OLD BOOKBINDING TECHNIQUES AND THEIR SIGNIFICANCE FOR BOOK RESTORATION

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Abstract. The evolution of bookbinding techniques from the invention of the codex is briefly reviewed. Special attention is paid to the introduction of the sewing support and to the gradual development of the rounded spine and its effect on the book function. The implication of some results for rebinding and restoration is discussed, such as the unsuitability of the rounded and backed spine for parchment manuscripts. Study of the binding techniques helps to disclose mistakes of the past, which can cause dilemma's to the conservator-restorer. Improved knowledge of binding history should provide safer guidelines.

BOOKBINDING HISTORY; BOOKBINDING TECHNIQUES; BOOK RESTORATION; BINDINGS, MEDIEVAL; REBINDING OF MANUSCRIPTS; SEWING SUPPORT; SPINE SHAPE; CONSERVATION BINDING.

Historians of bookbinding have always been attracted to the decoration on the outside of the books rather than to the mechanism inside, the primary basis of book function. Our knowledge of ancient binding structures is rather scanty, due to a general lack of scholarly interest in the past, but also as a consequence of the massive loss of old bindings over the centuries as a result of rebinding and restoration - often prompted by fashion rather than by necessity. Large libraries possess no more than a few percent of medieval works in their original binding [1], and for the beginnings of the codex our knowledge is based on very fragmentary evidence. The purpose of this paper is to briefly review the evolution of the codex, with emphasis on its mechanical function, and to point out some implications for book restoration and conservation.

The birth of the codex

The codex replaced the ancient scroll probably in the first centuries of the Christian era, although there are some indirect archeological indications of earlier occurrence, such as representations on stone-reliefs from the Neo-Hittite Empire, 6th to 8th century B.C. [2]. The earliest evidence are Christian (Coptic) codices from excavations and finds in Egypt, in general dating not before the third or fourth century A.D.. Often they came to light badly damaged or fragmented; in some cases, the physical history of the binding has been obliterated by subsequent restoration, and sometimes lack of interest even resulted in pulling ancient bindings without any record of their structure [3].

We can reconstruct, from the often incomplete remnants, with some degree of certainty the main features of the early multi-section codex: the gatherings (sections) were connected by sewing through the fold using the chain-stitch, and the

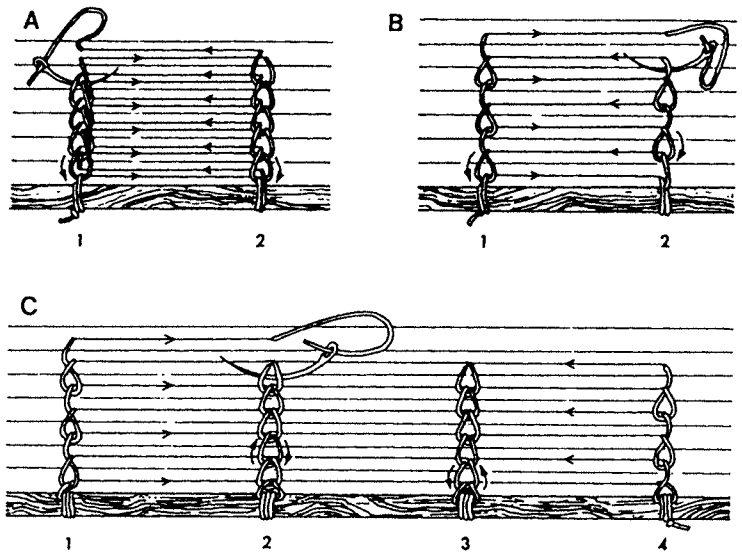

Fig. 1. Various chain-stitch sewing patterns. A, Sewing of the Stonyhurst Gospel (end 7th century), from the data of R. Powell & P. Waters [1969] (for ref. see Note 4.); B, Typical chain-stitch pattern of an Islamic binding; C, Sewing pattern of a Coptic or Byzantine/Greek binding (B and C modified from T.C. Petersen [1954], see Note 4.).

sewing thread was also generally employed to attach the protecting boards to the text block. As this ingenious system spread throughout the literate world of those days, various modifications of the chain-stitch sewing were developed (See fig. 1). For example, the Ethiopian prayer-book is sewn with two needles for each pair of sewing stations; nearly the same effect is obtained with one needle only in the sewing pattern of the oldest intact binding of the Western world, the Stonyhurst gospel, dating from the end of the seventh century A.D.. One needle is used for any number of sewing stations in the Byzantine/Greek bindings, and in all these cases the sewing thread also serves for the attachment of the boards. The chain-stitch technique was also adopted by the Islamic world [4].

But this highly ingenious and successful principle also had some shortcomings. One of these was the weakness of the attachment of the boards: whereas the linking of the sections lasted for centuries, the sewing thread was often not strong enough to withstand the considerable mechanical strain at the joints, with the resulting breakage. Another seeming deficiency was the lack of stability: the flat spine had an inherent tendency to become concave with a resulting sagging of the fore-edge and a deformation of the book. The history of bookbinding techniques shows that one was aware of these imperfections and many attempts have been made to remedy them.

Sewing support and board attachment

Concern about the relative weakness of the board attachment through the sewing thread was probably the reason for doubling the sewing thread in the first and last gathering, as found in some early Coptic codices. The Byzantine/Greek board attachment shows many variations, sometimes with a markedly increased number of linking threads, with the obvious intention to reinforce the weak point. Some remarks on possible methods of reinforcing the sewing in these bindings by Berthe von Regemorter [5] inspired the present author to undertake some experiments on models; the results suggested that introducing a thread or cord into each of the half-loops of the chain-stitch could be a very effective reinforcement of the board attachment. The recognition that the resulting structure is virtually identical with the herring-bone sewing pattern of the early Carolingian bindings offered itself as a logical explanation of the origin of the sewing support (or band), a characteristic feature of the binding structure of the Western (Latin) world. The same idea has been put forward by Bozzacchi already in 1985 [6], also suggesting that the herring-bone sewing is in fact a chain-stitch sewing which has been worked around a double cord (See fig. 2). As pointed out previously [7, 8], the idea behind this innovation is obvious: the introduction of this reinforcing cord was meant to take over the task of the relatively weak sewing thread as the means of attachment of the text block to the boards.

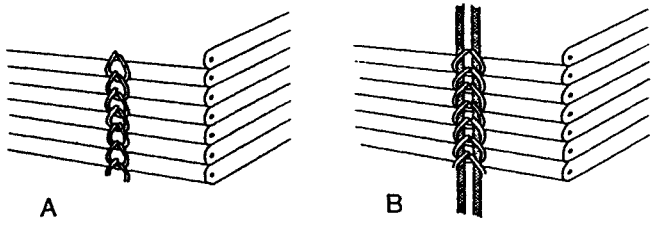

Fig. 2. The possible origin of the sewing support (B) as a reinforcement of the chain-stitch sewing (A). (From J.A. Szirmai [1990], see Note 8.).

The above hypothesis lacks proof: Bozzacchi [6] supports the idea by the finding of both supported and unsupported sewing on the same binding. But his examples date from the 10th or 11th century, whereas we know that the sewing support occurs, along with the herring-bone sewing, already in the earliest Carolingian bindings, that is, in the 8th century. However, hardly any original binding from that period survived, and the introduction of the sewing support may remain forever a white spot in the history of bookbinding techniques.

The material of the sewing support and the method of its attachment to the boards underwent many modifications, as could be verified in a recent study of medieval bindings in the St Gall Abbey Library [9]. In the earliest type, the Carolingian binding, flax or hemp cord was used; later, thick whittawed leather thongs appear, followed by vegetable-tanned leather. In

the 15th century, cord is again reintroduced - possibly one had recognized the limited durability and strength of the vegetable-tanned leather. Along with change in the materials, the methods of lacing through the boards become modified: the 'Carolingian' attachment (up to the end of the 12th century) is replaced by the 'romanesque', in both the supports entering the boards through the edge; towards the 15th century, the 'gothic' attachment appears, entering the boards over the beveled edge (See figs. 3, 4). Although the introduction of the sewing support was a successful innovation, the many variations in the method of board attachment signify the concern about the intrinsic weakness of the joint region, which continued to attract attention to the present day [10].

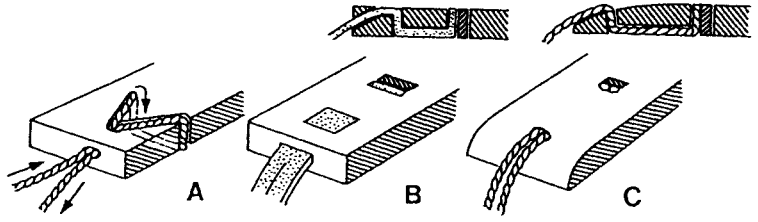

Fig. 3. The three main methods of attaching the boards. A, 'Carolingian' (cord, entering at the board edge and anchored as a loop); B, 'Romanesque' (leather thongs, entering at the board edge and fastened with wooden peg); C, 'Gothic' (cord or thongs, drawn over the beveled edge, fastened with wooden peg). (From J.A. Szirmai [1990], see Note 8.).

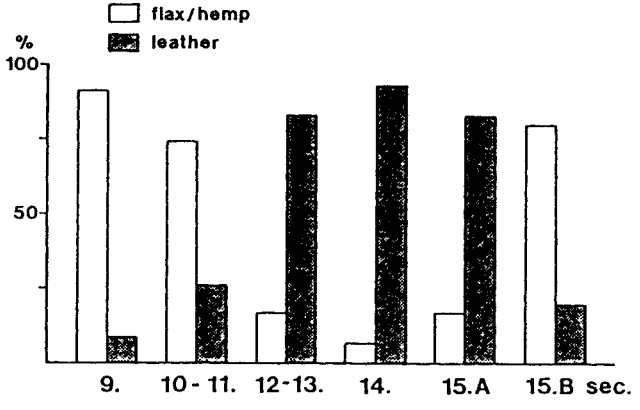

Fig. 4. Chronology of the use of various materials for the sewing support, as observed on 206 original medieval bindings in the St Gall Abbey Monastery, dating from the 9th to the 15th century.

Stability and the rounded spine

We do not know how far the ancient reader was disturbed by the lack of stability and the tendency to deformation of his books. It could be that concern about this appeared when it became custom to place the books standing on the bookshelves, rather than to have them laying horizontally in cupboards or on slightly slanted lecterns. The earliest indications of recognizing the problem of deformation seem to be the attempts to fix the spine in the flat state, notably in the case of the simple limp parchment bindings designated in medieval catalogues as libri sine asseribus, that is, books without (wooden) boards. This was achieved, for example, by sewing through rigid plates of horn, wood or stiff leather: the so-called 'chain-stitch' or 'long-stitch' bindings form the 14th and 15th century. Sometimes rigid reinforcements were hidden under the cover, like the brass rods in the sewing of 16th century limp parchment bindings [11]. Attempts of this kind have continued over the centuries, but their success was limited: the spine, immobilized and rigid, did not always allow a free book movement and a full, unrestricted opening.

The bindings with wooden boards, the libri cum asseribus, seem to have offered a better approach for increasing the stability and counteracting the sagging of the fore-edge, namely, to round the spine and to adapt the board edge as a shoulder to support the joint region. The gradual evolution of the rounded spine could be assessed in the St Gall Abbey Library research project mentioned above. To determine the shape of the spine, a simple instrument was designed: a transparent plate with five circle segments, the radius ranging from 20 to 320 mm. This templet, held over the profile of the spine, allowed the curvature to be rated in a semi-quantitative way. The results on a series of original bindings, ranging from the 9th to the 15th century (See fig. 5).

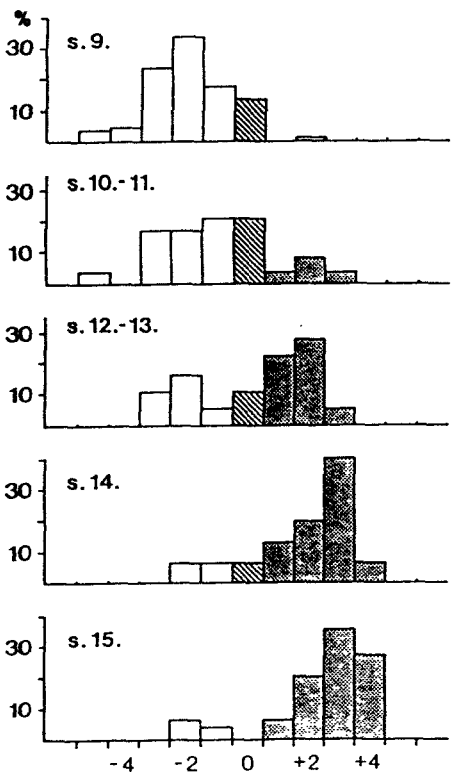

Fig. 5. Changes in the shape of the spine of 206 medieval bindings in the St Gall Abbey Library, dating from the 9th to the 15th century. Flat shape: 0, concave spines: -1 to -5, convex spines: +1 to +5. (From J.A. Szirmai [1989], see Note 7.).

clearly show that the flat or hollow spine is a characteristic feature of the Carolingian binding, and that the rounding of the spine appears already in the 13th century.

The rounding of the spine is, in general, the result of the swelling caused by introducing the sewing thread into the centre fold of the gatherings. It is interdependent on factors like the thickness of the thread, the thickness of the leaves and the number of the gatherings. One can only speculate which of these factors, or some others, played a crucial rol in initiating the spine rounding. A thick thread, sometimes up to 2 mm in diameter, could frequently be observed in the later periods. Beveling of the inner edge of the boards along the spine becomes a regular feature, and perhaps more important, marks caused by the backing hammer indicate that obtaining a rounded spine with a shoulder was a deliberate effort.

If the swelling produced by the thread in the centre fold was found to be insufficient - one cannot increase the thread thickness indefinitely -, a reinforcement of the rounding and its maintenance was achieved using extra turns of the thread around the sewing supports. This 'arch sewing' (or 'pack sewing') produces a sort of arteficial arch, a construction principle employed in the architecture to withstand deforming forces; aided by the clasps, which keep the boards closed, this structure firmly locks the rounded spine and prevents its distortion [12]. Finally, animal glue was introduced to fix the spine folds and to attach linings of leather or parchment to the spine surface, which undoubtedly contributed to maintaining the shape of the spine.

The result of all these measures was the binding with the rounded spine, which has become a general feature in the course of the 15th century (See fig. 6). With the rounded spine the history of bookbinding passed an important mile-stone: the 'renaissance' binding was born, and in fact the modern binding of the coming centuries, with important implications for the mechanism of book function.

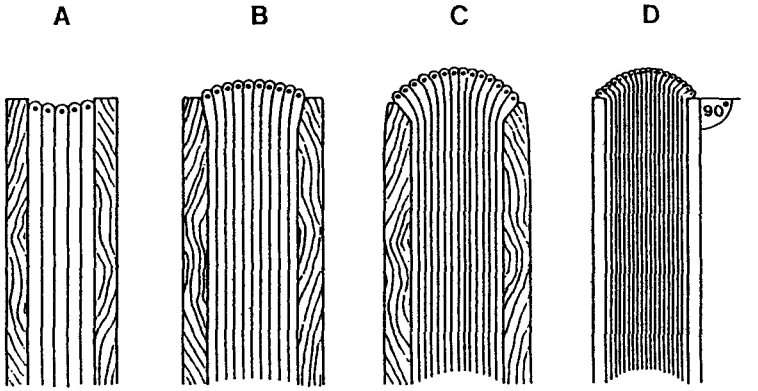

Fig. 6. Diagram showing the evolution of the spine shape from the early flat codex (A), through gradual rounding (B, C) to the tight joint binding around 1500 (D); the latter has covers of paste-board, in contrast to the earlier wooden boards. (From J.A. Szirmai [1989], see Note 7.).

Spine shape and book function

The function of a book, that is the way it can be opened and its leaves folded open without restriction, depends to a large extent on the shape and the mechanical charcteristics of the spine. Bending along the fold, which acts as a hinge, is the essential type of the movement in the codex form. With the flat spine and its surface free of heavy linings, the opening proceeds without much resistance, there is no bending of the surface of the leaves and they tend to lay flat. This is the case with the unsupported bindings of the Coptic type, like the Ethiopian prayer-books, as well as with the Carolingian bindings (See fig. 7 A).

Rounding and backing of the spine makes movement a much more complex process. The sharp bending of the outer leaves along the shoulder line, result of the action of the backing hammer, produces a kind of lever, apparent on the cross section of the leaves (See fig. 7 B). Thus, before any opening of the folds is possible, a lever action is necessary to release the locking effect of the shoulder - in other words, the back has to 'throw up'. This requires a pulling action, implying considerable strain on the leaves, bending them over large areas, and movement between the leaves with the danger of abrasion, etc., the extent of all this being dependent on the stiffness and degree of resiliency of the spine. In extreme cases, the heavily glued and lined books with a tight back require brute force to be opened and hardly allow reading the text at the inner margin. Ironically, the advantages of the rounded spine manifest themselves not when the book is read, but when it is closed and put away on the shelves: than the built-in shoulder of the consecutive sections produces a mutual interlocking, assuring a permanent rounded shape.

The above oversimplified presentation of these two basically different principles of book movement disregards the many subtle differences due to variants of the techniques and differences in the properties of the materials used. Admittedly the subsequent evolution favoured the rounded spine: early printed books, with their relatively thin paper sections, might have profited from the increased stability, and the solid spine

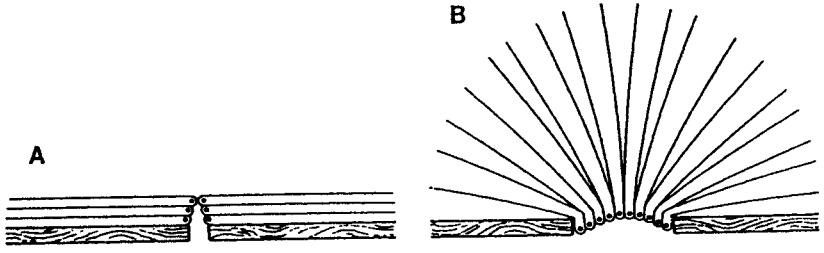

Fig. 7. Spine shape and book movement. A, Unrestricted complete and flat opening of the early codex (spine as in Fig. 6 A); B, Restricted opening of the book with rounded and backed spine (spine shapes as shown in Fig. 6 C or D). Resistance depends, among others, on the degree of rounding, the shoulder angle, the amount of lining and glue on the spine and the elasticity of the covering leather, as well as on the mechanical properties of the leaves. (From J.A. Szirmai [1989], see Note 7.).

provided a suitable foundation for the gilt decorations. It became the preferred binding structure of the future, but one cannot help wondering whether an impaired book function was the price for the fulfillment of esthetic preferences [13].

Parchment manuscripts rebound with rounded spine: a lesson

Whereas the binding structure with the rounded spine might have been favourable for the future, it was definitely much less so for the past: for the early medieval manuscripts the use of this technique was decidedly harmful. This is borne out by the many examples of this practice, dating mainly from the second half of the 15th century, when massive repair and rebinding took place in many cloisters as the result of monastic reforms. This was the case also with St Gall Abbey Library, where, in adition to minor repairs, some 120 Carolingian manuscripts have been rebound around 1462 - of course, according to the new fashion, with the rounded spine. They could be compared, in the already mentioned research project, with about 115 original Carolingian bindings, mostly from the 9th century, with the flat spine (See fig. 8).

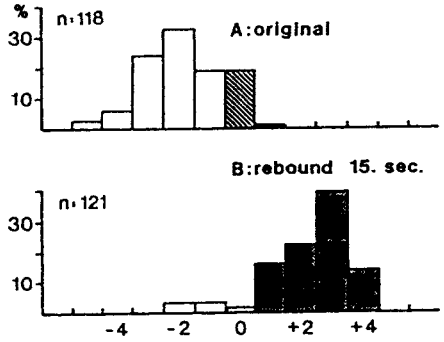

Fig. 8. Spine shape of Carolingian manuscripts (9th-11th century) in the St Gall Abbey Library. A, original bindings of the Carolingian type; B, Manuscripts rebound about 1462. Flat spine: 0, concave spines: -1 to -5, convex spines: +1 to +5 (From J.A. Szirmai [1990], see Note 8.).

Sadly enough, the rebound manuscripts greatly suffered from the rebinding operation: the freedom of movement has gone, the rounded spine with its raised bands, heavily glued, resists full opening - as if the books had lost their soul! In addition, physical damage to the parchment leaves can be observed. The immobilization of the spine folds of the parchment gatherings by the animal glue, restraining their adaptation to climatic changes, resulted in marked cockling of the text block; signs of abrasion are not uncommon, probably due to increased movement of the extensively bended leaves when attempting full opening. All this is a sad testimony that the bookbinder of the 15th century already has lost understanding of what is appropriate for a parchment manuscript: he immobilized the spine folds with glue, he hammered a shoulder on the parchment leaves, he has, in other words, forced upon a medieval manuscript a binding structure which was never intended for it!

Unfortunately we have continued to repeat the mistakes of the 15th-century bookbinder, as far as rebinding of parchment manuscripts is concerned, even to the present day. Thousands of manuscripts have been rebound again and again - the more often

rebound, the more damage, the sooner the next rebinding is needed -, and of course according to the fashion of the period and to the fancy of the owners, but seldom to the benefit of the book [14].

Mistakes of the past - what to do?

The above example of parchment manuscripts, bound in an unfit structure with lasting damage as a result - supported in this case by observations on over hundred cases - raises some awkward issues. First, we are compelled to accept that, in the good old times, honest craftsmen made mistakes. Mistakes due to lack of insight, knowledge or experience, or because they were forced to carry out the whimsical wishes of their patrons. One only needs to look at some fancy bindings of the 17th to 19th century, reflecting the changing fashions, or to read the many amusing remarks on the customer's ideas in the early bookbinding manuals, to appreciate that aesthetic criteria of the patrons could have been more influential than insight into a sound book structure on the part of the binder. Of course, he also sinned: sloppy work was often his only answer to the commercial pressures. Cheaper materials, minimized sewing - easily compensated with a lavish amount of glue -, cutting off the slips instead of bothering by lacing them through the boards, fake headbands, and dozens of similar tricks helped the binder to survive - at the expense, perhaps, of the survival of the bindings themselves. But whatever the reason, a great number of internally deficient bindings do land to-day on the restorers bench, and can constitute a dilemma.

The dilemma is obvious: is the restorer supposed to maintain the deficient, erroneous or inferior structures and to restore them according to the original state, or is he allowed to depart deliberatly from the mistakes of his predecessor, correct him and ensure that sound structures and materials help to safeguard the preservation of the object? Should he restore the genuine but faulty and inadequate structures, or should he aim at conserving the text block to the best of his knowledge? And it is knowledge indeed which should provide the answer. In some cases, like with the parchment manuscripts in the rounded and backed later bindings, we know enough by now of the harmful effects, have sufficient data and observations to support the legitimate doubt as far as re-using an unfit, faulty binding structure is concerned.

In other instances the answer is less clear, due to our stil very limited knowledge of the binding techniques of the past centuries. The example of the virtues of the tight back (the 'flexible' sewing with the leather cover adhering directly to the spine) against those of the hollow back can illustrate the point. In the first case, there is, theoretically, an unrestricted spine movement, with an easy 'throw-up' when the book is opened (See fig. 9 A); unfortunately, creasing of the leather on the spine causes breaking of the gold. The latter is prevented by the use of the hollow back, where the spine surface and the leather cover are kept separate. But here a new source of strain is introduced: while the outer regions of the spine tend to approach each other when the book is being opened, the hollow back acts as an opposing force, tending to cause damage of the vulnerable joint structures (See fig. 9 B).

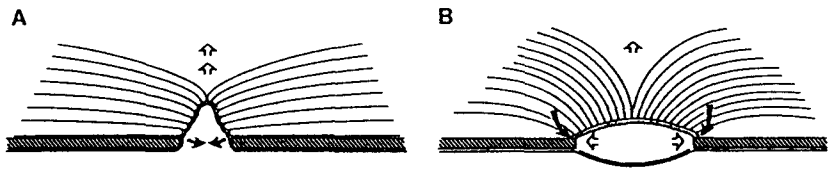

Fig. 9. The effect of the tight back (A) or hollow back (B) construction on the movement of the book. In A, the outer regions of the spine can move towards each other (arrows), thus allowing the spine to 'throw up' and facilitate the opening of the leaves - resistance depends on mechanical properties of the spine and the leaves (see legend to Fig. 7 B.). In B, the movement of the spine is counteracted by the hollow back (open arrows), with as a result reduced 'throw up' and considerable strain on the joint region.

The mechanics of these two constructions has sofar not been studied, and our decisions as to what is preferable are based on bias, feelings or belief - the worst possible guides for the restorer-conservator. Here one must await the results of future research on such binding structures which should lead to their thorough understanding.

Conservation binding

Less problematic seem to be those cases where the original binding is lost or is damaged so badly that restoring its function is beyond hope - or when the binding structure is evidently damaging the contents to such an extent that its removal is imperative. In such instances one is justified to resort to a 'conservation binding', meant solely to allow a proper function and to protect the text block. This notion is only seemingly new, since it was - or shoud have remained - the sole criterium of any binding structure since the invention of the codex some 2000 years ago. New perhaps is only the recognition, that aesthetic criteria and over-stressed refinement, characteristic of the de luxe decorated bindings of the last one or two centuries, decreased our sensitivity towards the value of sound craftsmanship. That the simple undecorated limp parchment bindings survived the Florence flood of 1966 far better than the more elaborate fancy bindings, led to the appreciation of the former as a potential type of 'conservation binding', a concept which was thoroughly researched and significantly promoted by Clarkson [15]. Since then several other proposals for 'conservation bindings' have been made, varying from simple chain-stitched constructions to elaborate bindings with wooden boards [16]. They are inspired by historical models, but freely incorporate new insight and experience, and try to avoid some of the errors brought to light by the test of times.

The significance of the 'conservation binding' is twofold: first, it gives the restorer the liberty to provide a rational binding structure rather than to be forced to patch up bindings with a doubtful functional capacity; second, it can stimulate the restorer to explore with a fresh mind areas of craftsmanship beyond the limits set by bookbinding traditions. But such explorations should be guided by a thorough and systematic analysis of the mechanics and functional qualities of

original bindings - and here again one must deplore that research on old bookbinding techniques received so far only limited attention. Also it must be stressed that the introduction of 'conservation bindings' should be accompanied - or rather preceeded - by testing their qualities under scientific criteria - one should try to prevent making mistakes, as we did so often in the past!

In conclusion: this paper gives a brief outline of our stil very limited knowledge of the evolution of the bookbinding techniques from the introduction of the codex. It shows that systematic analysis can help to understand the reasons behind introducing new techniques; the appearance of the sewing support and the gradual evolution of rounded spine are given as examples, with emphasis on the implications for the basic book function. But innovations were not always an improvement: for the parchment manuscripts, the rounded and backed binding structure was far from beneficial. Bookbinders did make mistakes in the past, and the conservator-restorer is often faced with the dilemma they cause. In some instances, a conservation binding is a honest and preferable solution.

Notes

1 Only 1% of the medieval manuscripts in the Royal Library Albert I in Brussels was found to have preserved its original binding (L. Gilissen, 'La reliure occidentale antérieure à 1400', Turnhout 1983); no more than about 2% of the Carolingian manuscripts of the Reichenau Monastery, now in the Badische Landesbibliothek, Karlsruhe, Germany, survived the rebinding in 1457 and restorations in 1967-78 (J.A. Szirmai, 'Stop destroying ancient bindings', in: Gazette du livre médievale, 13(1988), p. 7-9; also in: The Abbey Newsletter, 13(1989), p.86, and id., 'Zur Zerstörung alter Einbände - ein Appel', in: Restauro, 96(1990), p. 171-2.

2 B. van Regemorter, 'Le codex relié à l'époque Neo-Hittite', in: Scriptorium, 12(1958), pp. 177-81.; J.A. Szirmai, 'Wooden Writing Tablets and the Birth of the Codex', in: Gazette du livre médiévale, 17(1990), pp. 31-2.

3 P. Needham (Twelve Centuries of Bookbindings 400-1600, New York, London 1979, p. 13) relates the sad story of how an eminent scholar, Franz Ehrle, in charge of the restorations at the Vatican Library, took his desk scissors and separated the covers from the contents of the famous Hamouli codices, discovered in 1910 in Egypt, without keeping any record.

4 Some data on the structure of the early Coptic codices can be found, among others, in C.T. Lamacraft, 'Early Book-bindings from a Coptic Monastery', in: The Library, 20(1939), pp. 214-33; T.C. Petersen, 'Early Islamic Bookbindings and their Coptic Relations', in: Ars Orientalis, 1(1954), pp. 41-64, and in J.S. Kebabian, 'The Binding of the Glazier Manuscript of the Acts of the Apostles', in: Hommage to a Bookman, Essays for H.P. Kraus, Berlin 1967, pp. 25-9. For the Byzantine bindings see B. van Regemorter, 'La reliure Byzantine', in: Revue Belge d'Archéologie et d'Histoire de l'Art, 36(1967), pp. 99-162; C. Federici & K. Houlis, 'Legature Bizantine Vaticane', Roma 1988, and G. Petherbridge, 'Sewing Structures and Materials: A Study in the Examination and Documentation of Byzantine and Post-Byzantine Bookbinding', in: Akten II. Internationales Kolloquium Griechische Paläographie und Kodikologie, Berlin, Wolfenbüttel 1983, in press. The structure of the Ethiopian codex is described by S.M. Cockerell, 'Ethiopian Binding', in: Designer Bookbinders Review, 10(1977), pp. 5-9, and in E. Bartelt & E. Hammerschmidt, 'Die Technik des Athiopischen Handschrifteneinbandes', in: Folia rara, Festschrift Wolfgang Voigt, Wiesbaden 1976, pp. 6-10. For the use of the ancient codex form in the Western World see R. Powell & P. Waters, 'Technical Description of the Binding', in: The Stonyhurst Gospel of Saint John (T.J. Brown, Ed.), Oxford 1969, pp. 45-55; a thorough treatment of the Islamic book structure is given in G. Bosch, J. Carswell & G. Petherbridge, Islamic Bindings and Bookmaking, Chicago 1981. For more details about Islamic and Byzantine binding structures see G. Petherbridge, 'Cross cultural Relationships in Christian-Oriental and Islamic Bookbinding Traditions, in: La Legatura dei Libri Antichi tra Conoscenza, Valorizzazione e Tutela, Parma 1989, in press.

5 loc. cit. (Note 4.), pp. 117-8.

6 G. Bozzacchi, 'The codex as product and object of restoration: observations on method', in: The Conservation of Library and Archive Property, in: PACT 12(1985), pp. 239-59.

7 J.A. Szirmai, 'The Evolution of the medieval Codex: some mechanical Considerations, in: La Legatura dei Libri Antichi tra Conoscenza, Valorizzazione e Tutela, Parma 1989, in press.

8 J.A. Szirmai, 'Evolution of the Structure of the medieval Codex: Consequences for Conservation and Restoration', in: Proceedings Conference on Book & Paper Conservation, Budapest 1990, in press.

9 This project comprises a detailed study of the bindings in the St Gall Abbey Library, Switzerland, from the 9th to the 15th century. The author thanks Dr P. Ochsenbein for his permission to undertake this study and the Netherlands Organization for Scientific Research (NWO) for financial support.

10 Details on various methods of board attachment are given, among others, in A.Th.E. Heinz, 'Über Heft- und Bindweisen von Handschriften aus der Karolinger Zeit', in: Archiv für Buchbinderei, 38(1938), pp. 33-8; G. Kattermann, 'Die Karolingischen Reichenauer Bucheinbände und die Technik des frühmittelalterlichen Einbandes', in: Archiv für Buchbinderei, 39(1939) pp. 17-20, 31-2; B. van Regemorter, 'Evolution de la technique de la reliure de VIIIe au XII

siècle', in: Scriptorium, 2(1948), pp.275-85; J. Vezin, 'La réalisation matérielle des manuscrits latins pendant le haut Moyen Age', in: Codicologica, 2(1978), pp. 15-51; J. Vezin, 'Deux manuscrits de Würzburg et leur reliure', in: Litterae Medii Aevi (Festschrift J. Autenrieth), Sigmaringen 1988, pp. 87-92; G. Pollard, 'Some Anglo-Saxon Bookbindings', in: The Book Collector, 24(1975), pp. 130-159; G. Pollard, 'Describing Medieval Bookbindings', in: Medieval Learning and Literature (Essays for R.W. Hunt), Oxford 1976, pp. 50-65; L. Gilissen, (see Note 4.); A.A. Nascimento, 'Les reliures médiévales du fonds Alcobaça de la Bibliothèque Nationale de Lisbonne', in: Calames et Cahiers, (Festschrift Léon Gilissen) (J. Lemaire & E. Van Balberghe, eds.), Bruxelles 1985, pp. 107-17; D. Carvin, La reliure médiévale, Arles 1988.

11 W.K. Gnirrep & J.A. Szirmai, 'Spines reinforced with metal rods in sixteenth-century limp parchment bindings', in: Quaerendo, 19(1989), pp. 117-40.

12 P. Franck, A Lost Link in the Technique of Bookbinding and how I found it, Gaylordsville 1941; also id., Die Rundbogenheftung und wie ich sie entdeckte, Stuttgart 1949. The author describes his finding of 'arch-sewing' in a Basel binding of 1641, unaware of the fact that it has been practised at least 300 years earlier.

13 The significance of the rounded spine for the function of the codex has received little attention. Some aspects concerning modern bindings are discussed by O. Gurbat, 'Warum rundet man den Buchrücken?', in: Allgemeiner Anzeiger für Buchbindereien, 44(1929), pp. 1007-9; O. Gurbat, 'Der gerade Rücken', in: Archiv für Buchbinderei, 35 (1935), pp. 20-4, und E. Kretz, 'Das alltägliche Buch', in: Archiv für Buchbinderei, 30(1930), pp. 51-6. An inspiring source of thoughts and observations on the physical structure and functional qualities of the medieval bindings is C. Clarkson, 'The Conservation of Early Books in Codex Form: A Personal Approach', in: The Paper Conservator, 3(1978), pp. 33-50. See also G. Frost, 'Structure and Action in Hand Bookbinding', in: The New Bookbinder, 10(1990), pp. 31-41, and id., 'Mobility and Function in the Codex Bookbinding', in: The Complete Binder, (Festschrift Roger Powell), (G. Petherbridge, ed.), in press.

14 The recognition that parchment manuscripts and books printed on paper require different binding structures is not new. Thus Roger Powell started to rebind manuscripts without using any adhesive already in the early 1950s, and followed this method in rebinding precious works like The Book of Kells (see N. Pickwoad, 'Powell Multiscient', in: The New Bookbinder, 2(1982), pp. 3-16. The harmful effects of the heavily glued, rounded and backed spine on the parchment text block have been pointed out, among others, by N. Pickwoad, 'A Report on The Parker Library' (Cambridge 1983, internal report), and by D.-E. Petersen, 'Notes on the binding and storage of vellum-leaved books', in: Conservation of Library and Archive Materials and the Graphic Arts (G. Petherbridge, ed.), London etc., 1987, pp. 211-17.

15 C. Clarkson, 'Limp Vellum Binding and its Potential as a Conservation Type Structure for the Rebinding of early Printed Books - A Break with the 19th and 20th Century Rebinding Attitudes and Practices', in: ICOM Committee for Conservation, 4th Triennial Meeting, Venice 1975, pp. 1-15; (also published under the same title by The Red Gull Press, Hitchin 1982). See also E. Fitzsimons, 'Limp vellum bindings: their value as a conservation binding', in: Restaurator, 7(1986), pp. 125-42.

16 G. Frost, 'Historical Prototypes for Conservation Binding' BookLab Booknote 9, (pamflet by BookLab, Inc., 8403 Cross Park Drive, Suite 2-E, Austin, Texas 78754, USA), see also The Abbey Newsletter, 12(1988), p. 35; B. Levy, 'The "K-118" Binding Structure: A 500-Year-Old Experiment for Modern-Day Book Conservation', in: Conservation and Preservation of Humanities Research Collections, (D. Oliphant, ed.), Austin 1989.