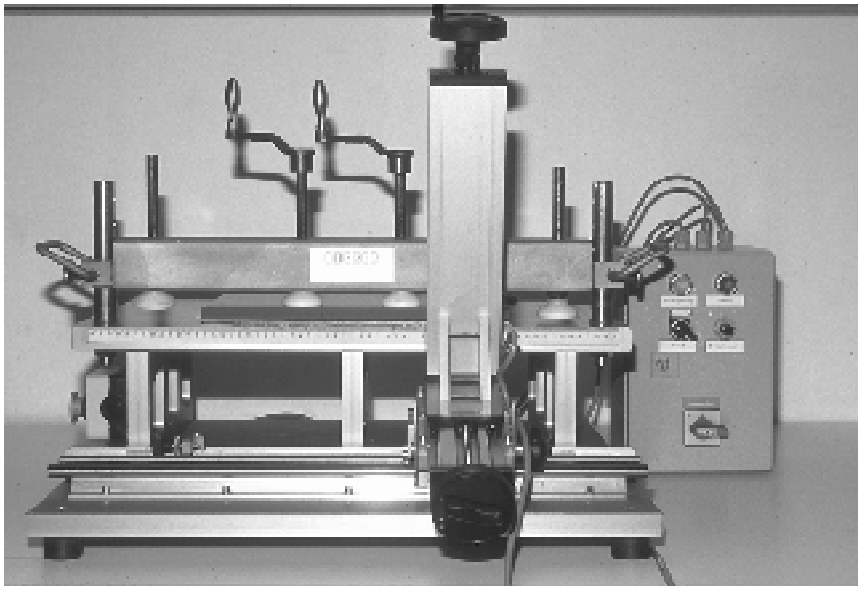

Fig. 5. The new board slotting machine: front view

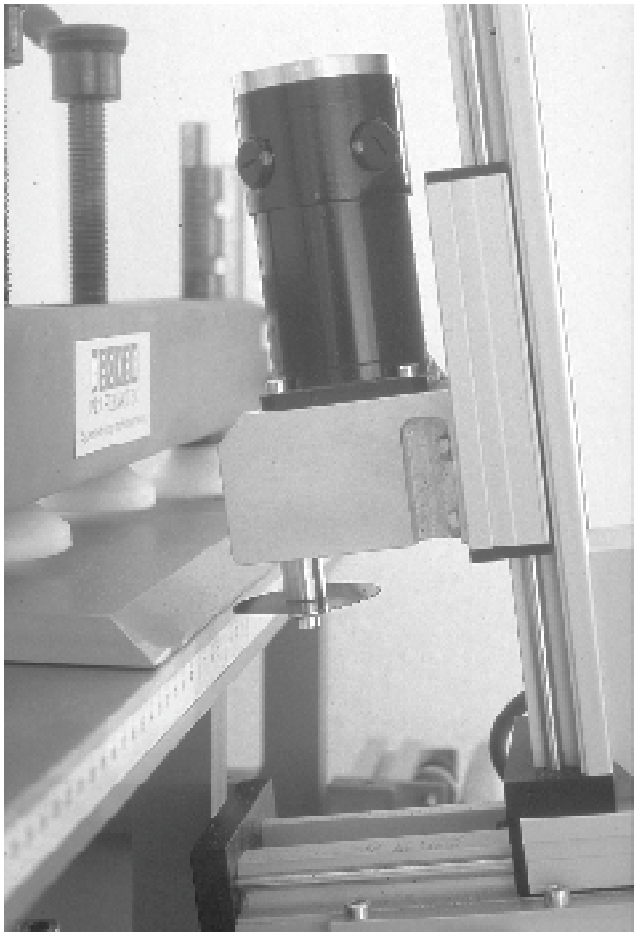

Fig. 6. The new board slotting machine: side view

Part of my project was the cooperative improvement of the technical basis of board slotting by combining the expertise of book conservators and engineers in order to meet the requirements of the method better and reduce the working time. Thus for my thesis a new board slotting machine was developed in collaboration with the engineering company Becker Preservotec, Winnenden, Germany. Figure 5 shows the new board slotting machine from the front, figure 6 from the side. The sawblade guard is missing to give a better view of the sawblade. The positioning of the board is now very easy and quick. It just needs to be put onto the machine table, then the clamp has to be lowered and the spindles tightened. The sawblade, including the motor, slides on a track, moving freely in the horizontal direction. The sawblade is adjustable and can be locked in any angle between -20° and +20°. Boards up to a height of fifty-six centimeters (about twenty-two inches) can fit onto the machine table. This means that based on height approximately ninety percent of library books could be treated on this machine.

In contrast to the machine in Oxford, this machine is simpler to handle and therefore saves preparation time, so that it only takes approximately fifteen minutes for two boards.

## SCIENTIFIC ANALYSES

This method, as with any type of conservation treatment, is only as good as its repair material. Therefore the new materials used were tested for their strength and stability.

## FOLDING ENDURANCE TEST

The newly inserted fabric needs to flex at the joint each time the book is opened. For this reason, the fabric should possess very good bending strength. Consequently folding endurance tests were carried out on linen and cotton fabric. The following fabrics were tested: Aerolinen 155g/$m^2$, Aerocotton 145g/$m^2$, and Aerocotton 100 g/$m^2$ (see Materials and Suppliers). Three samples of each material were tested with the grain direction of the fabric parallel to the folding. The material was tested until it tore and the average of the three samples was taken. The test machine was an apparatus made by the company Louis Schopper, Leipzig. It could bend the fabric 180° under tension. This was a non-standard test method but the results could be compared between each other.

RESULTS

| | |
|---|---|
| Aerolinen 155 g/m$^2$ | 16,000 folds |
| Aerocotton 145 g/m$^2$ | 90,000 folds |
| Aerocotton 100 g/m$^2$ | 71,500 folds |

The results show that cotton in general has a better folding strength than linen. Even the thinner cotton fabric is stronger than the linen. Though linen has a better tear resistance and tensile strength, linen fibers are much more inflexible and break much earlier than cotton fibers. Results gained from folding tests against the grain direction showed at least one-third less strength than with the grain direction.

TENSILE STRENGTH TEST

A second parameter to be tested was the strength of the adhesive within the slot. Three different kinds of adhesives were tested: polyvinyl acetate (PVA),[1] gelatin, and wheat starch paste. Under special conditions fabric samples were pulled out of their board slots. This was done at the Institut für Textilchemie, Denkendorf, according to the German standard DIN 53857. Three samples of each adhesive underwent this test.

RESULTS

| | |
|---|---|
| Polyvinyl Acetate | 24.8 kg |
| Gelatin | 22.7 kg |
| Wheat Starch Paste | 19.5 kg |

These attempts showed that PVA and gelatin were slightly stronger than paste. PVA and paste, as opposed to gelatin, have an appropriately long open working time, which is helpful when inserting the tongue into the slot. Paste is preferred over the PVA because of its well-known permanence. In addition the paste exhibited sufficient adhesive power to hold the fabric inside the slot.

DYEING WITH REACTIVE DYES

After the book treatment the second fabric will be seen at least at the outer joints. Therefore it should match the original color of the book cover. This is always a difficult task to achieve because spine and board coverings have faded differently due to their dissimilar exposures to light. Cotton fabric has normally a cream color and would catch the eye very much if the leather color, for example, is dark brown. Therefore a dyeing procedure with reactive dyes was adapted from the Bodleian Library (Simpson 1994b) and slightly modified. Light fastness tests were applied and the dyeing procedure was found to be acceptable. Still the dyeing procedure is very time-consuming. It might be easier in general to find a company that would sell a good standard cotton fabric (like aerocotton) dyed in several tones with dyes stable to light and water.

CONCLUSIONS

The board slotting method is not to be seen as a replacement for other methods. Rather it represents an enrichment to the already well-known techniques for reattaching book boards. In contrast to other methods the board slotting method has the following advantages:

- Gilding and decoration on the cover, as well as on the board edges, will not be affected.

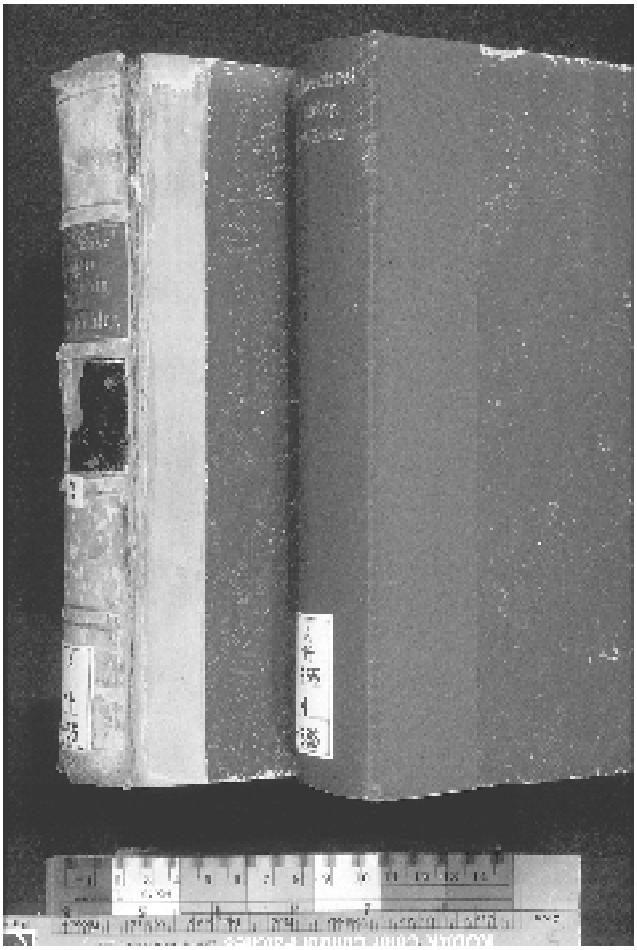

Fig. 7. These books are different volumes from the same edition. The right volume has a book cloth simply glued over the spine, a method that has been frequently used. Compare this to the non-treated book on the left.

- Original leather parts on the boards and the pastedowns will not be damaged.
- The method is applicable for degraded leather, because there is no manipulation of the leather itself.
- In contrast to the manual slotting of boards, slotting by machine is much more exact and even. In machine slotting parts of the cardboard are removed and the slot will not swell due to the newly inserted fabric.

The board slotting method is a treatment that is fast, economical, and returns the book to a durable and usable condition without changing the integrity of the object, as you can see in figures 7–8. With this technique the appearance of the book does not change much.

ACKNOWLEDGMENTS

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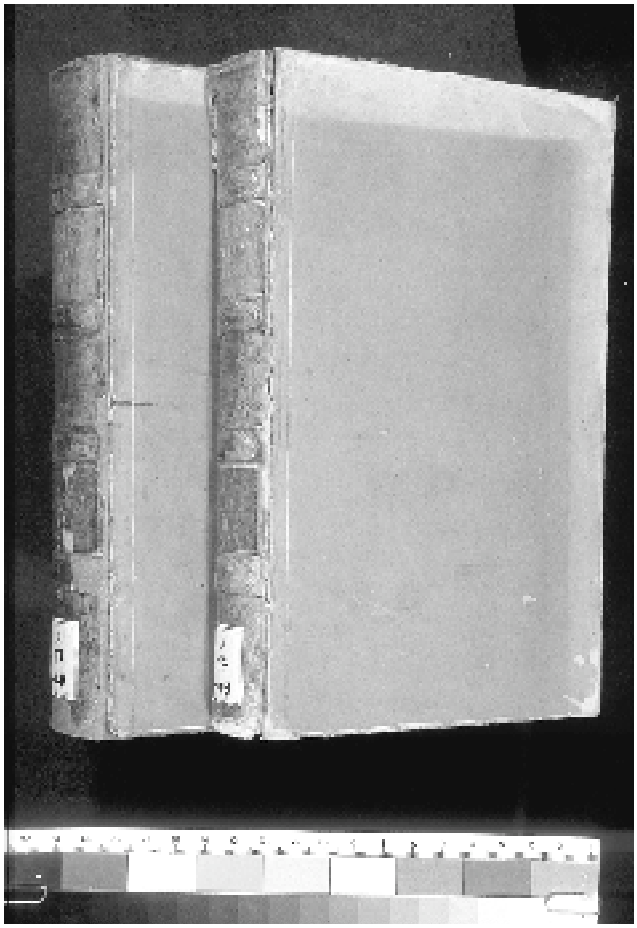

Fig. 8. These books are different volumes from the same edition. The right volume is untreated; the left was treated with the board slotting method.

NOTE

1. The polyvinyl acetate was "BB" from the company Planatol GmbH, Germany.

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## MATERIALS AND SUPLIERS

*Aerocotton:*
Samuel Lamont & Sons Limited
Railway Street
Ballymena BT 42 2 AL
North Ireland
Price 1997: £6.50/1m

*Flugzeugleinen (thinner aerocotton):*
No. 55110
Friebe Luftfahrt-Bedarf GmbH
Flughafen Neuostheim
68163 Mannheim
Tel.: 0621/412408
Price 1997: DM 11.74/1m

*Reactive Dyes: Proxion MX (BASF):*
Kemtex Educational Supplies
Textile Consultant: Dyestuffs and Chemicals Supplier
Kemtex Craft Dyes
Tameside Business Center
Windmill Lane, Denton
Manchester M34 3QS
Tel: 0161/3206505
Price 1997: £25 for 250 g ready-mixed colors
Brown tones are called: Douce, Locke, Erasmus, Talbot, and Holkham
Red tone is called: Shelly

*Board slotting machine*
For more information about the machine, please contact the author.

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