

SYMMETRY ASPECTS OF BOOKBINDINGS

M. ROZSONDAI

Department of Manuscripts and Rare Books, Library of the Hungarian Academy of Sciences,
P.O. Box 7, Budapest, H-1361, Hungary

B. ROZSONDAI

Structural Chemistry Research Group of the Hungarian Academy of Sciences, Eötvös University,
P.O. Box 117, Budapest, H-1431, Hungary

Abstract—Geometric and other relations of decorated leather bookbindings are analysed. Symmetry properties of the ornamentation, the symmetries of motifs and of the layout, and some correlations of symbols and ideas, furthermore the occurrence of one- and two-dimensional space groups and interlace designs are demonstrated by Romanesque and Gothic bindings, Hungarian, Italian, French and German Renaissance, as well as by Baroque and rococo bindings, and finally, by some pieces of modern bookbinding art.

INTRODUCTION

“Numero pondere et mensura Deus omnia condidit”—“God created everything by number, weight and measure.” Isaac Newton dedicated these words (Fig. 1), his “tessera”, to a Hungarian student, Ferenc Páriz Pápai Jr, the possessor of the album held by the Department of Manuscripts and Rare Books of the Library of the Hungarian Academy of Sciences [1]. The Academy, now embracing all branches of knowledge from arts and humanities through natural sciences to applied sciences, was

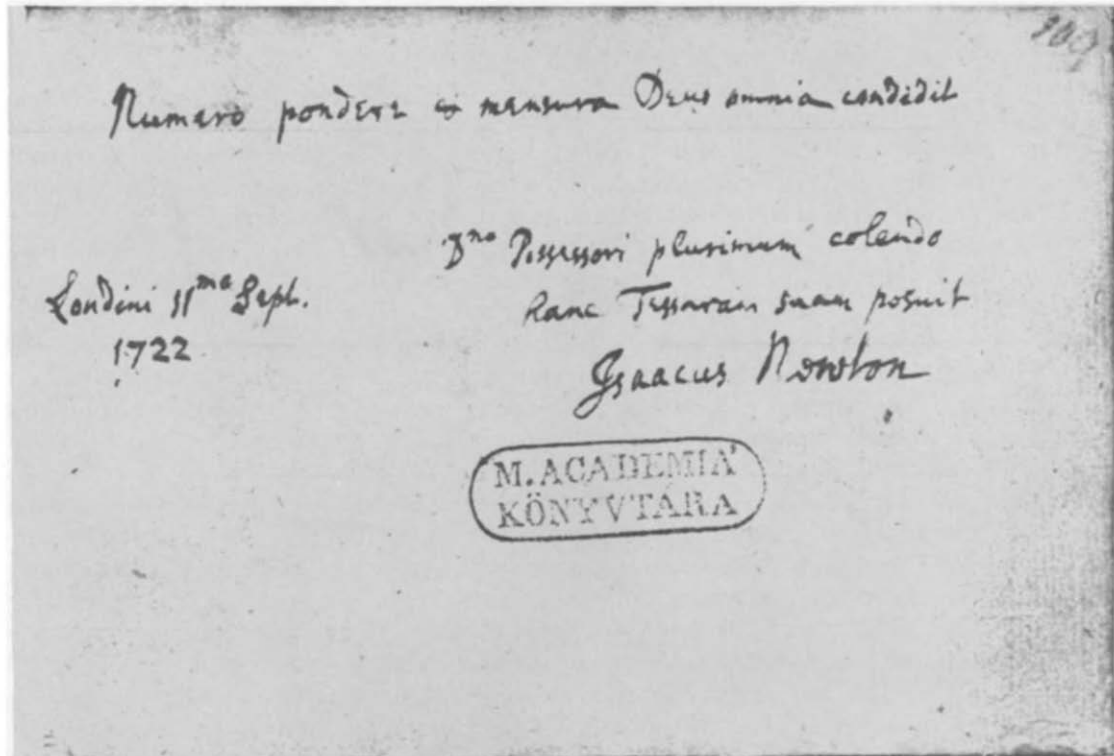


Fig. 1. Isaac Newton's autograph in the Library of the Hungarian Academy of Sciences. [Shelf-number: Tort. naplók, kis 8° 6.] Reproduced by permission. The authors are grateful for the kind permission to reproduce material from the holdings of the Library of the Hungarian Academy of Sciences (abbreviated hereafter in figure captions as Bibl. Acad. Budapest; no special mention of the permission will be made).

founded in 1825 as a “Learned Society” to promote above all Hungarian language and literature. Thus, in addition to scientific books and periodicals, the Library contains literary monuments and bequests, manuscripts and rare books. Most of our examples of bookbinding decorations will be taken from there.

Jan Amos Komenský (Comenius), the Czech educator, who founded modern visual teaching by his most renowned work, *Orbis Sensualium Pictus* (*The Visible World in Pictures*, Nuremberg 1658; London 1659) [2], set up the ideal of pansophia, a unified science reflecting the indivisibility of nature. His book, which he drafted during his stay (1648–1654) in Sárospatak, Hungary, is also a realization of these ideas in teaching Latin and other foreign languages. It contains a passage on “Bibliopegus, the Book-binder”, as well as others on “Printing, the Book-sellers Shop, a Book, and a School”.

Recalling Newton’s maxim, one of the striking manifestations of $\text{measure} = \tau\acute{o} \mu\acute{\epsilon}\tau\rho\nu$ is symmetry as it appears in nature and in man’s work. It may also be a bridge, as the present and a previous special issue of this journal exemplify, between different fields of artistic and scientific human activities.

In the following discussion we try to investigate geometric and analogous relations throughout the history of bookbinding decoration. No attempt has been made to give a complete representation of all periods and styles; the selection of examples was influenced by our personal interest and the accessibility of material.

One of the conspicuous geometrical relations is symmetry. Point groups and space groups will be used here to classify symmetry properties of ornaments but no knowledge of the theory is assumed. A point group (with the properties of a mathematical group) is a set of symmetry operations, which leave at least one point of the object fixed in space. For the planar figures to be discussed, the symmetry operations include reflection through a plane (mirror plane, m) and rotation about an axis (two-, three-, four-fold etc. axis, 2, 3, 4, . . . or, in other notation, C_2 , C_3 , C_4 , . . .). Mirror planes and rotation axes are perpendicular to the plane of the figure. Conventional notations of symmetry groups indicate the basic symmetry operations of the group. In the case of space groups, additional symmetry operations are translation and glide reflection, i.e. a reflection combined with a translation. A space group applies to an infinite lattice or periodic pattern, and when we speak of the one- or two-dimensional space-group symmetry of a decorative pattern, we regard it as a section of an infinite structure. For that matter, imposing geometrical relations such as congruence, symmetry or similarity on real objects is more or less an approximation. Deviations from exact relations are more apparent on handicraft products—historical bookbindings typically belong to this category—and the extent of deviations depends on several factors such as technique, craftsmanship, tools and material used. Sometimes a deviation can be intentional.

Stone, wood, clay tablets, parchment or papyrus scrolls bore written records in ancient times before the book in its present form appeared. Its precursor was the diptych, a pair of ivory tablets or wooden boards, possibly decorated, protecting the inscription in wax inside. Some folded parchment sheets were then placed, later also fastened, between the panels—and thus the book was born! All the essential elements that constitute a book today had been brought together by the dawn of the Middle Ages. A handwritten and illuminated book was itself a great asset; ivory or precious metal covers and jewels added to its value and impressiveness [3]. Even in recent centuries jewelled or ivory bindings have been occasionally applied to special or ceremonial books.

Yet the bookbinder’s craftsmanship finds its proper expression in the preparation and embellishment of leather bookbindings. Leather had been a favourite material for covering books from the early Coptic bindings until the age of large-scale book production when the cheaper binding materials of cloth and paper replaced it, at least partially.

Leather bindings were most commonly decorated by means of finishing tools, each having an engraved design on its face and producing a corresponding blind or gold-tooled impression on the leather. A pallet or fillet was used to impress a line or parallel lines, a smaller stamp to have a unit motif. The roll, a tool with a brass wheel, with an engraved pattern on its circumference, and the panel, a larger block of metal, were in general use from the fifteenth to the nineteenth century. The tool itself and its impression are denoted by the same words, viz. a stamp, a roll, a panel. A simple technique of reproducing an impressed motif or design of a bookbinding is to put a piece of paper on it and rub it with various soft lead pencils.

Even after the invention of printing in the 1450s, when hundreds and hundreds of identical copies of an edition were produced, hand bookbinding transformed each copy into a unique entity. The purchaser and user had the book bound in most cases. Bookbinding research, which grew out of bibliophilic interests in the last century, goes into the details of the “when, where, by whom, for whom” etc. of a book and its binding, and, relying on the exact identification of tools used for decoration, on owners’ notes in the book, on fragmental pages used as auxiliary material in binding, on archival sources etc., has become a complex field of study. Decorated bookbindings reveal a lot about the books and the culture of a given age.

BOOKBINDING IN THE MIDDLE AGES

Some Coptic leather bindings from Egypt have come down to us [4] from the sixth to the eighth centuries but such bindings existed in earlier centuries. In Europe the earliest leather bindings date from the Carolingian age (ninth and tenth centuries). These are followed by the books bound in Romanesque style (twelfth and thirteenth centuries). 139 such bindings are recorded today [5], and they represent a fully developed art of book decoration.

It must be remembered that at the time of the *Romanesque* bindings, *Gothic* art was flourishing and dominating in the architecture of Europe [6], and the same intellectual trend, Scholasticism, influenced bookbindings and architecture alike. Applied arts—including bookbinding—are in general characterized by a certain delay in relation to fine arts.

Romanesque bindings, i.e. their layout (Fig. 2), are related rather to Coptic or Islamic bindings than to those of the Carolingian and Ottonian ages. The transition from Romanesque to Gothic bindings is, however, quite continuous. Motifs are similar, and even the recutting of some Romanesque tools, especially palmetto and dragon stamps has been noted [7].

The most frequent Romanesque and Gothic stamps (Fig. 3) represent lily (fleur-de-lis), palmetto, foliage, rosette (four, five and sixpetalous), birds, a pair of birds, deer, dragon, eagle, double-headed eagle, griffin, the Holy Lamb, mermaid, monkey, pelican (the Christ-symbol), unicorn, and the symbols of the four Evangelists (Matthew, Mark, Luke and John: angel, lion, ox and eagle). On Romanesque bindings usually there are many stamps, certainly more than on Gothic bindings. Only eight kinds of stamps (Fig. 5) but altogether more than 600 (!) impressions of them figure on the upper and lower cover of the early Gothic leather binding of a parchment codex from the fourteenth century (Fig. 4). The proper Gothic binding shows a looser layout and a much smaller number of repetitions of the stamps.

Bilateral symmetry of motifs (Fig. 3) (point group m or C_s) and rotations with mirror planes (point groups $3m$, $4mm$, $5mm$ and $6mm$ or C_{3v} , C_{4v} , C_{5v} and C_{6v} , subscript v for vertical) are common, but pure rotational symmetry (point groups 2 , 3 , 4 , . . . or C_2 , C_3 , C_4 , . . .) is rarely applied. A playful collection of symmetries appears on a roll (Fig. 6), including point group C_3 with

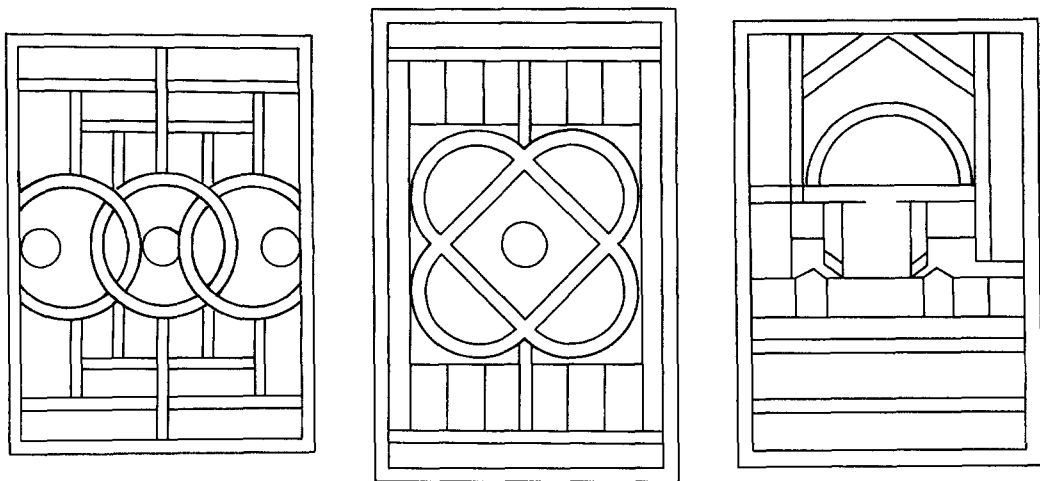


Fig. 2. Layout of three Romanesque bindings after [5], Nos 1, 7, 13.

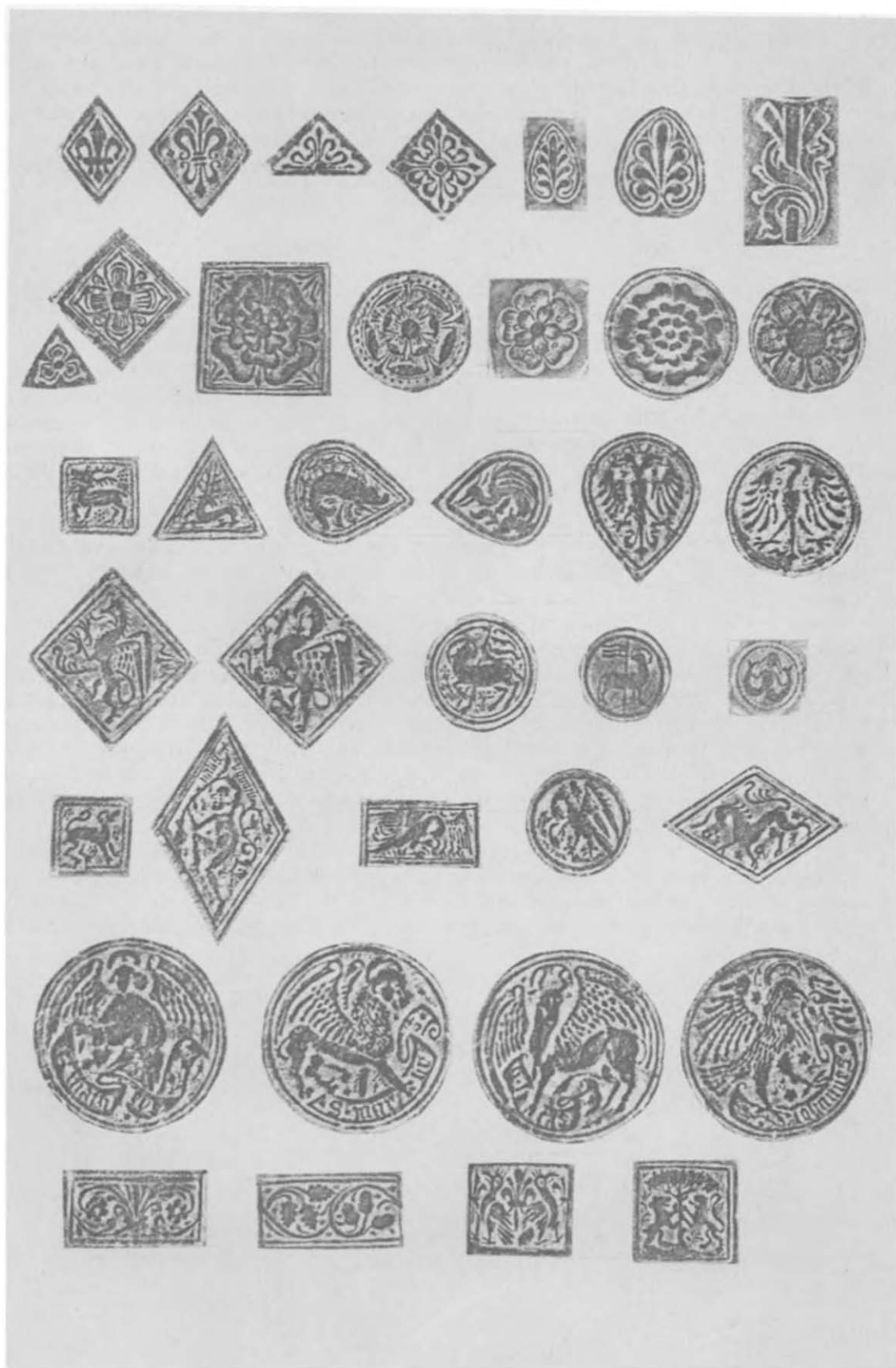


Fig. 3. Stamps from some Gothic bindings of the Bibl. Acad. Budapest.



Fig. 4. Early Gothic leather binding, upper cover. National Széchényi Library, Budapest: Clmae 79. Reproduced by permission.



Fig. 5. Stamps on the binding in Fig. 4: pair of birds, doubleheaded eagle, the Holy Lamb, pelican, deer, dog, monkey, bird.



Fig. 6. A roll from a Gothic binding made in Augsburg. The motifs have C_{4v} , C_{4v} , C_3 , C_{3v} , C_{6v} , C_{4v} , C_{6v} , C_{4v} , C_{3v} and C_{4v} point-group symmetry, respectively. Bibl. Acad. Budapest: Ráth 1058. This roll is identical with that in Ref. [8, Plate 171, 6].

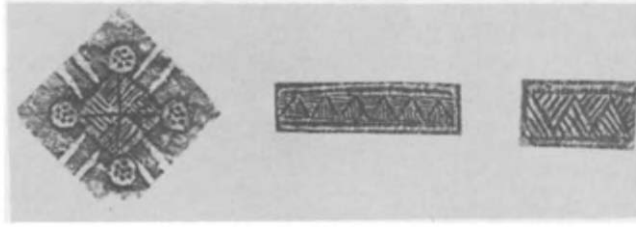


Fig. 7. Hatched motifs from Gothic bindings. Bibl. Acad. Budapest: Inc. 192, Inc. 668.

a three-fold rotation axis. Asymmetric motifs are often confined to a symmetric planar figure like a circle, a lozenge, or a square, and the encircling line is also shown.

Hatched motifs (Fig. 7) can be considered to possess colour symmetry, which means a combination of a geometrical symmetry operation (reflection, rotation, translation etc.) with a simultaneous permutation of colours. The use of hatching to indicate colours in heraldry explains the name "fer azuré" (azured tool) of the hatched stamps introduced in the sixteenth century on French Renaissance bindings.

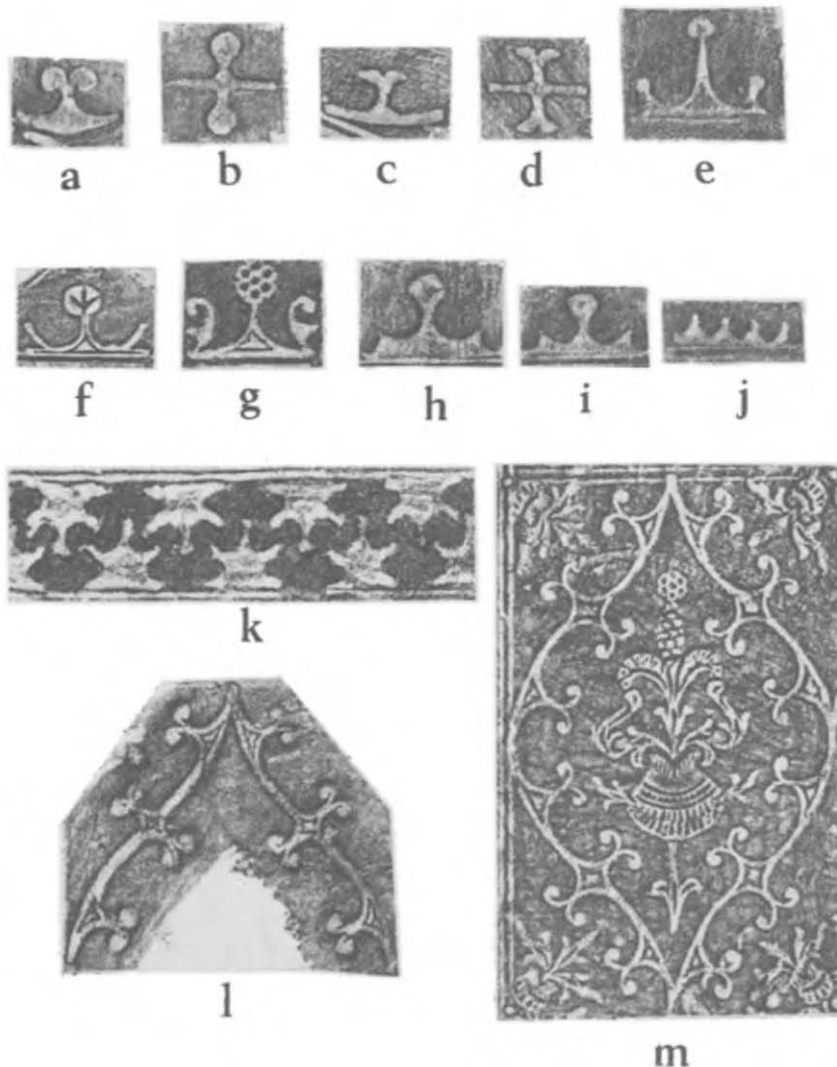


Fig. 8. Some Gothic headed outline stamps (a-k) and two blocks (l, m) derived from them. Bibl. Acad. Budapest. The complementary space between stamps k gives the popular "cloud" pattern [9].



Fig. 9. Gothic binding from a workshop in Herzogenburg (Ref. [8, Plate 27]). Bibl. Acad. Budapest: Inc. 534.

The headed outline or cusped edge stamps (*Kopfstempel* in German) played an important role in the decoration of leather bindings (Fig. 8). The central field of the upper cover, within the borders, was decorated with curved branches, with a repeated vine-like tooling, especially in the southern parts of Germany (Fig. 9). This pattern became popular in Austria, Bohemia and Hungary, and it is a good example of technical progress as demanded by the increasing book production. In the 1470s a whole curved diamond-shaped compartment (Fig. 9) was circumscribed in twelve steps by impressing eight double-headed cusped edge stamps [Fig. 8(a)] and four stamps with two “heads” on the opposite sides [Fig. 8(b)]. A large number of operations was needed to fill the central panel. To accelerate the working process, a half curved branch was engraved in the tool [Fig. 8(l)], and the bookbinder obtained a whole curved lozenge in two actions. Soon after the panel with all the details engraved was introduced [Fig. 8(m)]. The half curved branches began a new life on some Renaissance bindings in the early sixteenth century, and they appeared as ogee branches (Fig. 10).

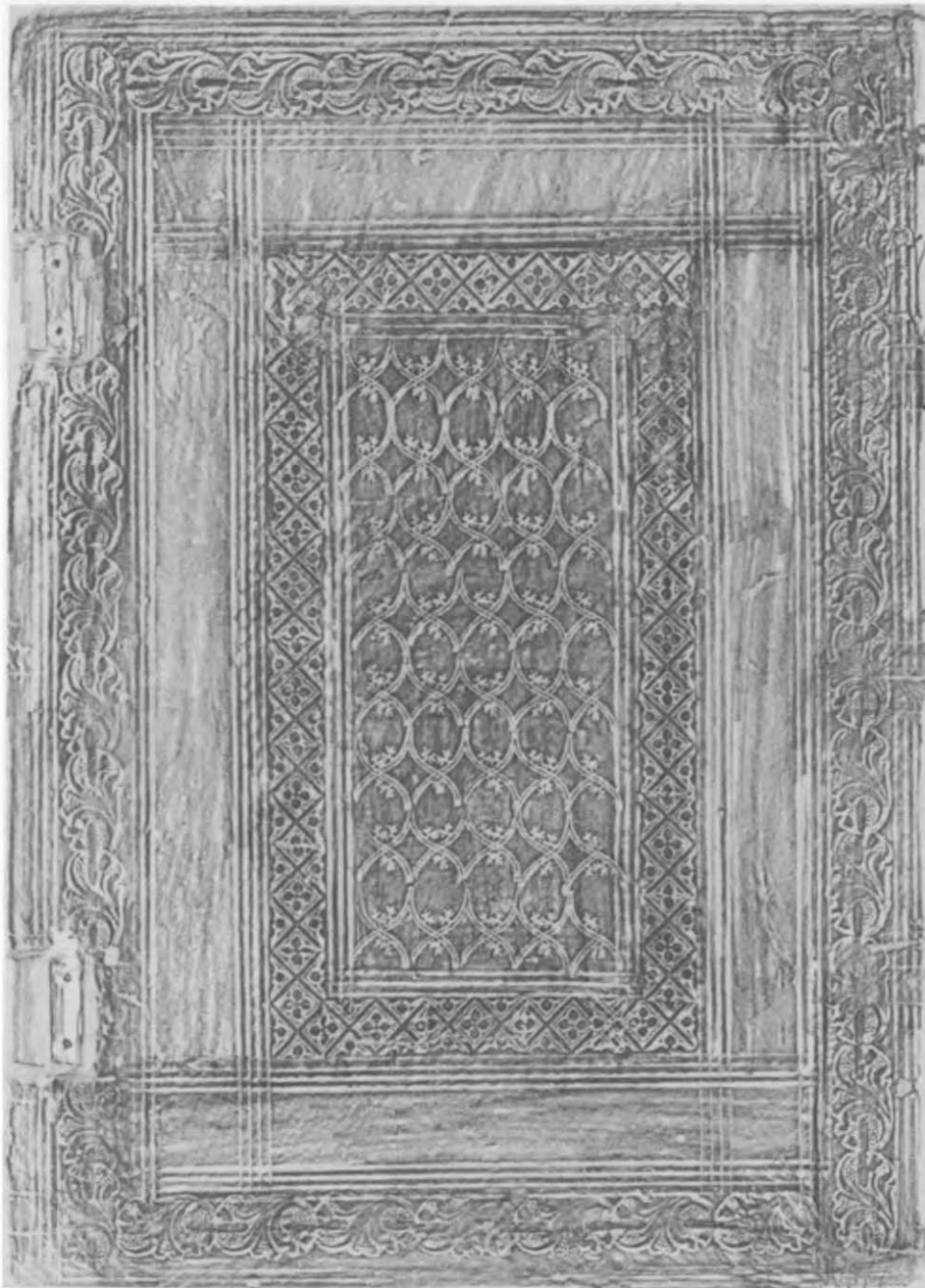


Fig. 10. Early Renaissance binding with ogee pattern, lower cover, from a secular workshop in Buda [10].
Bibl. Acad. Budapest: Inc. 877.

The cuir ciselé, i.e. the cut-leather bindings make up a special group of Gothic bindings [11]. The outline of the pattern is cut into the dampened leather and is emphasized by punching (stippling) the background by a pointed tool (Fig. 11). This embellishment required skilful masters. A similar appearance could be reached more simply by the ingenious use of the cusped edge stamp. The master had to choose the most suitable stamps to get an indented outline of an oak leaf (Fig. 12), or he had to think over carefully the proportions and the distances between the headed outline tools (Fig. 13). Thus, he achieved a turnover of foreground and background, and a good appearance of the oak leaf or of a four-leaved fleuron. The impressed curved lines mark the nervure of the leaf.

The upper cover of Gothic bindings shows a more abundant ornamentation than the lower cover (Fig. 14). One or two borders, marked out by fillets, surround a central field, which is then



Fig. 11. Cut-leather binding, Germany, fifteenth century [11, item 62]. National Széchényi Library, Budapest: Clmae 74. Reproduced by permission.

subdivided by oblique straight lines to form a diamond pattern (Fig. 15), or by an arched vine-like network into curvilinear compartments (Fig. 9). While rectangular or rather square, semicircular and quadrant subfields were preferred on Romanesque bindings (see Fig. 2), resembling structures of Romanesque architecture, perpendicular crossings of lines were avoided in the central field of Gothic bindings. The central rectangle is subdivided only by its main diagonals (Fig. 12), or, more often, by additional lines parallel to them (Fig. 16). On the binding in Fig. 15, the short sides of the rectangle are divided into two sections, the long sides into three sections by intersecting lines, while the main diagonals do not appear in the pattern. Using the latter and, consequently, an equal number of divisions on the sides of the rectangle, would have produced too slim diamonds. In all these cases, the original C_{2v} point-group symmetry of the rectangle, with two mirror planes and a two-fold rotation axis perpendicular to the plane of the figure, is retained if we disregard the pattern within the subfields. An interesting skewly oriented quasi-diamond tiling is shown in Fig. 13. The minor discrepancy between the two sides of the rhomboid is emphasized by the alignment of one and two cusped edge stamps along them, respectively.

The symmetries of a field and of the motifs which fill it often disagree. A pentamerous rosette can sit in the centre of a diamond (Fig. 15). The half diamonds along the sides of the central rectangle contain different motifs. The foliage on the binding in Fig. 14(b) breaks through the rigid frames of the rectangle and has four-fold rotational symmetry, point group C_4 . Figure 17 shows a naturally simple arrangement of alternating drop-shape figures, all pointing downwards in the central field with the antlers in this unnatural orientation, and outgrowing the corner boxes. Adjoining single stamps in the inner border take the shape of a tracery so characteristic of Gothic architecture and decorative art. David's six-pointed star (Solomon's seal) in the outer corners encloses a pentapetalous flower. Bearing in mind that a rosette is the Virgin Mary's symbol, is this a hint at her line of descent?

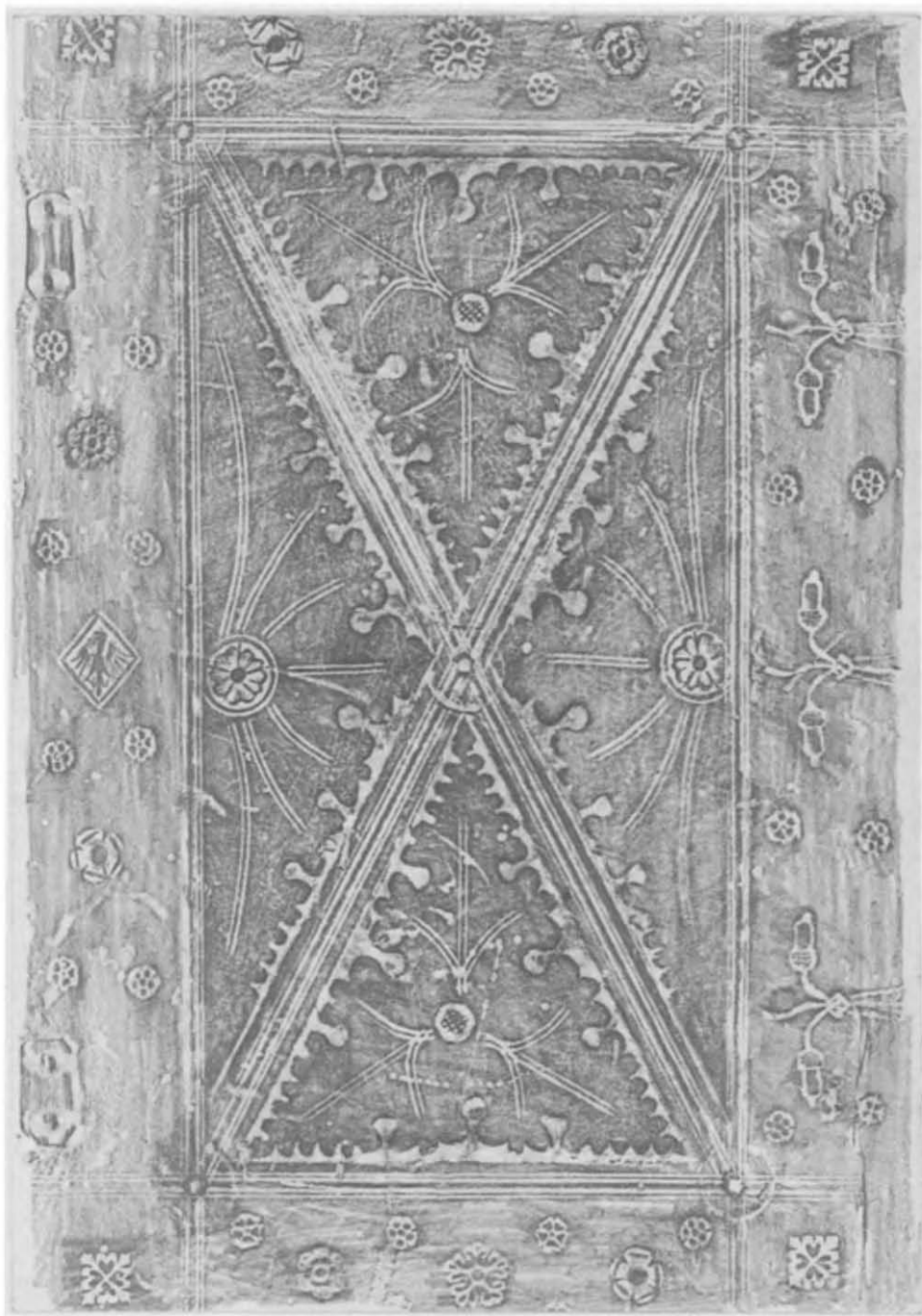
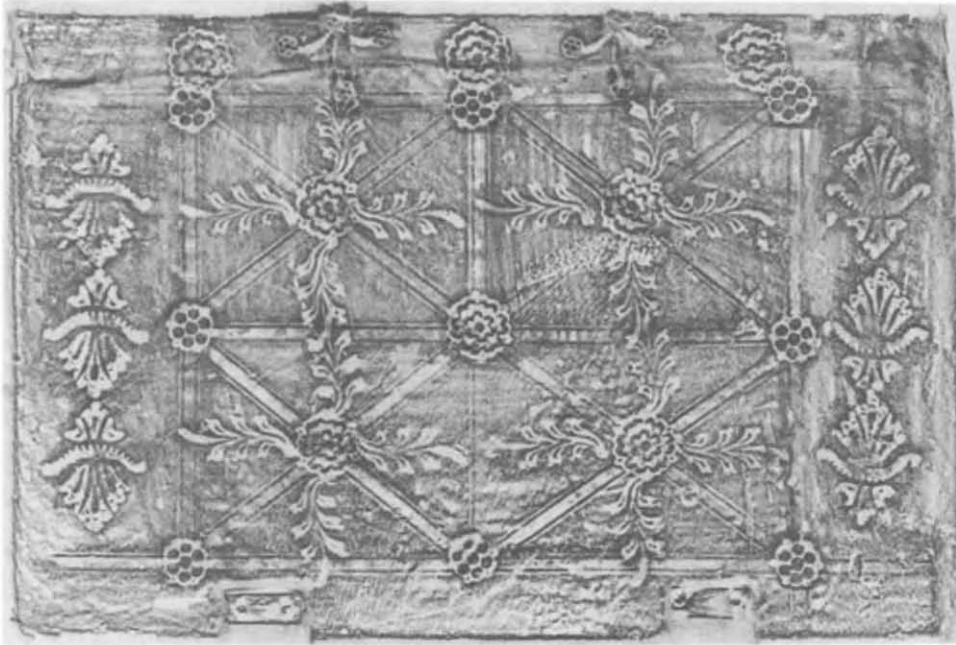


Fig. 12. German Gothic binding with leaf relief obtained by the headed outline tools in Fig. 8(h-j).
Monastery bindery, Aldersbach, Bayern. Bibl. Acad. Budapest: Inc. 746.



Fig. 13. Gothic leaf-relief binding. Probably Ingolstadt. National Széchényi Library, Budapest: Clmae 223. Reproduced by permission.



(b)



(a)

Fig. 14. Upper (a) and lower cover (b) of a Gothic binding. Near Linz. Bibl. Acad. Budapest: Inc. 400.

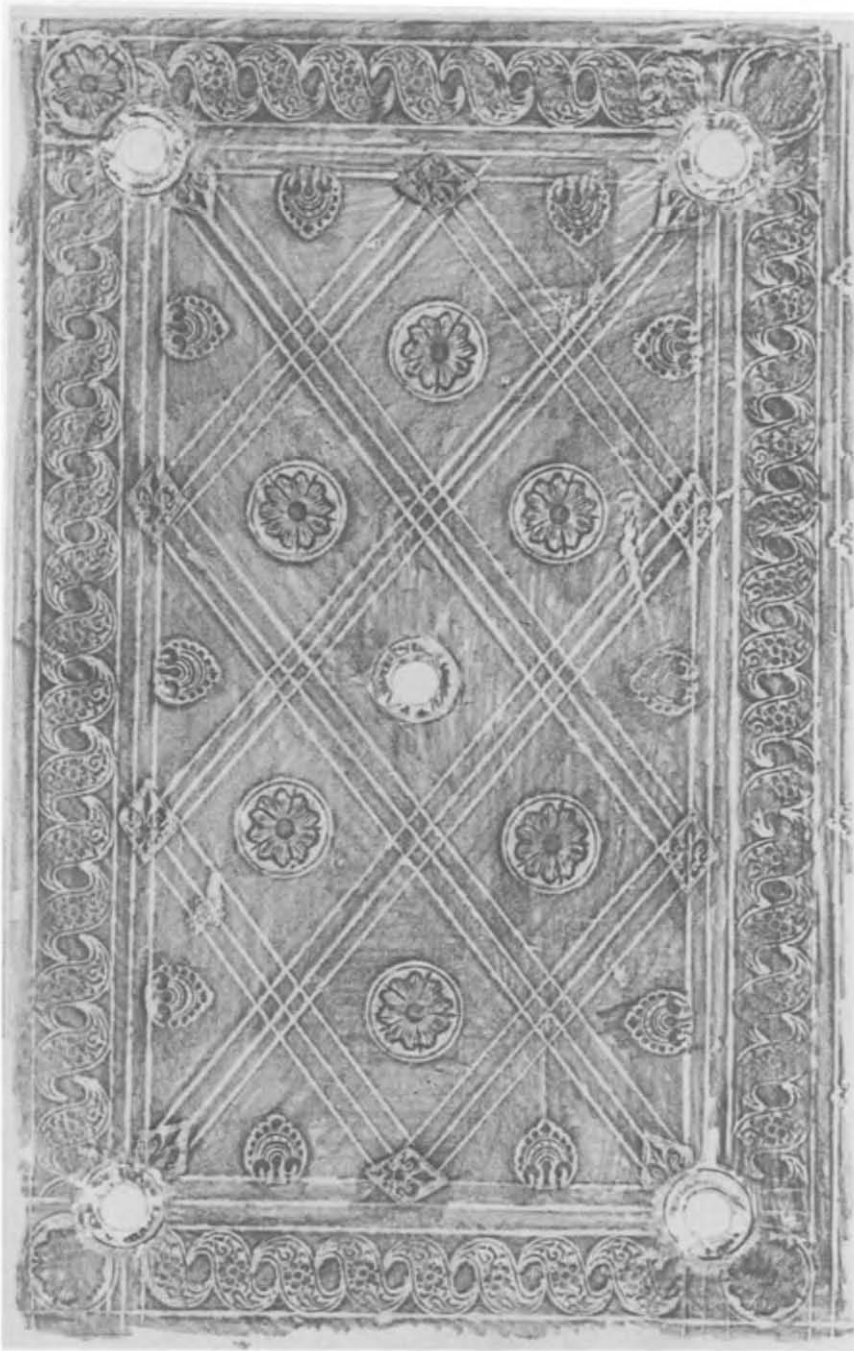


Fig. 15. Monastery binding from Vienna [12]. Bibl. Acad. Budapest: Inc. 148.

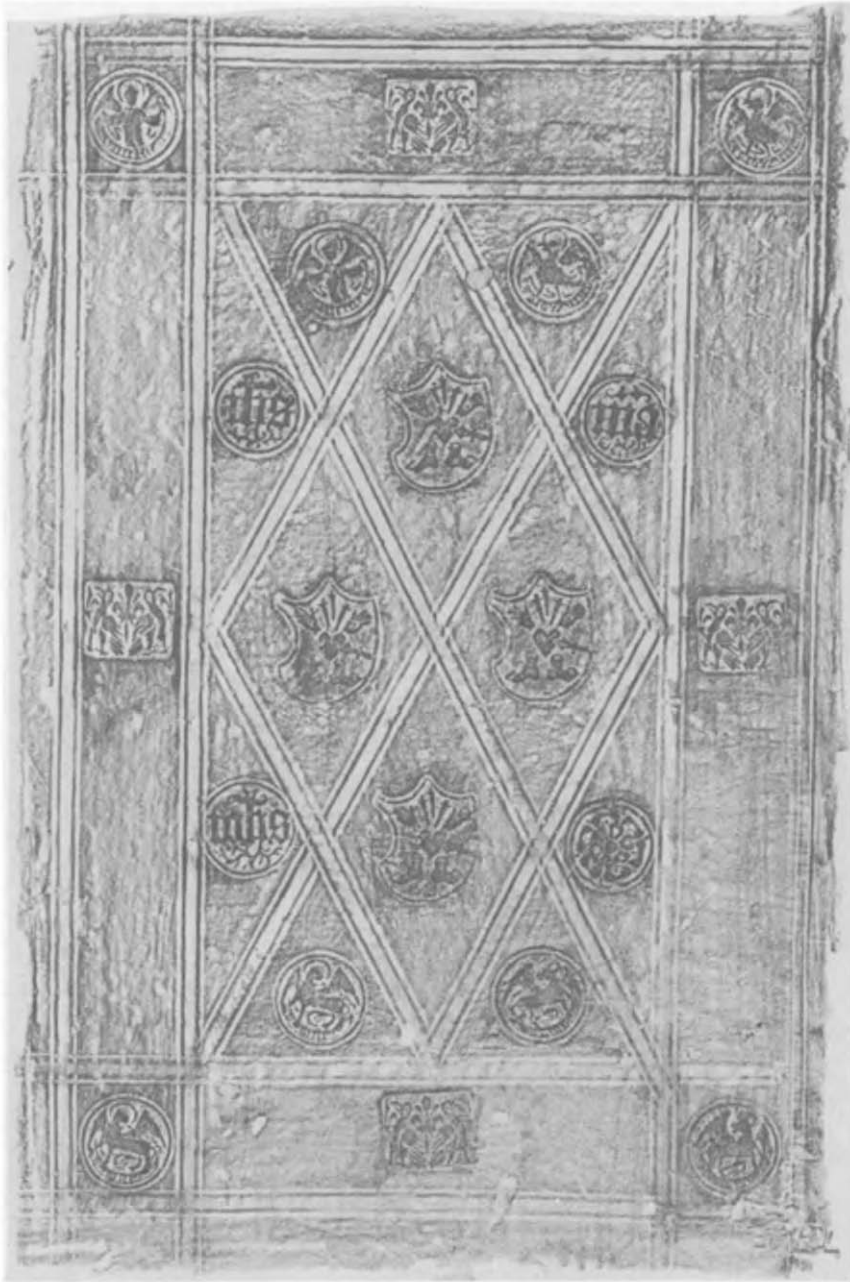


Fig. 16. Monastery binding from Weddern near Dülmen [13]. Pelbartus de Themeswar: *Pomerium sermonum de sanctis*. H. Gran, Hagenau (1520). Bibl. Acad. Budapest: RM III 93.

A symmetry of ideas and persons is represented on a simply decorated lower cover (Fig. 16) by the images of Christ's suffering in the shields (two hands, two feet, three nails, a heart and spear), the names of Jesus, his mother Mary and her symbol the rosette beneath, and John, the disciple whom he loved and who stood with Mary by his cross, and the symbols in the corners and half diamonds of the four Evangelists who told the story of the Passion. A binding decorated with the same tools is kept in the British Library [14].

The edges of a binding, and sometimes its central field too, are decorated by "frieze" patterns. The seven possible symmetries of infinitely repeating patterns, the one-dimensional space groups have been nicely illustrated by Hungarian needlework [15]. Similarly, border patterns from book-bindings are shown in Fig. 18, and classified according to symmetry groups. (See e.g. Ref. [17] for notation and explanation.) Such patterns were produced either by repeated impressions of single



Fig. 17. Gothic binding from Ulm [13]. Bibl. Acad. Budapest: Ráth F 1065.

stamps [as most of the patterns in Fig. 18 and the “cloud” pattern in Fig. 8(k)] or, especially later, on Renaissance bindings, by a roll. The period of the design, i.e. the shortest distance at which the motif recurs, shows the dimensions, the perimeter of the roll (Fig. 19), or, rather with geometric ornaments, the same motif is repeatedly engraved in the periphery, and it is difficult to find out the true dimensions of the tool. The floral curls in Fig. 18(b) fit roughly in space group 1g, while there exist actually at least four variants of flowers and birds, and translation remains the only symmetry operation.

While searching for and selecting from examples of space groups of border designs occurring on bookbindings, one may reflect upon how and why symmetries of ornaments were chosen, preferred or neglected. The conventions of the given style, its stock of forms and motifs seem to be decisive.

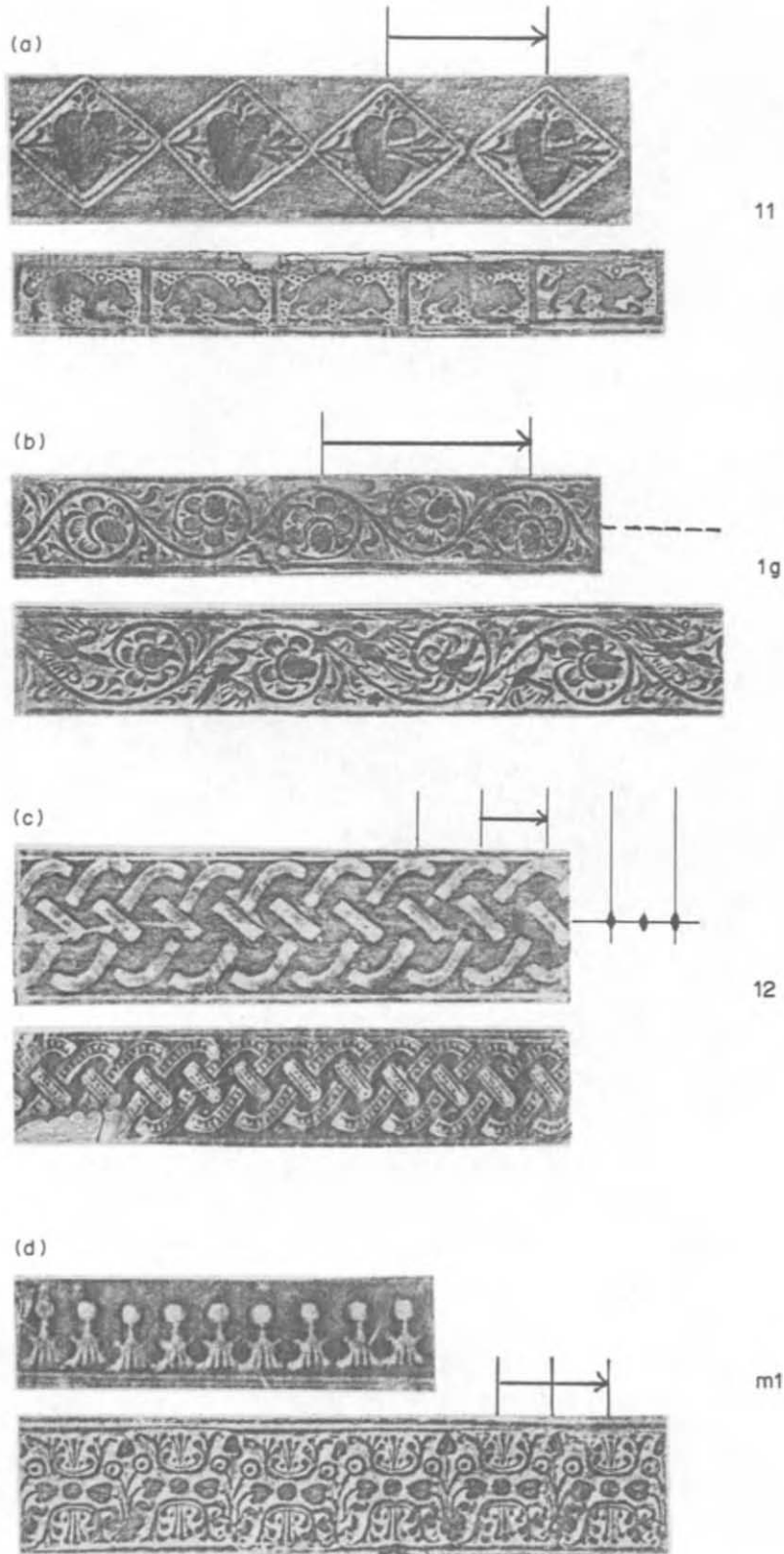


Fig. 18(a)-(d).

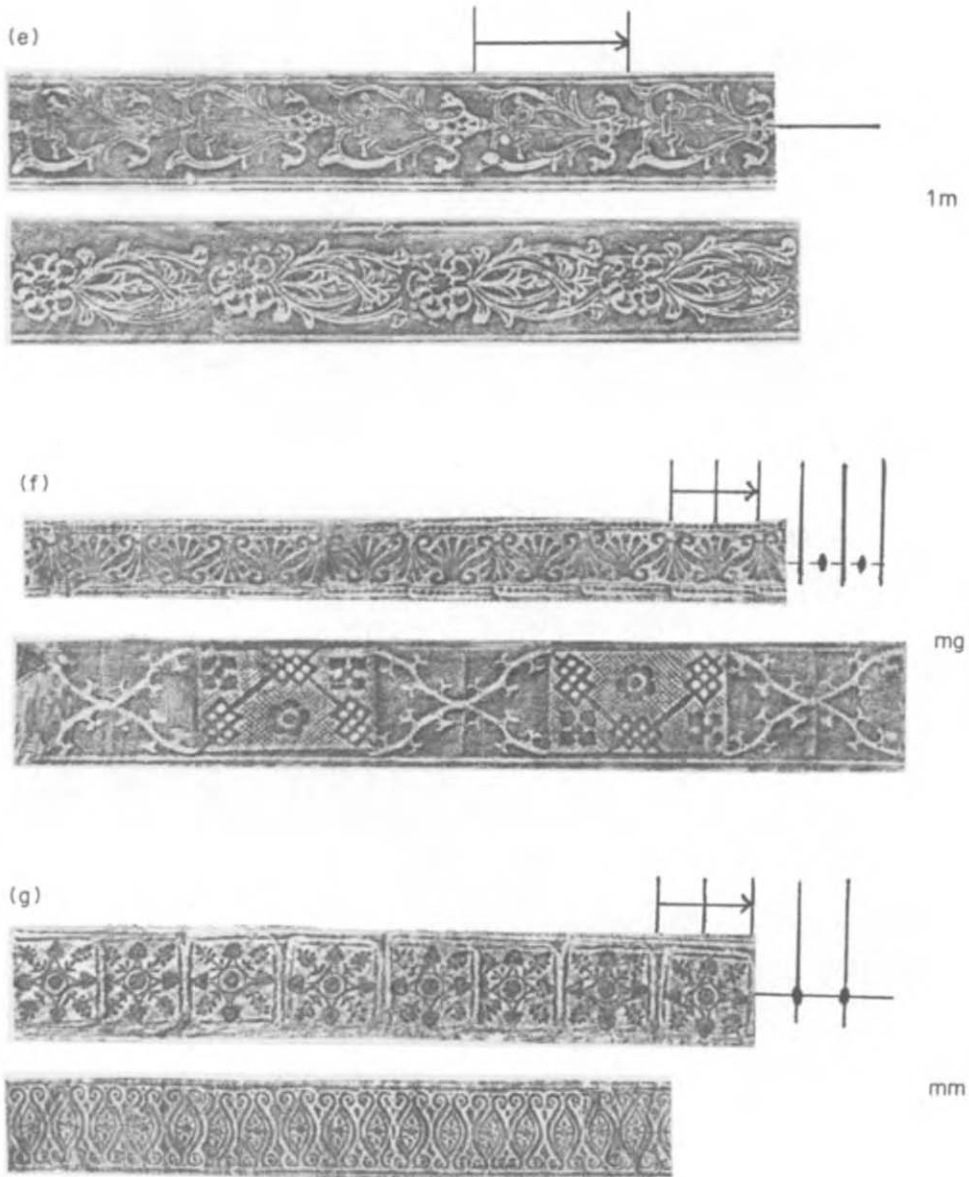


Fig. 18. Border patterns from Gothic (G) and Renaissance (R) bindings [16], and their one-dimensional space groups. \rightarrow translation vector, $-$ reflection plane, $----$ glide reflection plane, \bullet two-fold rotation axis. (a) Monastery bindery Buda (G)–Dominican bindery Vienna (G); (b) both from Augsburg (G); (c) both from Vienna (G); (d) Vienna (G)–Vienna (R); (e) Buda (R)–Venice (R); (f) Florence (R)–Minden, Germany (G); (g) Bamberg (G)–Spanish (R). Bibl. Acad. Budapest.

Gothic figures of animals, birds etc. or a hunting scene (Fig. 19), all viewed from the side, present no symmetry at all, and the simple repetition of these motifs in a strip leads to space group 11 [Figs 18(a) and 19]. Other arrangements with further symmetry elements are not likely to occur, because it rarely happens that an ordinary animal is represented upside down; a nice dragon, however, may be an exception (Fig. 20)! Bookbinders of the Renaissance, however, rejected such restrictions when they impressed a roll horizontally along the edges of the cover with portraits or mythological and allegorical figures. We have not met with a head-to-head tail-to-tail alignment of animals making up symmetry group $m1$. At any rate, a mirror plane or a glide reflection plane in an arrangement of asymmetric motifs, when realized by single stamps, would require both “enantiomers” (mirror image copies) of the tool. Flowers, foliage, vine or geometrical forms offer a wider variety of symmetries of either the motif itself or the pattern it comprises.

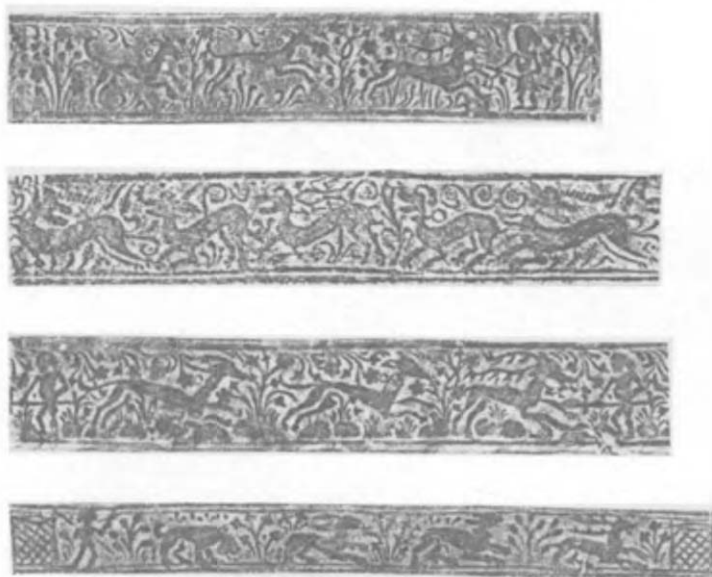


Fig. 19. Rolls with hunting scenes on late Gothic bindings from Augsburg (the upper three) and Memmingen (below) [16]. Bibl. Acad. Budapest.



Fig. 20. Dragon stamps forming a border design, space group 12. Drawing by Éva Kovács-Rozsondai after Ref. [18].

Masters of Romanesque and Gothic bookbindings obviously did not speculate about symmetry, they just applied it intuitively. The spirit of their age, the object of their artistic endeavour, i.e. the book cover, and the nature of their materials and tools determined their work. The symmetries of general layout, patterns covering fields and motifs making up patterns do not necessarily harmonize, and thus the resulting complete decoration may have a lower symmetry than its components, or even no symmetry at all.

RENAISSANCE BOOKBINDINGS

While the Gothic style is international and its general criteria are the same all over Europe, the Renaissance has national marks, and these are characteristic of the country whose “make” the given binding is. The bookbindings to the south of the Alps differ considerably from those of the Transalpine area.

Everyone who is fond of beautiful books must have heard of the Corvinus bindings. The once famous library of the Hungarian king Matthias Corvinus (1458–1490) held about 2000 codices [19]. Approximately one-tenth of the stock has survived, scattered throughout 44 towns in 14 countries. There are 47 Corvinus manuscripts and 3 incunabula† today in Hungary. Some of the books have their original silk, velvet or coloured gold-tooled leather bindings. The upper and lower covers of the decorated leather bindings are identical, apart from the title or the author’s name, impressed at the top of the lower cover. Italian Renaissance and oriental influences are mixed with local decorating tradition on these typically Hungarian products (Fig. 21). The floral motifs: rosette, calyx-flower, leaves, peltate, palmettos and tulips are in general gilded, the cablework is blind, the

†Books printed in the fifteenth century.

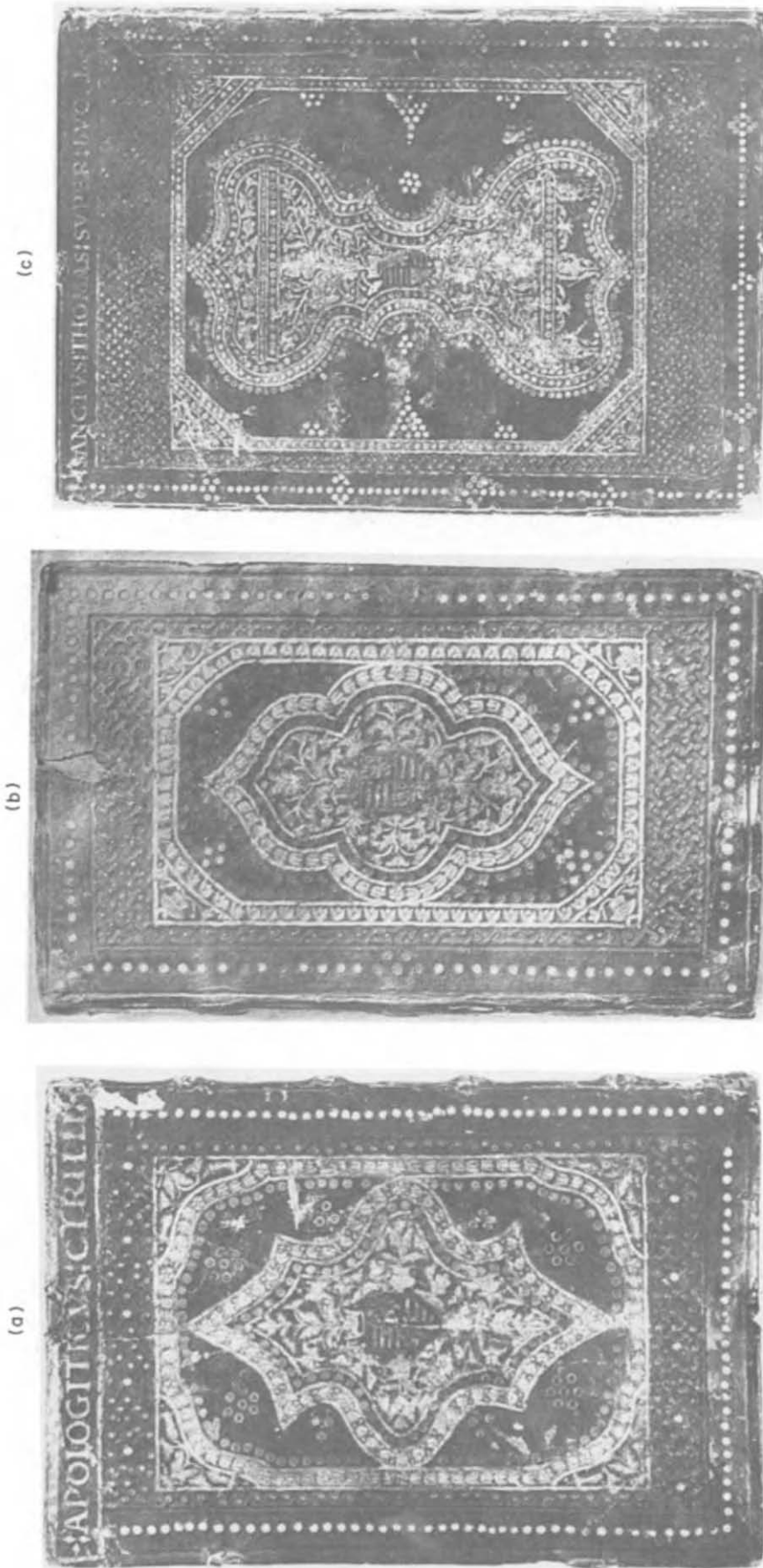


Fig. 21—continued overleaf

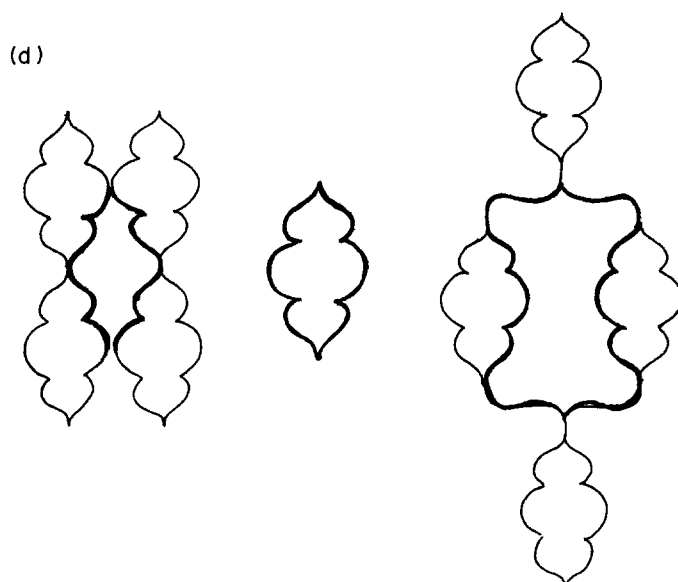


Fig. 21. Gold-tooled Corvinus bindings. (a) Österreichische Nationalbibliothek (ÖNB): Cod. Lat. 1037. (b) National Széchényi Library, Budapest: Clmae 422. (c) ÖNB: Cod. Lat. 1391. Reproduced by permission. (d) Schemes of the central designs after Ref. [20].

punch dotting coloured. Either the royal coat of arms or Matthias' raven (corvus in Latin, hence his epithet) is placed in the centre. Among the extant copies one cannot find two identically decorated bindings. The overall symmetry is quite simple, C_{2v} , except for some details. An interesting feature of the large number of emphasized central panels has been noted [20], a leap of a form into its negative, an interconversion of figure and its background. All these forms can be imagined as enclosures shaped by surrounding copies of one and the same motif [Fig. 21(d)], which by itself also appears as a central piece. The figure/background effect is even more pronounced in the repeated pattern of Fig. 22, which was obviously inspired by a certain type of oriental carpet (Fig. 23).

Some tools of the Corvinus bindings, first of all the flower-cup, were recut and used in other binderies in Buda in the first three decades of the sixteenth century. In addition, new stamps and rolls were produced (Fig. 24), and among them the different interlaced knotwork motifs and the rolls combining palmettos with leaves of the acanthus became extremely popular. A number of their variants existed [Fig. 25(a)] on Hungarian Renaissance bindings. The acanthus leaves were a common ornamentation in Greek architecture in the fifth century B.C. and revived in the fifteenth and sixteenth centuries all over Europe [Fig. 25(b), (c)]. The interlace or strapwork also occurs in architecture (Fig. 26).

Italian Renaissance bindings are lightly decorated and pleasantly spaced out. A large scale of knotwork stamps, arabesque centrepieces, linked arabesque circles as borders are their most prominent stylistic features (Figs 27, 28). Coptic and Islamic motifs as well as Persian elements like the peas-trailer or clasper can be recognized on them (Fig. 29).

Different types of Renaissance bindings developed in France in the sixteenth century. A number of the books bound for Jean Grolier, the bibliophile, were decorated by complicated interlace work (Fig. 30). Another trend of book ornamentation, which was connected with the French royal court and had remained in practice well into the seventeenth century, created elegant masterpieces by simpler geometrical means. These *semé* bindings (*semer* = to sow) provide an opportunity to demonstrate two-dimensional space groups.

Only some of the 17 possible two-dimensional space groups occur on bookbindings. The continuity of the pattern is broken not only by field boundaries but also by variant or extrinsic elements of decoration, and the number of repetitions of the basic motif or tile is too small to speak of an "infinitely repeating" pattern. On a *semé* binding, the lattice points, in which the motifs are placed,

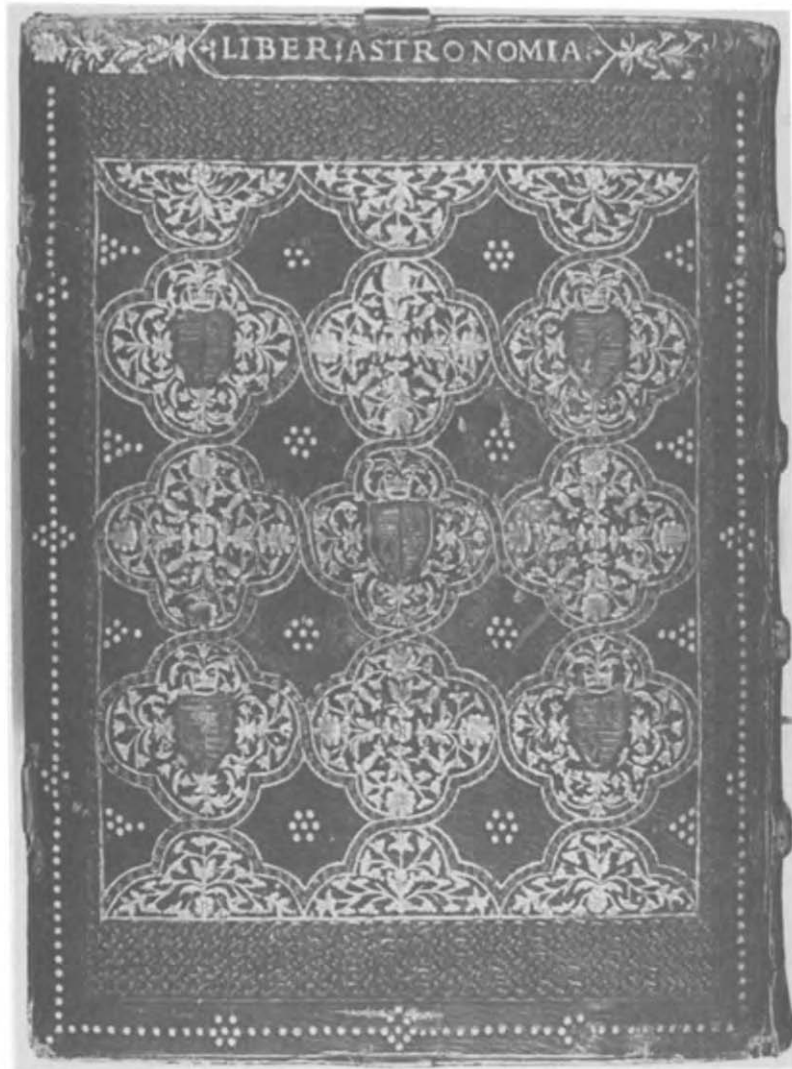


Fig. 22. Gold-tooled Corvinus binding with repeated pattern. Österreichische Nationalbibliothek: Cod. Lat. 2271. Reproduced by permission.



Fig. 23. Holbein-carpet. Anatolia, sixteenth century. 150 × 220 cm. Museum of Applied Arts, Budapest: Inv. 14785. Reproduced by permission.

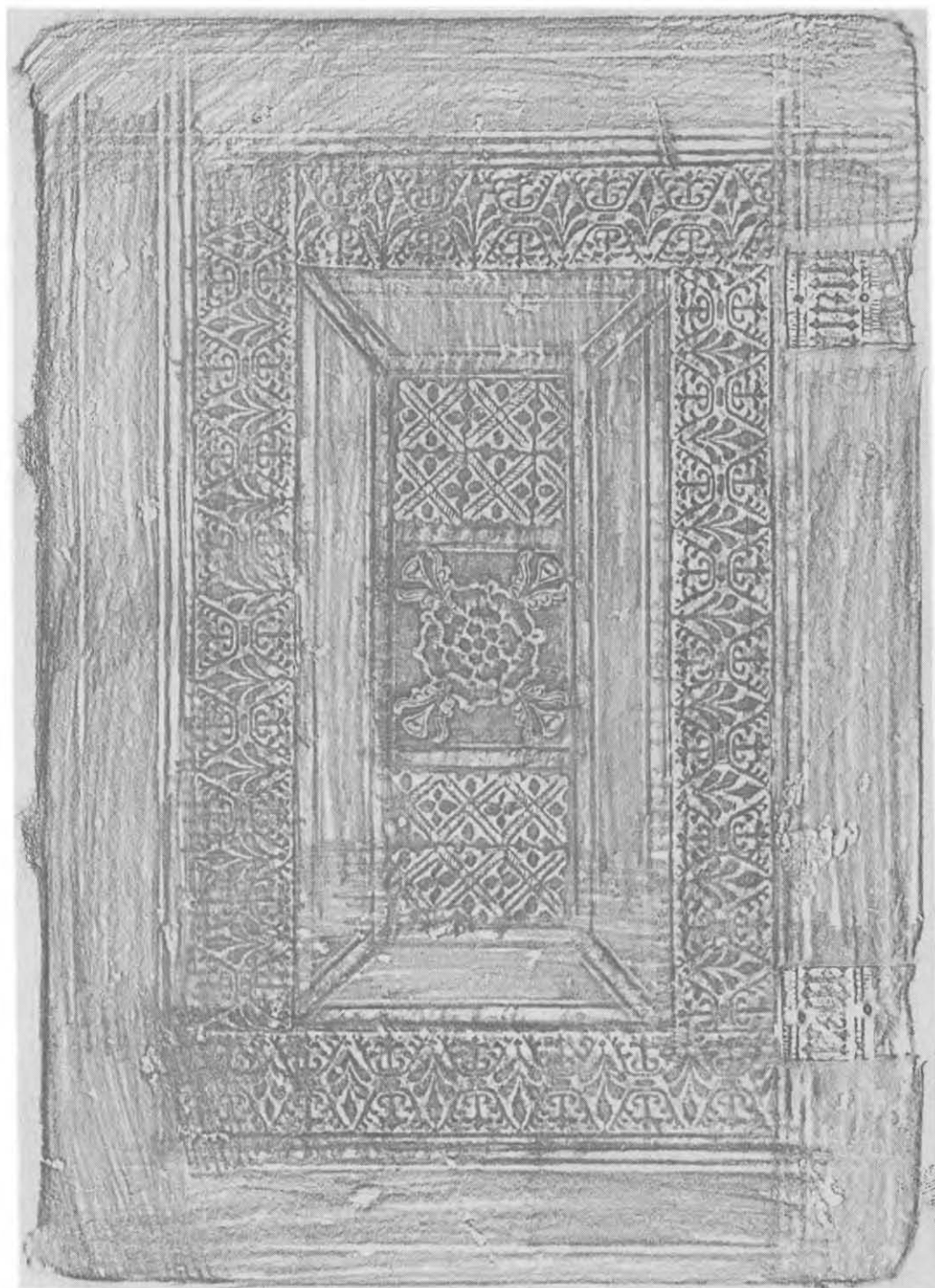
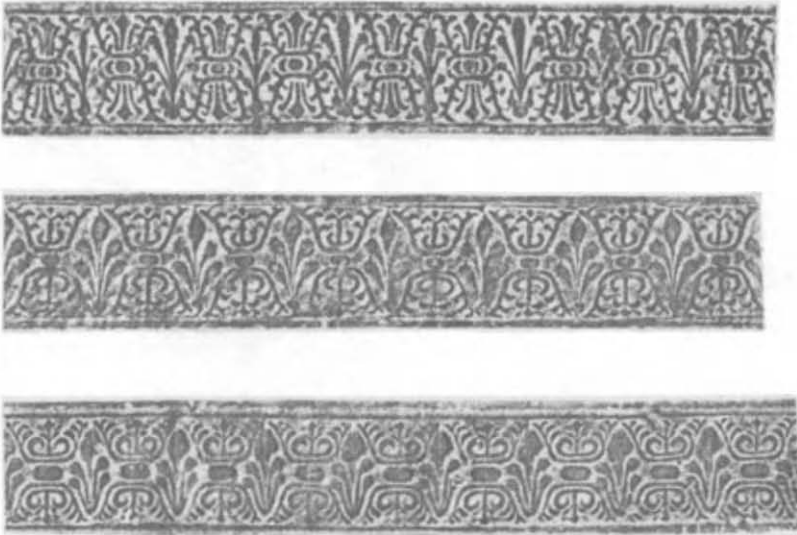


Fig. 24. Hungarian Renaissance binding [21] of the so-called Virginia Codex, a Hungarian linguistic record. Franciscan monastery, Buda, 1510–1522. Bibl. Acad. Budapest: K 40.

(a)



(b)



(c)



Fig. 25.(a) Rolls of palmettos and acanthus leaves from Hungarian Renaissance bindings. (b) Frieze from the Erechtheion, Acropolis, Athens. (c) Pilaster head from king Matthias' palace, Buda.

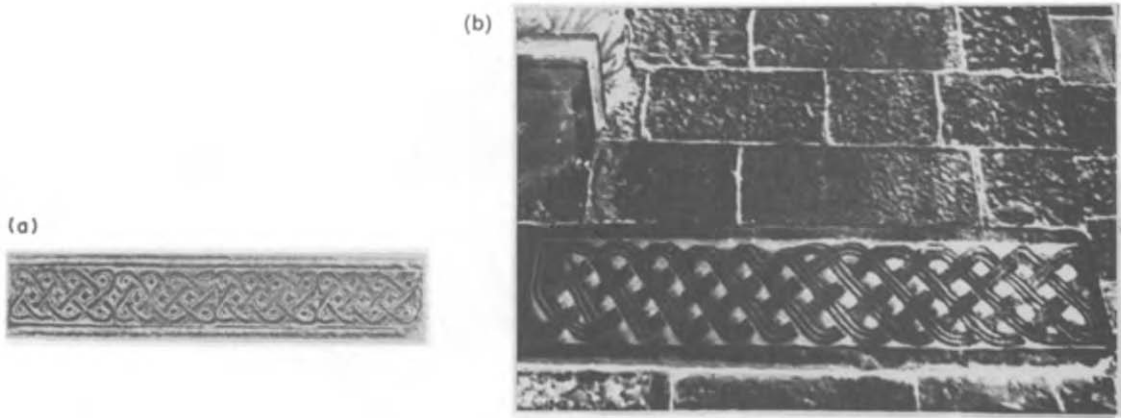


Fig. 26.(a) Knotwork border design composed of single stamps from the Hungarian Renaissance binding: Bibl. Acad. Budapest: Inc. 1018. (b) A five-strand knotwork frieze in the town-hall yard of Trogir, Yugoslavia.

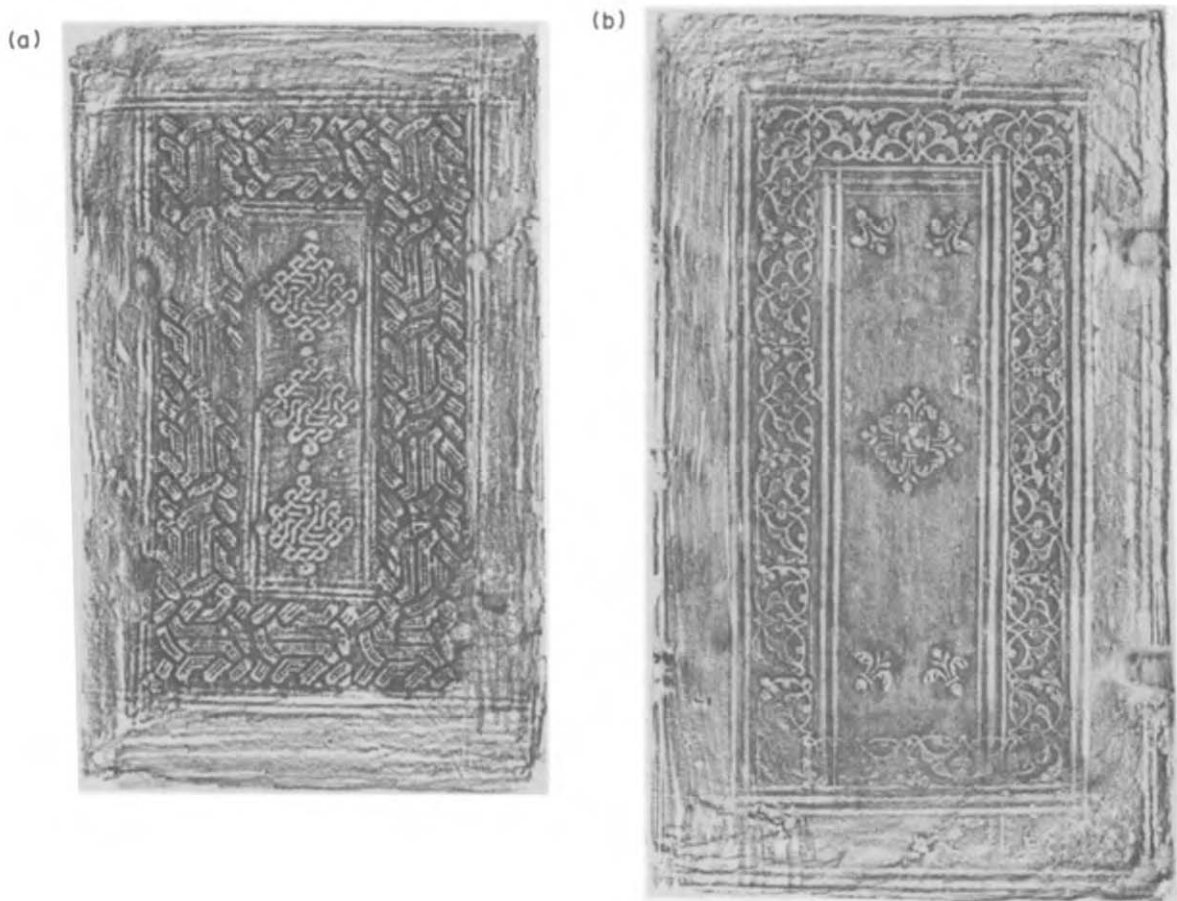


Fig. 27. Italian Renaissance bindings, sixteenth century, with different types of knotwork (a), and arabesque circle border (b). Bibl. Acad. Budapest: K 394, Ant. 195.

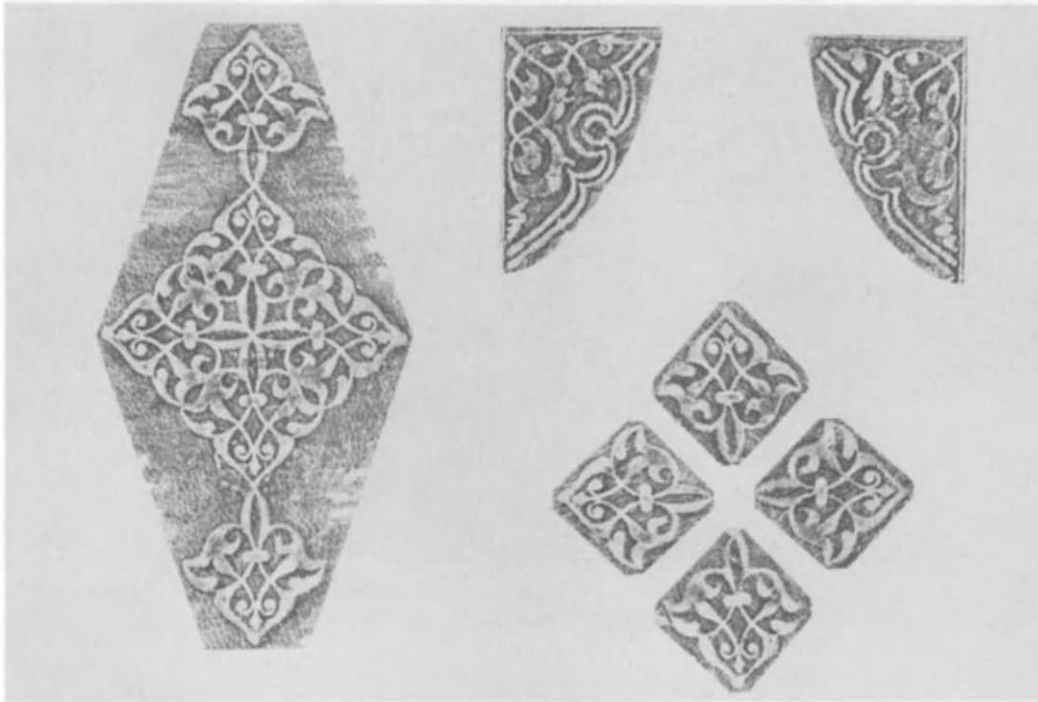


Fig. 28. Arabesque centre and corner pieces. Bibl. Acad. Budapest: Ant. 899, RM IV F 164.



Fig. 29. Gold-tooled Renaissance binding. Venice [22, 23]. National Széchényi Library, Budapest: Clmae 313. Reproduced by permission.



Fig. 30. French Renaissance binding for Jean Grolier [23, Plate 116]. Österreichische Nationalbibliothek: 73.E.20 (ES 191). Reproduced by permission.

form a rectangular (space group pmm , see Ref. [17] for notation) or a diamond tiling (cmm) (Fig. 31). The symmetry of the pattern is then determined by the symmetry of the underlying motif and the lattice. The fleur-de-lis motifs in a lozenge-type arrangement (Fig. 32) form a pattern with symmetry cm (Fig. 31). A system of alternating motifs is a superposition of two or more lattices (Fig. 33). Although this array has a low geometrical symmetry, it possesses further symmetry elements that include permutations of the motifs. This is then a case of colour symmetry, with the motifs representing the different colours. The Gothic diamond tiling (Figs 15 and 16) and the analogous vine-like diaper (Fig. 9) also belong to space group cmm (Fig. 31). The binding from the Corvinian Library (Fig. 22) has a higher tetragonal symmetry $p4m$ (Fig. 34) if the details and the layering of the interlace work are disregarded. A much wider variety of space groups and colour groups occurs on decorated papers used as book covers or lining [24] or as wallpaper.

The symmetry of an interlace pattern can be studied at different levels. First, we may regard the pattern as a composition of lines and figures in the plane they decorate, exactly as it appears, disregarding its three-dimensional appearance. The two interlaced square frames in Fig. 35 thus possess only an eight-fold rotation axis but no mirror planes (point group C_8). This figure can also

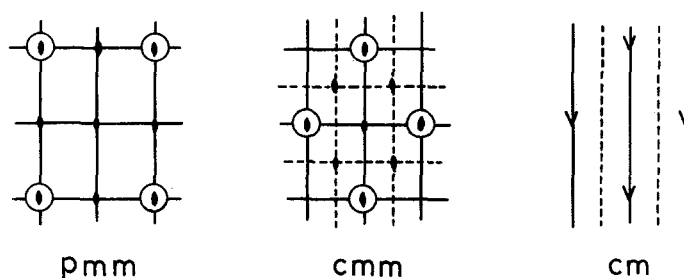


Fig. 31. Two-dimensional space groups of the rectangular (pmm) and the lozenge (cmm) lattice, and a lozenge-type array (cm) of motifs with C_2 point-group symmetry. \circ and \bullet motifs, — reflection plane, ---- glide reflection plane, \bullet two-fold rotation axis.



Fig. 32. Semé binding, first half of the seventeenth century, probably from the Netherlands. Museum of Applied Arts, Budapest: Inv. 51.86. Reproduced by permission.

be regarded as an eight-pointed star, with “hidden” parts of the strips added. Now it has eight reflection planes in addition to the eight-fold axis (point group C_{8v}). A third way of looking at the figure is to consider its two or more layers and introduce symmetry operations such as a combination of reflection with a permutation of layers. Geometric and such combined symmetry operations make up the layer groups. The double-square motif (Fig. 35) can be regarded as lying in a two-sided plane, or it can simply be characterized as a three-dimensional object of point-group

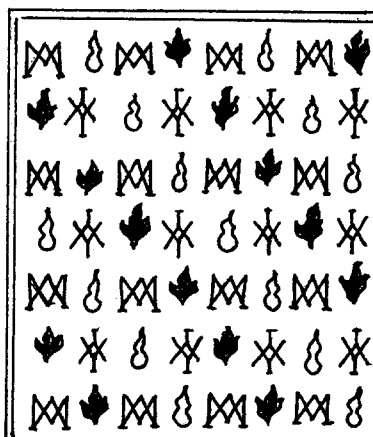


Fig. 33. Pattern, space group $p1$, composed of double letters M and Y, tears and flames on a semé binding. Sketch after Ref. [4, Plate 93].

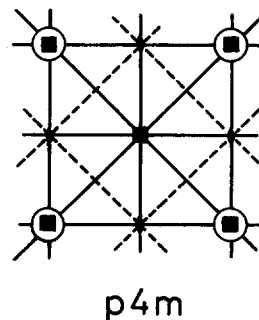


Fig. 34. Symmetry elements of the two-dimensional space group $p4m$. See Fig. 31 for notation, and ■ four-fold rotation axis.



Fig. 35. Interlace motif from a Renaissance binding. Venice. Bibl. Acad. Budapest: RM IV F 164.



Fig. 36. Italian-type Renaissance binding, middle of the sixteenth century. Bibl. Acad. Budapest: Ant. 833.



Fig. 37. Portraits of Luther and Melancthon on the central panels of upper and lower cover, respectively, of the binding by Thomas Krüger, Wittenberg, 1571 [25]. *Novum Testamentum*. Interpreted by Th. Beza. H. Stephanus, Genevae (1567). Bibl. Acad. Budapest: 542.338.

symmetry D_8 , with an eight-fold axis and eight two-fold axes perpendicular to it. Further examples of layered motifs and patterns are shown in Figs 18(c), 27(a), 30, 36 and 54. On bookbindings, a braid of continuous strands or an interlace of loops and strands is often simulated by single stamps [Fig. 26(a)], and imperfections at the linkages may make an exact evaluation of the structure difficult. The four-strand knotwork in Fig. 18(c) (upper) is obtained by two single stamps: one straight, one curved. Note the different slopes of the ascending and descending branches, giving serrated rather than symmetric wave lines.



In the countries north of the Alps panels and rolls dominate on Renaissance bookbindings. Both have mainly figural decorations, a portrait or a scene from the Holy Bible etc. The upper and lower covers are almost the same, except for the central panels, which, however, are related conceptually. Thus, if leaders of the Protestant Reformation are shown, Luther is accompanied by Melancthon (Fig. 37), Calvin by Bèze, and if a “Reformer roll” is used we can nearly always see the following four portraits: Martin Luther, Johann Hus, Erasmus Rotterdamus and Philipp Melancthon (= Marti–Iohan–Eras R–Phi Me: Fig. 38).

Personified virtues such as Justitia, Fortuna (Fig. 39), Fides (faith), Spes (hope), Caritas (Christian love), Patientia, Prudentia (prudence and providence), Fortitudo (strength of mind, courage) and Temperantia (moderation) are also favourite figures of the panels and rolls (Fig. 40) on Renaissance bindings of the German type. The counterpart of Justitia is Fortuna, sometimes Lucretia or Judith. The thematic symmetry of the panels on the upper and lower cover exists here, too.

A classical element was revived with the Janus-faced Prudence on a leather binding (Fig. 38). The inscription of the panel: “Seek advice from me—I who am called Prudentia—if you wish for counsel in your affairs.” Janus, the Roman god with two opposite faces looking forward and backward, gives good advice and is considerate and provident like Prudentia on our panel. Janus is the god of all beginnings, and it is advisable to begin everything with consideration and circumspection, i.e. prudence.

The virtues as well as the Muses (Fig. 40) and the seven liberal arts (Fig. 41) are as a rule represented in every field of Renaissance art, hence also in book illustrations (Fig. 42) and on bookbindings. Note the analogous depiction of arts and virtues in Fig. 41.

If we see the panel of the Judgement of Solomon (1 Kings 3:16–28) on the upper cover then we see another scene from the Old Testament, viz. Samson with the lion and—in the background—he



Fig. 38. German Renaissance binding with a Reformer roll and a Prudentia panel. Bound by M W (meaning Melchior Wagner, Leipzig?) after 1567 [25]. Bibl. Acad. Budapest: RM IV 427.



Fig. 39. Justitia and Fortuna on the upper and lower cover, respectively, of a German Renaissance binding by H W (meaning Hans Welcker, Nuremberg?) [25]. Daniel Wintzenberger: *Warhafftige Geschichte und gedencckwürdiger Händel* . . . Dresden (1583). The inscription under Justitia: “Sum cuique juste tribuo” is a saying attributed to the Roman jurist Ulpianus; under the “ambiguous” Fortuna: a variant from *Tristia* 5.8.15 by Ovid. *Bibl. Acad. Budapest: RM IV 428*.

is taking away the gates of the city of Gaza (Judges 14:6; 16:3) (Fig. 43). Or on another binding: The most outstanding heroine in the Old Testament is Judith (the book named after her is one of the Apocrypha), who beheaded Holofernes, the general of the Assyrian troops of Nebuchadnezzar, and thus saved Israel from its enemies. Judith inspired many artists to depict her and her feat in paintings, in sculptures and in metal engravings. In topical symmetry parallel to Judith, we see either Justitia holding a sword and a pair of scales or—more often—Jael, who inflicted something very similar on another enemy, Sisera (Judges 4:21) (Fig. 44).

The strongest testimony of faith is Abraham’s readiness to offer his only son Isaac (Genesis 22). “No one is so great as Abraham! Who is capable of understanding him?”—asks Søren Kierkegaard (1813–1855), whose influence is larger today than it was in his own time, and for whom the story of Abraham was the greatest paradox of faith. And yet he included a “Panegyric upon Abraham”, “the knight of faith”, in his book [26]. The example of Abraham’s faith also fascinated customers who had their books bound in the sixteenth century. On a panel decorating the upper cover of a book (Fig. 45) we see Abraham with a sword in one hand, the other hand lying on the head of his son, who is bending forward, and below, to the right, is the sacrificial fire in a pot, while in the centre of the picture, in the background, Abraham is climbing Mount Moriah with Isaac and, finally, in the upper right corner, is the angel of the Lord in the clouds, seizing Abraham’s sword. The inscription reads “Abraham credidit deo”—Abraham has believed in God. (Present perfect, as it has already been demonstrated!) The middle panel of the lower cover is decorated with the arms of the Dukes of Württemberg with the initials of their motto (Fig. 45): V D M I E—*Verbum Domini manet in [a]eternum* (a variant of Psalm 118 = 119: 89). The word of the Lord remains for ever. We think that the panel of Abraham’s sacrifice was chosen deliberately to emphasize the motto and the arms, and this is again a case of conceptual symmetry.

Let us return to Kierkegaard’s vision and interpretation. He sketches four variants of what had happened and how the last act of this sacrifice was reached [26]. Each of them is fearful and shocking but what is more amazing is that he draws a parallel between the deed of Abraham and the weaning of a child from its mother. Kierkegaard comes to optimistic conclusions only in the cases of the mother and child. Father and son, mother and child are presented in analogous situations—as regards a kind of separation—and in four aspects. Intellectual symmetry is mostly indirect, hidden symmetry, what is more, the symbolism itself is inherently symmetrical. The author’s life reveals a



Fig. 40. Rolls with representations of the virtues (a), and the Muses (b). Bibl. Acad. Budapest: RM IV 177a, RM III F 175b, 542.169, RM III 92.



Fig. 41. The seven arts and the virtues on panels. Inscriptions (above) Grammatica–Dialectica–Rhetorica [!]-Arithmetica –Musica (two figures)—1574 (digit 4 reversed!)—Geometria–Astronomia; (below) Iustitia [!]-Prudentia [!]-Fortitudo–Temperantia [!]-Fides–Spes–Charitas–Paciencia [!] [25]. Bibl. Acad. Budapest: 542.495, Ant. 944.

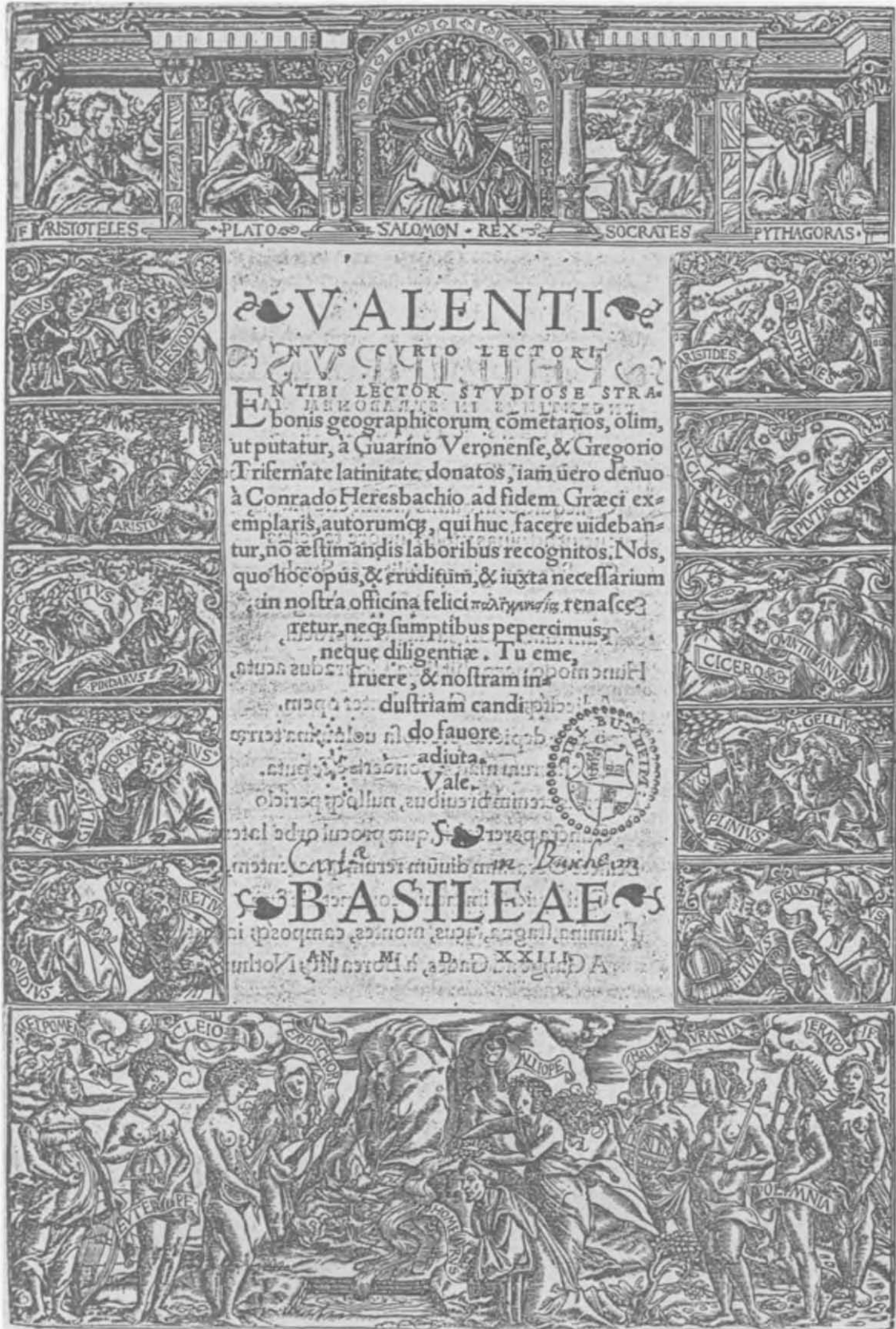


Fig. 42. The nine Muses on the title page of Strabo: *En tibi Strabonis geographicorum commentarios a C. Heresbachio recognitos*. Valentinus Curio, Basileae (1523).



Fig. 43. The Judgement of Solomon and Samson with the lion on a binding by Caspar Kraft [25]. Bibl. Acad. Budapest: 542.150.



Fig. 44. Judith with Holofernes and Jael with Sisera on a binding. Inscription under Judith from Psalm 144 = 145: 19; under Jael: Judges 5: 31. Bibl. Acad. Budapest: 542.496.



Fig. 45. Abraham's sacrifice and the coat of arms of the Dukes of Württemberg on a binding. *Kurtze auszlegung über ... Euangelia ... in Crobatischer Sprach ...* (Ed. Primus Truber). Tübingen (1562). Bibl. Acad. Budapest: Ráth 1772.

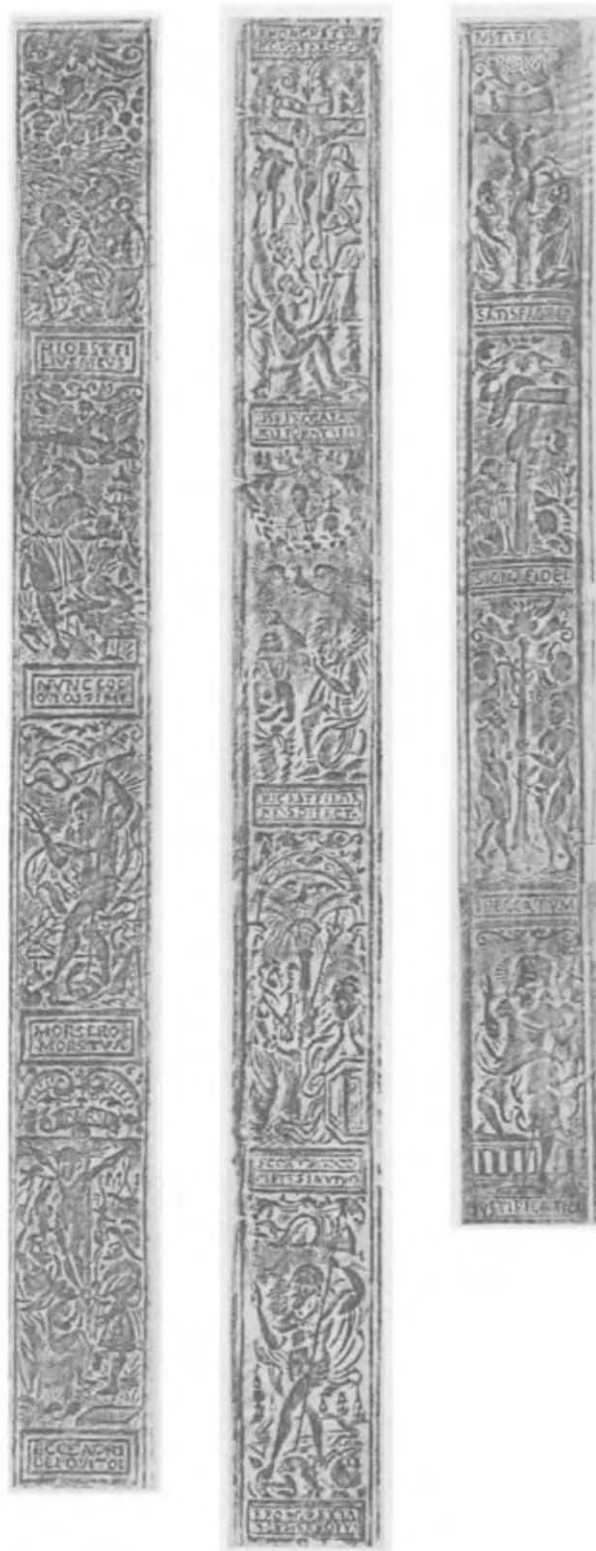


Fig. 46. Biblical scenes on German Renaissance rolls. Metropolitan Szabó Ervin Library, Budapest: Bq 0941/69; Bibl. Acad. Budapest: RM IV F 596, Ráth 1069–70. Reproduced by permission.

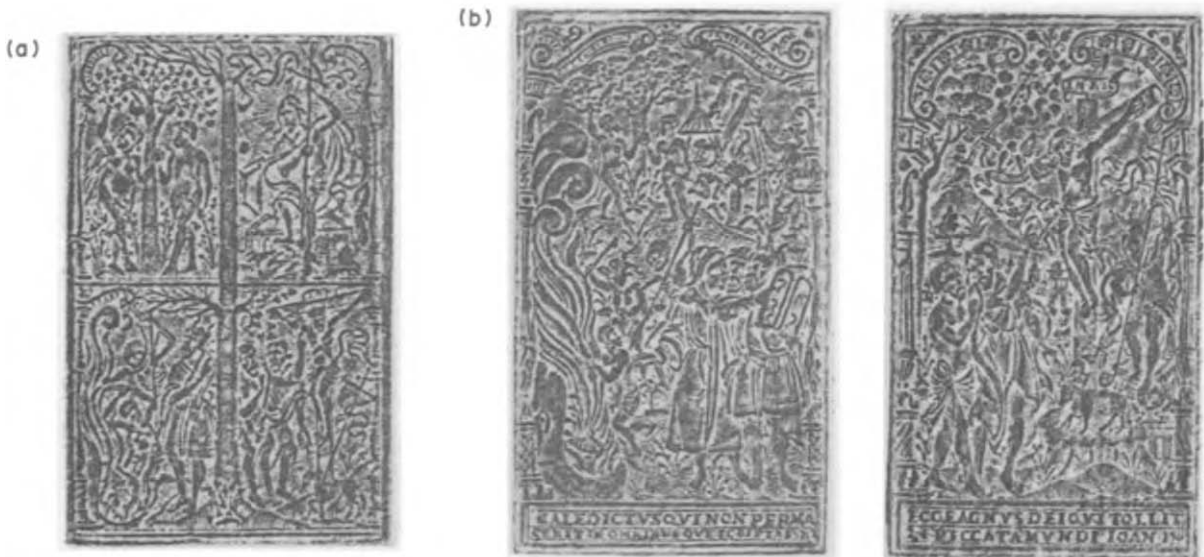


Fig. 47. (a) A Justification panel. Pietro Martire Vermigli, In *Epistolam S. Pauli Apostoli ad Romanos Commentarii*. Perna, Basileae (1568). Bibl. Acad. Budapest: 543.024. (b) The Justification represented on two panels. Jean Calvin: *Institutio Christianae religionis*. Rebulius, Genevae (1561). Bibl. Acad. Budapest: 542.080.

further dimension of the structure. The retold story of Abraham and the parallel cases of mother and child are reflections of Kierkegaard's emotional crisis after his engagement and tragic rupture with Regina, subtle allusions to the waves in his soul of hope and despair, faith and final resignation.

The scene of Abraham's sacrifice is often engraved on rolls, too, together with other scenes from the Bible. In general, such a roll consists of four little pictures. The Crucifixion and the Resurrection are represented on all three rolls shown (Fig. 46). These two scenes occur on panels in another connection [27]. The four scenes on the panel in Fig. 47(a) are divided by the tree of life: to the left the Fall (Adam and Eve under the tree of knowledge of good and evil), underneath Damnation and Moses with the tablets of stone; this side of the tree is dead. The right-hand side of it is in leaf, since this half of the panel comprises the Crucifixion and the Resurrection.

The complex theme and the method of representation come from the paintings of the Allegory of the Fall and the Redemption or Justification by Lucas Cranach Sr and his workshop [28, 29]. These paintings and other similar ones, e.g. that in the Budapest Museum of Fine Arts (Fig. 48) reflect the idea—the exegesis of Justification—of the great Reformer Martin Luther and his circle. In the painting in Budapest we can observe Mount Sinai, where the Lord God gave Moses the two tablets of stone, the Fall, the serpent of brass and Death. In the middle Adam or Everyman is sitting between a Prophet and John the Baptist, both of them pointing to the Crucifix. Mary is kneeling on the top of a mount—opposite Moses—accepting a small child gliding down on golden rays; on the two sides of the Crucifix we see the Holy Lamb and the Bethlehem scene with the Angels, the shepherds, and the Holy Family in the stable; and at last Christ triumphant over Death. All this can hardly be accommodated on one panel [cf. Fig. 47(a)]. The picture of Justification, divided symmetrically into two parts along the tree, occurs commonly on two panels [Fig. 47(b)] on the upper and lower cover of the given leather binding. Sin and Justification, Law and Redemption, Death and Resurrection; grave-stone, skeleton, objects, persons, gestures and ideas are positioned in a wonderful antisymmetry, in other words implying less geometrical rigour, in a counterpoint.

Even if figural representations appear on a Gothic or Renaissance binding, no definite connection to the contents of the book can be recognized. (See the captions to the figures named here.) The book of sermons by Pelbartus de Themeswar is decorated by the insignia of the Passion (Fig. 16). The covers of a New Testament which was interpreted by Bèze and printed in Geneva were nevertheless embellished by the portraits of Luther and Melancthon (Fig. 37). It is of course thus, since the book was bound in Wittenberg, the stronghold of the Lutheran Reformation. Similarly, the Lutheran dogma of Justification is represented on Calvin's work [Fig. 47(b)]. *Justitia* appears on a



Fig. 48. *Fall and Redemption (Law and Grace)*. Painting, German master, middle of the sixteenth century [30]. 82 × 59.5 cm. Deposited at the Budapest Museum of Fine Arts. Reproduced by permission.

book of historical events (Fig. 39), and Abraham's sacrifice on a collection of Gospel commentaries (Fig. 45).

FROM BAROQUE TO MODERN BINDINGS

Baroque leather bindings catch the eye by their rich gold tooling (Fig. 49). Their characteristic ornamental elements are the elongated leafy spiral, the curl, borrowed from late Renaissance "fanfare" style bindings, voluted C- and S-shaped figures, sprays and floral motifs (Fig. 50). The asymmetrical spirals are skilfully combined to give heart-shaped and other symmetrical constructions, which in turn form the diamond or marquise-shaped central panel and the enchantingly harmonizing corner pieces. These masters must have had therefore a pair of stamps to impress both mirror image forms of the asymmetrical spiral motifs. Two or three borders run along the edges. One of these rolls (Fig. 50) reminds us of an arabesque circle border pattern used 200 years before [Fig. 27(b)].

The brightest period of Hungarian Baroque bindings in the eighteenth century is associated with the Jesuits in Nagyszombat (today Trnava, Czechoslovakia), who maintained their Academy and

printing house there (predecessors of Eötvös University and the University Press, Budapest). These bindings bear Jesus' monogram, IHS, the Jesuits' sign in the middle of the upper cover, and correspondingly the letters MARIA on the lower cover (Fig. 50).

There is no remarkable borderline between Baroque and rococo bindings. The frequent occurrence of shellwork gave the name to the style (*rocaille* = shell, shellwork in French). The central piece is often omitted, and only the borders of the cover(s) are decorated (Fig. 51). Books were the essential ornaments of the splendid library halls of the Baroque and later periods, and, very often, only the spines of these books were embellished.

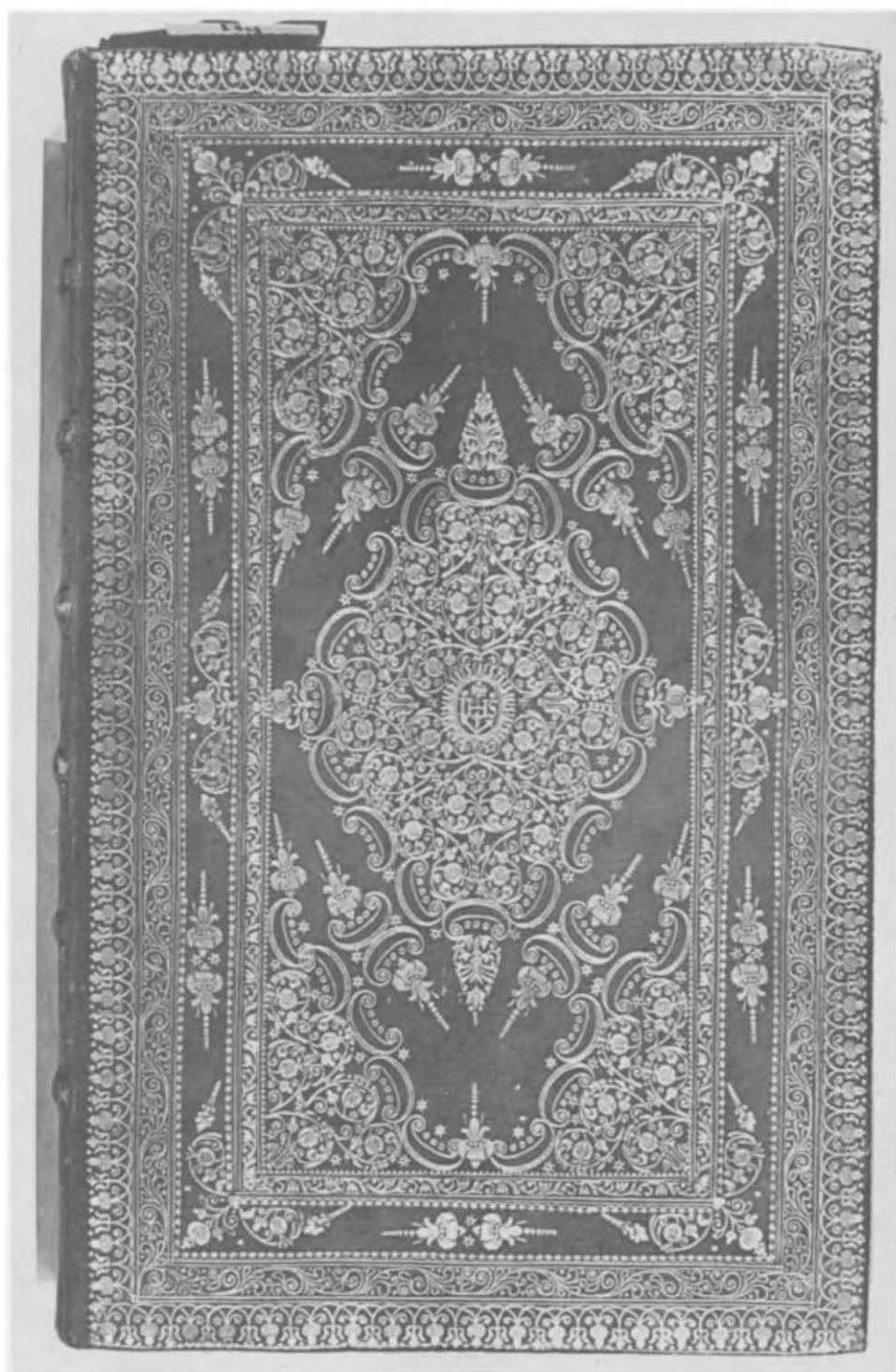
A distinct period of Hungarian binding began in the first half of the eighteenth century and lasted for about a hundred years. The overwhelming majority of these popular coloured parchment bindings was produced in the town of wealthy urbanized peasants, Debrecen (Fig. 52). Their layout follows the interlace outlines of French Renaissance bindings, and the uncoloured strips surround brightly coloured fields with gilt or coloured fleurons and the curls known from Baroque bindings. The master of the binding in Fig. 52(a) even turns the flower-pot upside down for the sake of preserving the symmetry of the rectangle (C_{2v}). Colouring seems to have been applied instinctively to enhance brilliance but no conscious colour symmetry appears.

A curiosity of book construction, and an example of a three-dimensional point-group symmetry is the *dos-à-dos* binding (Fig. 53). Two, sometimes more books, related by their contents and usage, are bound together "back to back" with one common board and their spines on opposite sides.



(a)

Fig. 49—continued overleaf



(b)

Fig. 49. Hungarian Baroque bindings, eighteenth century. (a) Bibl. Acad. Budapest: 542.987. (b) Metropolitan Szabó Ervin Library, Budapest: Bf 0910/234 (MS). Reproduced by permission.

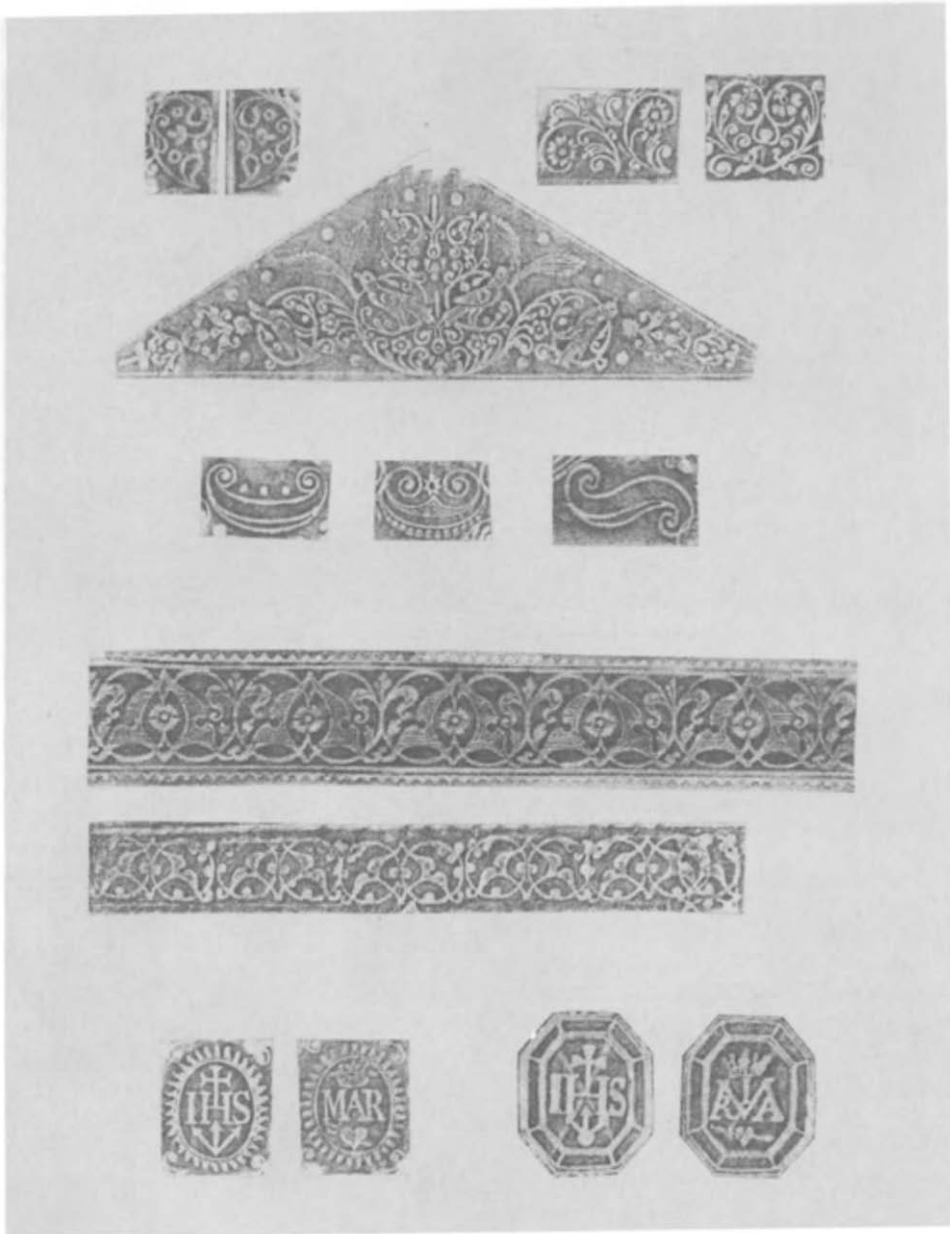


Fig. 50. Ornamental elements of Baroque bindings. The upper roll is from the binding in Fig. 49(a); the second roll is from the binding in Fig. 27(b).



(a) Fig. 51. Rococo bindings, eighteenth century. (a) Bibl. Acad. Budapest: 542.989. (b) Library of the Transilvanian Reformed Church District, Debrecen: G 6113. Reproduced by permission.



(a) National Széchenyi Library, Budapest: RK 89. (b) Library of the Transbiscan Reformed Church District, Debrecen: A 48. Reproduced by permission.

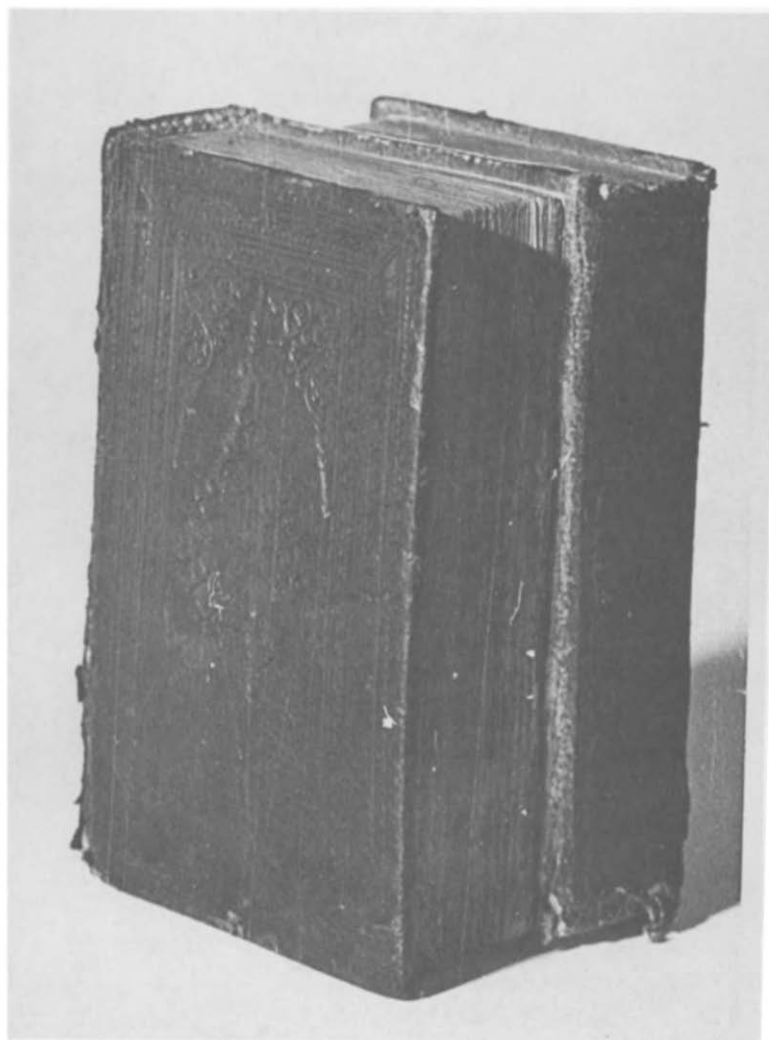


Fig. 53. Hungarian dos-á-dos binding, eighteenth century. Eötvös Loránd University Library, Budapest: RMK I 423a, RMK I 435 I–II. Reproduced by permission.

(Another example and references can be found in Ref. [4, item 91].) This structure possesses a two-fold rotation axis parallel to the spines and a reflection plane perpendicular to it (point group C_{2h}). How practical this form proves to be for a two-way pocket travel dictionary! In some modern pocket dictionaries the two integrated parts have rather one common spine and no board in the middle between the “running” and the “reversed” pages. The symmetry of this book is again trivial, point group C_{2v} , with the two-fold axis perpendicular to the spine. It is left to the reader to meditate on combinations of symmetry operations with an inversion of, say, a Hungarian–Italian dictionary to its Italian–Hungarian counterpart.

Some modern artists have created three-dimensional bookbindings [31] that resemble rather a sculpture or space construction, and which have lost their practical purpose of protecting and decorating a book in use.

Though masters of Baroque and rococo bindings retained much of the elements of preceding late Renaissance (curls, arabesque circles, interlace outlines, layout) or even late Gothic bindings [bird-in-vine [32], and cf. Fig. 18(b)], they succeeded in creating a new type of bookbinding decoration, distinguished by its appearance and effect. The wells of innovative power seem, however, to have been exhausted by the nineteenth century. At the same time when in architecture the different “neo” styles follow, bookbinders cannot but historicize, and the period is marked by phrases like Etruscan style, Cathedral style, and flourishing species of neo-Renaissance. It is in such nostalgic works that the technical perfection of hand bookbinding reaches a level unknown before (Fig. 54). Para-

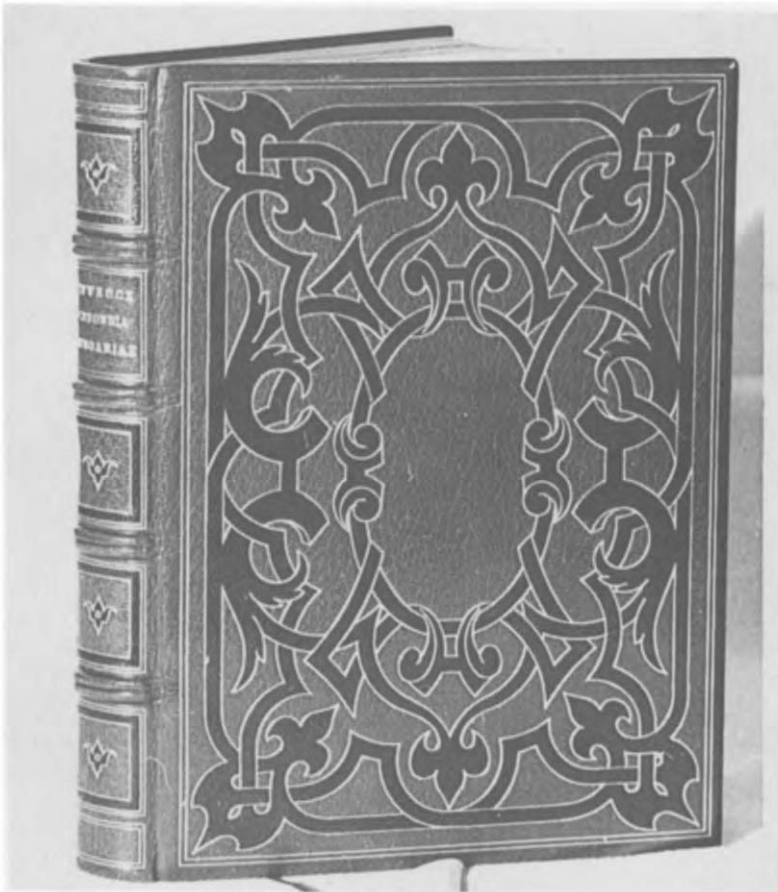


Fig. 54. Neo-Renaissance binding by Marius Michel for György Ráth, bibliophile, director of the Museum of Applied Arts, Budapest. End of the nineteenth century. Bibl. Acad. Budapest: Ráth 1044.



Fig. 55. Art nouveau binding by Evelyn Underhill, fec. op. 47, 1902, England. Museum of Applied Arts, Budapest: Inv. 6965. Reproduced by permission.



Fig. 56. Representation of the labyrinth on the external wall of the Cathedral in Lucca, Italy. Photograph by and courtesy of István Orosz, Budapest.

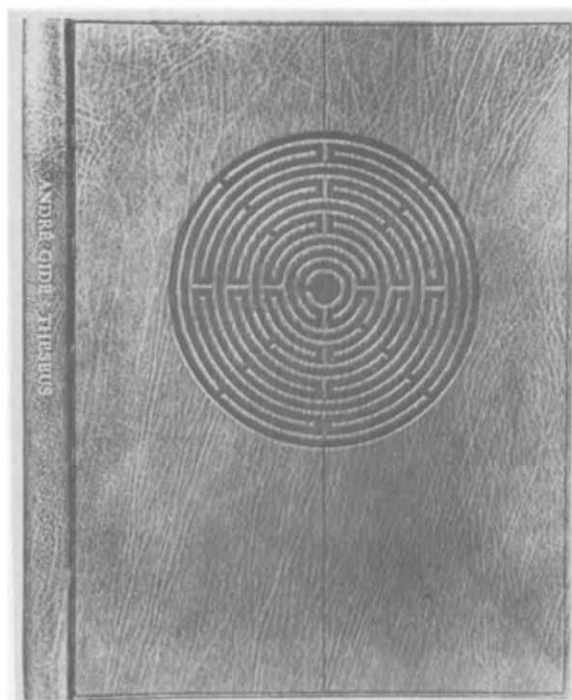


Fig. 57. Binding by J. A. Szirmai, 1983–84. Terra-cotta goatskin (Niger), on front cover blind impression by the use of a linocut. 32 × 25 cm. Cat. No. 45 [35]. André Gide: *Theseus*. Officina Bodoni, Verona (1949). Photograph by J. A. Szirmai. Reproduced by permission.

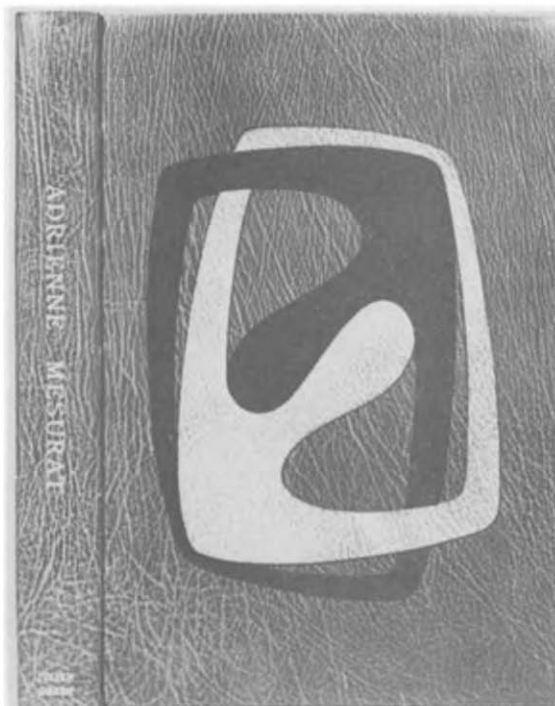


Fig. 58. Binding by J. A. Szirmai, 1975–77. Dark grey goatskin (oasis), on front cover onlays in black and light grey goatskin. 29 × 20 cm. Cat. No. 25 [35]. Julien Green: *Adrienne Mesurat*. Société Les Exemplaires, Paris (1929). Photograph by J. A. Szirmai. Reproduced by permission.

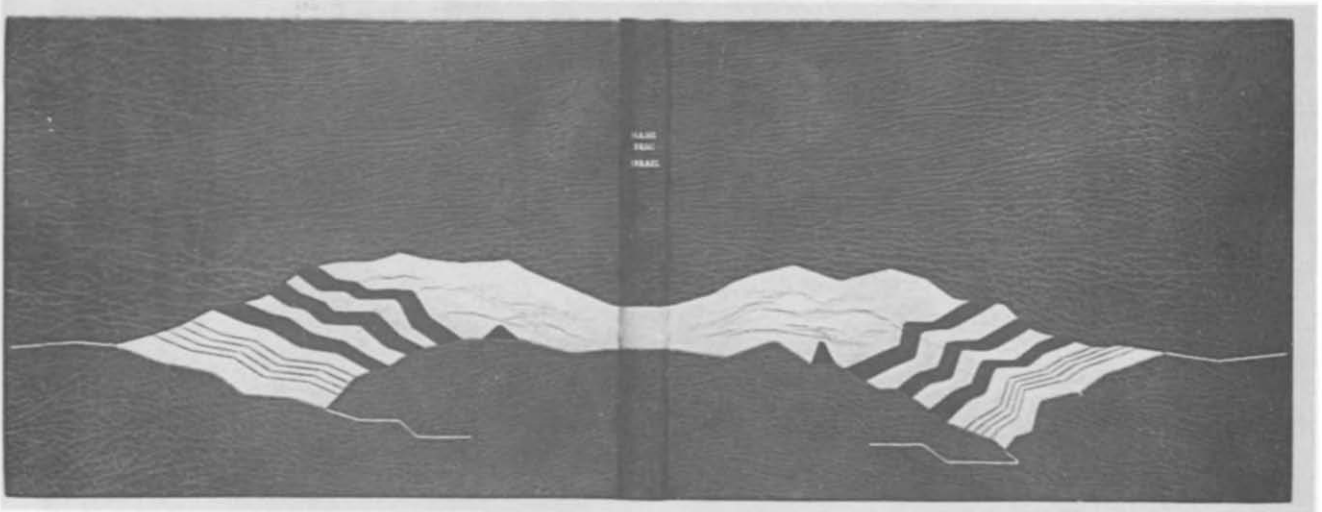


Fig. 59. Binding by J. A. Szirmai, 1972. Terra-cotta goatskin (oasis); onlays on front and back cover, partly crumpled, in yellow ochre, dark brown and green. 23.5 × 31.5 cm. Cat. No. 3 [35]. Hans Erni: *Israel. Ein Skizzenbuch*. Scheidegger, Zurich (1971). Photograph by J. A. Szirmai. Reproduced by permission.

doxically, at the same time, bookbinding as a handicraft loses ground and declines with the advent of machine binding.

The turn of the century is a landmark in the *art* of bookbinding. The modern bookbinder claims to be an artist who creates a work of art and not simply a decorated product of handicraft; he or she re-creates the contents of the book, expresses his or her impression of the work to be bound. Principles and forms, artistic endeavour and materials of modern fine art are reincarnated in modern bookbindings. A few examples have been selected here to show how apparently simple structures imply in the most intricate and sophisticated manner the arsenal of “symmetrology” [33]. Elements are consciously composed into a unit, and parts of the book, upper and lower cover, are often treated as a whole (Fig. 55).

The Labyrinth, originally the Minoan palace in Crete, has always provided an exciting adventure for the human mind, a source of secret, a many-folded symbol, among others, of the nether world and, at the same time, of redemption from death [34]. What it meant for Comenius is concisely expressed in the title of his work *Labyrinth of the World and the Paradise of the Heart*. It was represented in architecture (Fig. 56), arts and literature, as with, for example, the maze in the splendid book, *Three Men in a Boat*, by J. K. Jerome. Professor Szirmai’s bookbinding (Fig. 57) is based on a circular symmetry, which is modified by a pseudo-symmetry of four-fold rotation and reflection. Similarity is expressed by the set of concentric circles, and catamorphosis, the lowest category of geometrical relationships [33], by the decreasing number of radial passages and dead ends along the inner circles. On another binding by Szirmai (Fig. 58), the double figure is again a brilliant and ingenious superposition of two-fold rotational symmetry and deviation from it, symmetry and antisymmetry (two-colour symmetry of the figure on a “neutral” background), and, above all, the transfiguration of a phenomenon taken from the contents of the book. We must apologize to the reader for disclosing the keyword: it is schizophrenia. Figure 59 represents symmetry in a broad sense, so to say, a “topological symmetry”. Design and generalized symmetry extends over front and back cover.

P. L. Martin and M. Jeagle use rotations and reflections on their bindings (Figs 60 and 61) combined with affine transformation, reflection with “blowing up” (homothetic reflection [33]), and colour transformation.

CONCLUSIONS

Throughout the history of bookbinding decoration, the rectangular form of the book cover has been decisive. The general layout of decorated leather bindings most often conforms to the two



Fig. 60. Binding by Pierre Lucien Martin, 1966. Black box-calf, onlays in various shades of gray calf, doublures red peau de suède. René Crevel: *Feuilles éparses*. Original illustrations by Bellmer, Arp, Miro, Ernst. Paris (1965).



Fig. 61. Binding by Martin Jaegle, 1973. Dark blue oasis goatskin, onlays in white, red and dark red, line tooling in white. Voltaire: *Candide*.

mirror planes of the rectangle. One or more border designs along the sides leave a smaller, again rectangular (decorated) area in the middle. Details of Romanesque and Gothic figures, animals, floral motifs, religious symbols, or subdivision of fields disturb this symmetry. The orientation of such motifs is influenced by the conventional direction of view, i.e. the distinction between top and bottom of the book cover. The symmetries of border patterns do not indicate a preference of their outer or inner edges. A unified global composition, the emphasis on the central design, harmonizing border decoration and centre and corner pieces, and the symmetry of details begin with Renaissance bindings, either with geometric or floral patterns or with portraits and scenes. Interlace motifs and patterns become again popular. Colour symmetry occurs only sparsely.

Bookbinding decoration in each age retains some elements from its previous periods and follows with a certain delay the main styles of the arts. Decoration requires imaginative power and skill, above all in the case of cutleather bindings. Some nice parallels of geometry and symbols, depicted scenes, persons and ideas can be recognized, nevertheless, the representation has hardly any relation to the contents of the book.

The modern art of bookbinding breaks with tradition. It treats one or both book covers and even the complete book as a whole. The necessity of border designs is eliminated. Symmetry and the different kinds and levels of geometric relations are consciously applied or just abandoned. An allusion, albeit indirect, to the message in the book is intended.

Acknowledgements—Our thanks are due to Professor and Mrs Aladár and Éva Sarbu, Ms Éva Pröhle and Mr Bob Dent, who read the manuscript and made valuable suggestions to amend its English. We gratefully acknowledge the permission and photographs for illustrations from institutions and persons named in the figure captions.

REFERENCES

1. P. Gergely, *Pápai Páriz-album a Magyar Tudományos Akadémia Könyvtárában* (The Pápai Páriz Album in the Library of the Hungarian Academy of Sciences). Publicationes Bibliothecae Academiae Scientiarum Hungaricae 21, Budapest (1961).
2. J. A. Comenius, *Orbis Sensualium Pictus*. Facsimile of the third London edn (1672) (Introduction J. Bowen). Sydney University Press, Sydney (1967).
3. F. Steenbock, *Der kirchliche Prachteinband im frühen Mittelalter von den Anfängen bis zum Beginn der Gotik*. Deutscher Verlag für Kunstwissenschaft, Berlin (1965).
4. P. Needham, *Twelve Centuries of Bookbindings 400–1600*. The Pierpont Morgan Library—OUP, Oxford (1979).
5. F. A. Schmidt-Künsemüller, *Die abendländischen romanischen Blindstempelinbände*. Hiersemann, Stuttgart (1985).
6. E. Panofsky, *Gothic Architecture and Scholasticism*. Archabbey Press, Latrobe, Pa. (1956).
7. G. D. Hobson, Further notes on Romanesque bindings. *Library* 15, 161–211 (1934–35); Some early bindings and binders' tools. *Library* 19, 202–249 (1938–39).
8. E. Kyriss, *Verzierte Gotische Einbände im alten deutschen Sprachgebiet*. Textband. Tafelband 1–3. Max Hettler, Stuttgart (1951–58).
9. O. Mazal, Gotische Einbände mit Kopfstempeldekoration aus der Inkunabelsammlung der Österreichischen Nationalbibliothek. *Gutenberg Jb* 473–481 (1962).
10. É. Sz. Koroknay, *Magyar reneszánsz könyvkötések* (Hungarian Renaissance Bookbindings). Plate 36. Cahiers d'histoire de l'art 6. Akadémiai Kiadó, Budapest (1973).
11. F. A. Schmidt-Künsemüller, *Corpus der gotischen Lederschnitteinbände im deutschen Sprachgebiet*. Hiersemann, Stuttgart (1980).

12. M. Rozsondai, Wiener Dominikanereinbände in der Bibliothek der Ungarischen Akademie der Wissenschaften. *Gutenberg Jb* 234–244 (1981).
13. M. Rozsondai, The popularity of Pelbartus de Themeswar in Europe as demonstrated by bookbindings (in Hungarian). *Magy. Könyvszle* **100**, 300–319 (1984).
14. M. M. Foot, *The Henry Davis Gift: A Collection of Bookbindings*. Vol. 2, item 327. The British Library, London (1983).
15. I. Hargittai and Gy. Lengyel, The seven one-dimensional space-group symmetries illustrated by Hungarian folk needlework. *J. Chem Educ.* **61**, 1033–1034 (1984).
16. M. Rozsondai, Historical fine bindings in the Library of the Hungarian Academy of Sciences and their connection to book history (in Hungarian). Thesis, Budapest (1985).
17. D. Schattschneider, In black and white: how to create perfectly colored symmetric patterns. *Comput. Math. Applic.* **12B**, 673–695 (1986). Reprinted in *Symmetry: Unifying Human Understanding* (Ed. I. Hargittai). Pergamon Press, Oxford (1986).
18. M. M. Foot-Romme, Influences from the Netherlands on bookbinding in England during the late fifteenth and early sixteenth centuries. *Act. XIe Congr. Int. Bibl.* pp. 39–64, Bruxelles (1979).
19. Cs. Csapodi, *The Corvinian Library: History and Stock*. Akadémiai Kiadó, Budapest (1973).
20. É. Sz. Koroknay, Oriental influences in Hungarian Renaissance bookbinding (in Hungarian). *Műv. tört. Ertesítő* (1–2), 1–17 (1968).
21. É. Sz. Koroknay, Eine ungarische Renaissance-Einbandgruppe vom Anfang des 16. Jahrhunderts. *Gutenberg Jb* 361–371 (1966).
22. I. Schunke, Venezianische Renaissanceeinbände: Ihre Entwicklung und ihre Werkstätten. *Studi di bibliographia e di storia in onore di Tammaro de Marinis*. Vol. IV, pp. 123–200, Plate XXV, Verona (1964).
23. O. Mazal, *Europäische Einbandkunst aus Mittelalter und Neuzeit: 270 Einbände der Österreichischen Nationalbibliothek*. Plate 99. Akad. Druck- u. Verlagsanstalt, Graz (1970).
24. M. M. Foot, The Olga Hirsch collection of decorated papers. *Br. Libr. J.* **7** (1), 12–38 (1981).
25. M. Rozsondai, Signierte Renaissance-Einbände deutschen Typs aus dem 16. Jahrhundert. *Gutenberg Jb* 290–339 (1988).
26. S. Kierkegaard, *Fear and Trembling . . .* (Translated, introduction and notes by W. Lowrie). Princeton Univ. Press, Princeton, N.J. (1968).
27. K. von Rabenau, Reformation und Humanismus im Spiegel der Wittenberger Bucheinbände des 16. Jahrhunderts. *Von der Macht der Bilder*. Beiträge des C.I.H.A.-Kolloquiums "Kunst und Reformation" (Ed. E. Ullmann) pp. 319–328. Leipzig (1983).
28. Lucas Cranach d.Ä., *Verdammnis und Erlösung* (1529). Öltempera auf Lindenholz. 80 × 115 cm. Gotha, Museen der Stadt, Schlossmuseum. Inv. 722/676.
29. Lucas Cranach d.Ä. (Werkstatt), *Sündenfall und Erlösung*. (Um 1530). Nicht bez. Öltempera auf Holz. 51 × 99 cm. Weimar, Kunstsammlungen, Galerie im Schloss.
30. Zs. Urbach, The allegory of the Fall and Redemption (in Hungarian). *Diakonia: Evangélikus Szemle* **5**(2), 19–29 (1983).
31. *Modern British Bookbinding*. Bibliotheca Wittockiana, Bruxelles, Koninklijke Bibliotheek, 's Gravenhage 1985. Exhibition Catalogue. Designer Bookbinders, London (1985).
32. M. M. Foot, *The Henry Davis Gift: A Collection of Bookbindings*. Vol. 1, 2nd impression, Plate IV.19.A. The British Library, London (1982).
33. E. Makovicky, Symmetry of art: coloured and generalized symmetries. *Comput. Math. Applic.* **12B**, 949–980 (1986). Reprinted in *Symmetry: Unifying Human Understanding* (Ed. I. Hargittai). Pergamon Press, Oxford (1986).
34. K. Kerényi, *Labyrinth-Studien. Labyrinthos als Linienreflex einer mythologischen Idee*. 2. erweiterte Aufl. Albae Vigiliae 10. Rhein, Zürich (1950).
35. J. A. Szirmai, *Boekbandkunst*. Catalogus van boekbanden door J. A. Szirmai . . . in de Universiteitsbibliotheek. Amsterdam (1984).