How Books Work

Few readers pause to consider the physical form of the book they are reading. It is interesting and disturbing that such an important cultural tool can be used so unconsciously. Skilled handling of books begins with some appreciation of their mechanisms of mobility. In this discussion we will pause for a moment to consider book action and observe that the book is an intuitive device exploiting our own dexterity.

It is a curious fact that the hands once prompted the mind. We now imagine that dexterity has evolved with our brain, but the hominid fossil record shows otherwise. High dexterity and hand anatomy evolved in the earliest hominid species long before increasing brain size. Anatomical evidence also indicates that tool making precedes language. Culture originated through manual investigation of the natural world and skills of dexterity prompted the mind.

This first trait of communication is still with us. The book has its physical scale to permit page turning and we look at the book with hands before we look through it to the content. Skills of dexterity help explain the paradox of why we convey conceptual works via physical media. Precursors of books such as paleolithic time notation incised on bone, mesolithic counting tokens or Incan literary Quipu exemplify deft, talismanic objects that are also media of conceptual content. The convergence of physical media to transmit conceptual works perhaps reflects an old dependence on manipulation of physical objects to assist and confirm conceptualization.

Structure leads to action - types of bookbindings

Traditional components are the sheets or pages, the sewing and resulting text block, the boards and their attachment to the text block and the covering. A historical Ethiopian book consists of folios of vellum gathered into sections sewn in a pattern of unsupported stitches, producing chains connecting section to section and resulting in the sewn text block. The wooden boards have stitch tunnels and are attached in a continuation of the text sewing. Many such Ethiopian bindings are also covered in leather. Using only three materials; thread, skin and wood, this codex exemplifies the intuitive organization and convenient access required to manage information in any format. (see illustration 1.)

The simple sewn board Ethiopian book, in which gatherings and boards are linked directly by the thread, developed among early Christian communities of Ethiopia and Egypt by the third century and spread to Eastern Orthodox and
Islamic cultures. A structural innovation that occurred in the cultural context of Anglo-Saxon and Carolingian book work was the technique of sewing text sections onto supports such as thongs or cords of leather, vellum or flax. This innovation of supported sewing accelerated the development of binding structures which provide effective support across the back and transmit the leverage of the boards to the text block. An important feature influencing the action of Western wooden board binding are vellum linings adhered to the text back and carried under the boards. The sewing supports laced over the boards transmit the leverage of the boards to the text as the book is closed while the vellum linings transmit the opening motion.

In the following centuries sewing onto cord supports, lacing the supports into wooden boards and covering in leather, remained central to Western bookbinding technique. Beginning in the sixteenth century bookbinding structure was modified to reduce the cost of the work. The interaction of the cover and text changed with the advent of paper boards. Unlike wood, paper board lacked strength at the lacings and could not effectively transmit board leverage. Simultaneously other components of the cover-to-text attachment were weakened and abbreviated. By the eighteenth century glue was in common use for the consolidation of the back of the text block. Increasingly, glue and glued linings were used to compensate for abbreviated text sewing and weak sewing supports. Heavy gluing immobilized the back of the text block and restricted mobility. The advent of the "hollow back" in the early nineteenth century only increased gluing and lining while it disguised ever weaker sewing on sawed-in cords. By the end of the nineteenth century laced construction, leather covered work, though elegant, had been structurally debased with a crippled mobility antithetical to the action of early wooden boarded binding.

Another tradition of codex binding developed in the early European blank paper and stationers' trade. Beginning with the introduction of paper into Europe in the thirteenth century stationer's shops multiplied to supply sheets, notebooks, school copy books and accounting books. A generalized term for the binding provided by early stationers is "long stitch" or "archival" binding. These bindings are non-adhesive with the inner folds of the gatherings sewn through the cover wrapper and stiff spine tacket patches. In a trade separated from bookbinders, the stationers have evolved their own distinctive techniques for book work.

Evolution of printed book structure accelerated during the early centuries of the mass production of printed books. In Italy the use of limp cover binding heralded a redirection of binding structures away from the needs of larger, heavier books and into the design problems of quantity production binding for smaller books. In the limp binding style the boards and leather are eliminated and the sewing supports are laced through a cover made from a
piece of vellum or paper. Another redirection occurred as the German trade developed case construction during the last half of the eighteenth century. Unlike Italian laced case construction, the German work involved no lacing through the cover and used a completely adhesive attachment between the text block and cover.

The paperback is essentially an uncased text block. Without sewing or cover the paperback is an ultimate product of structural abbreviation of the codex binding. Yet this wrapper construction combined with increasingly improved paper stocks and binding adhesives provides a surprisingly useful product. Does the paperback also suggest a direction for future structural development? We will discuss this possibility later. Now let's consider the way these different bookbindings operate

Book action follows structure - mobility and function of bookbindings

Except, perhaps in the pop-up book, the experience of reading acts as a barrier to conscious operation of book mechanisms. It is possible to experience an integration of reading and physical support actions within the structure of the book itself. Benjamine Vorst, the vellum maker, has remarked that the scroll is its own binding. The skin or vellum of the scroll continues its natural function of outward protection and inner containment and the motions of access and reading are synonymous with support and protection of the text. Such a complete integration of the support and access action is more difficult with the codex binding. Here random access requires changing support and the individual leaves are both bound and free. Further, the potential support provided for the text varies greatly with the size, weight and structural features of the book. While the reader is preoccupied and unaware, the binding and text can be subjected to severe and distorting forces.

Action of laced construction binding - The prototype of unsupported sewn, laced construction binding from north Africa is characterized by its economical structure and docile, flat opening. This releasing opening action results as the text stitches relax at the opening. (see illustration 2.) Details from Byzantine mosaics and eastern Christian and Islamic art frequently depict the flat opening or over-opened book, or if it is cradled as with a Koran holder, the characteristically sharp throw-up of the text block as the back of the text assumes the profile of an inverted V rather than an arch.

The opening of the sewn board African prototype contrasts with the wooden boarded binding from Europe and the British Isles during the period from the eighth through the sixteenth century. Here the opening is self restraining as the heavy sewing supports resist a sharp V opening and tend to cantilever off the text back causing the fold stitches to tighten. With this arch opening the boards are more influential in their control of the opening motions as their
contradicting theologies and its personal challenge of living simultaneously in both worldwide and narrow ethnic social settings, all prefigure our current lives.

In the craft of bookbinding there were whole processions of book formats, the codex, the scroll, concertina and fan. The mythology of the Ethiopian church even includes possession of the Ark containing the tablets of the Law given to Moses. In the context of processions and in pilgrimage bookbinding was a liturgical art, not a commercial trade, and reading was a theatrical experience. Even the idea of books in a processional is suggestive to us as the use of books in a different reading mode.

The wider implication here may be the interaction of the traditional book with the on-line reading mode. There is conjecture that the book will migrate from the artifactual world into cyberspace and ultimately be more familiar in a searchable, electronic reading mode. The exemplar of the early African codex indicates a more complex scenario in which the book can be projected into many reading modes yet eventually return the reader to a personal and talismanic original. From the codex, to the text recited over and over, to the suddenly revealed reading and back again, these transitions were understood at the time of the adoption of the codex book.

There is also the parallel of the interaction of social institutions with their communication media. The codex was a missionary technology of the emerging Christian church, but while the codex enabled “distance learning” it also spread ideas beyond any central control and beyond any parent literature or culture. Now another change in reading mode is influencing social institutions. Visionaries project different political and social constituencies unified through electronic communication. We may be crossing a divide as human consciousness is augmented by machine consciousness. If so, the emergence of such a cyberspace consciousness echoes the story of the desert sectarians who also defined a new social order with a new reading mode.
openings that lay flat.

The attributes of the African codex prototype can be best realized in a sewn binding. At the moment, such sewn board bindings are gaining interest in both book collections care practice and limited edition binding, but there is a particular threshold to its acceptance. This threshold does not involve book action but fabrication methods. The sewn board binding is not a case binding and dispenses with separate steps of cover making and casing in. These potential advantages are also obstacles to acceptance wherever case construction is the standard. Trimming a finished binding, boards and all, or over-covering a book already in-boards are alien to case construction work. Even book conservation practice, which should be anxious to integrate the rich heritage of this prototype into its practice, is too immersed in western European models.

The production of the Dry Friio bindery is based exclusively on sewn board structures derived from the Christian cultures of northeastern Africa. The Utopian Ethiopian binding is a production blank book journal based on binding in the Abyssinian Church. The Post-Digital binding is the standard limited edition structure at the Dry friio Bindery. It features sewn boards made from a folded card stock. The Millennial binding is a double fanned text using transfer tape coated boards and a Tyvek covering which also follows the structure and action of the earliest codex binding. The Millennial binding is used for laser and copier printed publications.

It is time to bring back the sewn boards binding; the perennial millennial binding that disappeared before the advent of printing and returns now just as mechanical printing is receding. Its pliant structure and docile openings are perfectly suited to flat bed scanning and consultation at the keyboard. It is also an exemplar of the small, portable and hand held and palm-top book that integrates our dexterity with the experience of reading.
A. roll made from sheets pasted together - arrows indicate cuts for letter or book stock
B. proportion of letter sheet folds
C. folded square sheets gathered into a codex format
D. 4th century depiction of book action
E. 4th century Coptic codex
leverage is directly transmitted to the text through the laced supports, and through other components such as vellum back linings. Again, artistic representations show the restrained opening of these bindings. However, the structure was not rigid and this book anatomy can be especially mobile and graceful.

With a model of a wooden boarded binding of the sixteenth century, the boards may be opened only slightly before this action begins to induce motion in the text, first drawing up the initial leaves, and then bringing over the back and leaves of the whole text as the board is opened fully. (see illustration 3.) The action is continuous and even. Such action in books is exemplary, enabling the relatively great leverage of the boards to be dissipated and utilized without hazard to the overall structure.

It is also important to note the critical function of the fore-edge clasps in Western wooden boarded binding. These devices lock the strong leverage of the boards that is transmitted in the very final closing motion. At this point the supports are cinched taut over the outer gutter bevels of the boards, seating the boards securely against the shoulders, drawing the text back into a graceful arch, and, as the clasps are closed, locking the closed text block into a protective solid.

Late nineteenth century laced construction binding is characterized by a weak cover-to-text attachment, allowing the boards to drop away, and a glued and lined back which immobilizes the text block. Details of the cover-to-text attachment and text consolidation reveal a static packaging concept. The joint of the cover was increasingly refined, apparently toward an ideal dimension of zero. The fit of the tight, right angle joint causes a sharp flexing crease. The leather joint and inner hinge must be paper thin and the boards drop away without any influence on the text. (see illustration 4.a)

The text block itself was also treated as a static, solid form. Endpaper-to-text attachment invariably involved a stiff tip in the gutter, frequently covering whip stitching through the shoulder. Such a construction makes the openings at the initial leaves difficult and hazardous. They are forced into a severe one hundred and eighty degree breaking crease in the gutter (see illustration 4.b). A tube hollow is also invariably present in leather covered work of the later nineteenth century. The text back of such bindings today does not throw up or move away from the spine of the cover; the glued tube linings and the glue set rounding of the spine and the text back have immobilized the book. Frequently the only opening motion possible is a sudden break in the text back or in the tube hollow hinges (see illustration 4.c). Such stiffened structures attract load, but cannot dissipate it. The overall operational characteristic of this binding type is a complete discontinuity of action between the boards and the text and a complete lack of pliancy and
mobility in the text block. Such a book action is antithetical to that built into the sixteenth century, wooden boarded type.

The sixteenth century wooden boarded binding and some other structural prototypes achieve an integration of the reading and support actions. In these instances, the structure, like that of the scroll, operates itself during reading manipulations. Features such as transmission of leverage through the boards and a pliant, well sewn text assure a non-damaging, self-preserving response to the reader's actions. The wooden board binding responds to hand manipulation and enables the subtle motions of hand to eye reading. This is the purpose of bookbinding.

Action of stationers' binding - The mobility of stationery binding is based on ingenious and distinctive structures. The earlier long stitch binding is constructed without adhesive consolidation since the sections are sewn directly through the cover. This non-adhesive binding provides a sliding "escalator" motion between the unadhered folds of the gatherings. In a surprising action these books open flat in spite of inflexible tucket patches. (see illustration 5.) Another surprising action in stationers' binding is the sudden flat opening in later spring back ledger binding. Again the text is restrained by an inflexible spine, in this instance a laminated paper tube, and again the text back is unadhered to the cover. The cover-to-text attachment is set back at a great distance from the folds of the end papers and the rounded text back must spring through the transition from its convex closed profile into its concave opened profile.

Action of laced case construction binding - Limp vellum binding is light and resilient. The springy cover absorbs any impact from dropping or tossing. The lively vellum cover, securely laced to the text back, also produces an especially springy opening and closing. The spring is produced by the sewing support lacing through the cover at the spine creases. Lacing at this position creates text opening contours that are the counterparts of the spine movement of the vellum cover. Some vellum covers, and almost all one-piece paper covers, provide additional creases, set back from the spine creases, at the joint position, which ease the overall opening of the cover and represent the operating position between the paste down text attachment and the cover in case construction.

Action in cased binding - Laced, laced case and case construction bindings can be functionally separated by observation of the position of attachment between the cover and text block. With laced construction binding the attachment is at the fold of the end paper (see illustration 6.a,b). In cased construction the cover-to-text attachment occurs at the seat of the shoulder (see illustration 6.c). Laced case construction, as in the Italian limp vellum cover binding, is a combination structure operating at both the spine and
joint crease cover positions (see illustration 6.d). These seemingly slight
differences in cover to text attachment have major effects on mobility and
opening motions. The spine of the cover, according to its stiffness or pliancy,
restrains the text opening in the laced and laced case construction. With case
construction the spine is attached through a releasing hinge span, and the text
opening is not inhibited

The modern concept of the book as a text block with its cover acting as a
package is evident in early German case construction binding. A functional
characteristic of case construction is a slight set back in the position of the
cover-to-text attachment. The fundamental effect of case cover-to-text
attachment is that the spine of the cover does not inhibit the opening of the
text. The text has a characteristic docile, flat opening ideal for reading and
photocopying (see illustration 7.).

The future of book action

Modern book production is exemplified in the paper back. This structure
reflects many characteristics of the binding from Christian cultures of
northeastern Africa. Three characteristic features of this prototype codex
binding are (1) chain stitch sewing, (2) boards sewn to the text and (3) covers
and text equal in size. It is also important to realize that this family of sewn
boards binding is not case binding. The boards are sewn to the text before the
covering material is applied. The machine made paperback is usually
adhesive bound and the wrapper cover is adhesively attached, but we should
consider the possibility that this modern product could achieve the structural
integration and excellent reading action of the earliest codex binding.

An interesting incentive in modern book production is the search for a
binding structure that can be read without constant manipulation. Beyond
the need for music and cook books to lay opened there is now need for a
computer reference books to lay opened beside a keyboard. Another design
consideration is for uniformity of size and compact design that permits
stacking and shelving similar to that with CD's or cased audio or video
cassettes.

The African codex prototype from a previous millennium provides a model
of structure and action for books of the next millennium. Its docile opening
actions and compact design are exactly the features needed. Improved
adhesive binding flexibility exemplified by the cold emulsion Otabind
method or the principle of double-fan attachment as used by library binders
and the advent of more tenacious adhesive films all promise a more durable
adhesive attachment. The attachment of the wrapper cover free of the text
back, as with the Otabind structure, provides a development path to docile