Sewing and Other Methods of Leaf Attachment

Cover to Cover: Exposing the Bookbinder's Ancient Craft

Once the sections had been collated, the next step in the binding process was to sew them together. The purpose of sewing was to connect the leaves in such a way that they would be firm and yet easily opened when bound; it also provided the best means of attaching the book to its cover.

There were many different types of sewing methods. Most of them, however, required the use of common materials and equipment. These included: linen thread of a thickness appropriate to the size of the book; a needle; beeswax to facilitate the needle and thread in piercing the binding; unbleached linen tape or hemp cord; paper; a pencil and ruler, and most importantly, a sewing frame and its brass keys. Here's how the binder used these materials to complete some of the more common sewing systems:

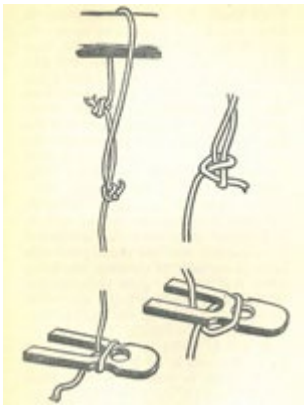
Flexible Sewing on Raised Hemp or Linen Cords

An exact abridgment of all the statues in force and use from the beginning of Magna Charta. Edmund Wingate et al. 1689
Flexible sewing on raised cords.

Raised cord sewing was the method most often employed until the mid-18th century. Essentially a form of 'all-along' sewing, in which the thread ran up and down each section and around the sewing supports uninterrupted, it was probably the strongest and tightest of all the sewing systems. Although examples of it have been found on vellum bindings as early as the 9th century, when leather thongs were used in place of hemp cords, it was a method typically associated with leather bindings. These could be easily identified by the raised bands which divided the book's spine into compartments, at least one or two of which would later be filled with title and author information.

To sew using this method the book first needed to be 'marked up'. If a book was to be marked up for five cords, for example, a strip of paper was cut the width of the spine and about one quarter of an inch longer than the book. One eighth of an inch was then marked off each end of the paper. The space remaining indicated the size of the leaves, whilst the overall length of the strip indicated the height of the finished volume – that is, the size of the book plus the overhang of the board which

would eventually form its cover. The length of the strip was then measured and divided by six. For the purpose of aesthetics, the space between the last band and the tail of the book was usually slightly larger, so a fraction was taken off the measurement to allow for this and the distance marked on the strip with a pencil. The head and spine of the book were then 'knocked up' or squared, the strip of paper laid against its spine, and the measurements transferred to the back of the sections using a triangle and strong pencil lines. At about a quarter of an inch from either end of the spine a mark was made for the kettle stitch, the chain that would secure one section to the next.



The sewing frame, examples of which can be seen below, was then strung up. Five loops, known as lay cords, were hung from the cross-bar and five pieces of unbleached linen or hempen cord were cut to a length at least four times the thickness of the book. One end of the cord was attached to the loop by means of a slip knot which, when pulled by its loose end, would easily untie. The other end of the cord was wrapped around the top of a brass key held below the frame. The key was then turned over, winding up a little of the cord in the process, before its prongs where slipped over the main cord. The key was then pushed through the slot of the frame bed with the prongs facing away from the sewer. The process was repeated for the remaining cords which were eventually tightened by screwing up the two wooden nuts on the uprights so as to lift the cross-bar. When all the cords had been set up, the book was laid against them, and they were moved to correspond with the marks previously made on the book's sections. The book was then removed and placed on the bench or table within arm's reach, facing upwards.

A manageable length of unbleached linen thread (no more than 50 inches) was then coated with beeswax and pulled through the eye of an appropriately sized needle. Sitting almost sideways to the frame and positioned closest to the tail of the book, the sewer turned over the first section, placing it face down with its fold against the cords. With the left hand resting inside the centre of the section, the sewer's right hand pushed the needle through the kettle stitch hole (previously marked up), at the right-hand side or head of the book, leaving a small tail of thread behind. It was received on the inside by the left hand which pulled the needle through the section and pushed it out again on the left-hand side of the cord at the first mark. The right hand then inserted the needle again to the right-hand side of the cord, essentially looping around the entire cord. The thread was pulled tightly and then the needle pushed out again on the left side of the second cord. This method was repeated around all five cords until the needle exited at the kettle stitch mark at the tail of the section. The next section was then placed on top of the first and it was sewn in the same way but from tail to head, at which point the thread was brought through the kettle stitch mark to the outside and tied to the loose end projecting from the kettle stitch of the first section. To make this knot, the thread attached to the needle was wrapped around the left hand to form a sort of noose. The hanging thread was then pushed through the bottom of the noose and the thread pulled up tightly. The loose end of the thread was then cut to about half an inch and placed between the section, on the inside of the text. Once the third section had been sewn and the thread brought out of the kettle stitch at the tail, the binder would discover that there was no loose thread to fasten to. The fastening was therefore made by inserting the needle under the second section and putting it through the loop made by the thread coming out of the third section at the kettle stitch. The thread was pulled up tightly and this manner of linking the sections was continued throughout the whole book. When the final section had been sewn it is fastened off, not only to the

section below it but again to the one below that. The thread was then cut and left between the sections. Finally, the book was removed from the sewing frame. By pulling on the loose ends of the linen or hempen cord that had been hung from the lay cords, the knot was automatically untied and the brass keys at the bed of the frame freed.

Sewing on Recessed or 'Sawn In' Cords

The ceremonies and religious customs of the various nations... Bernard Picart. 1733.
Sewing on recessed or 'sawn-in' cords.

'Sawn in' sewing referred to a method in which recesses were made across the back of the book with a saw, sufficiently deep to bury the cords flush with the back. The sewing thread was taken across the cords; it did not encircle them as in raised-cord binding. In England cords were being recessed into the backs of books as early as the 16th and 17th centuries. By the 18th century this sewing method had been widely adopted, in part because it was quicker, and hence more cost effective, but also because it allowed for a 'hollow back'. Unlike a raised-band binding, the leather of a hollow back binding was not glued to the recessed cords. Instead, when the book was opened, the back rested flat on the table, whilst the recessed cords bent upwards, creating a semi-circular space between them and the leather spine. This allowed the book to open more easily, and since it was only the lining of the back that creased, not the leather covering, any gilt work to the spine was less likely to split away from the leather.

To sew on recessed cords the sewing frame was strung up in the manner used for raised-cord sewing. The process for 'marking up', however, was vastly different. Once 'knocked up' or squared at head and tail, the folded sections were placed between pressing boards and set in a laying press such that the folds protruded from the boards by approximately one and a half inches. Once the press was tightened, the binder took a tenon saw, with a fine tooth blade of not more than 5-6 inches in length, and proceeded to make cuts along the back of the book. To sew a book on three cords, for example, the first cut was made one inch from the head of the book and the second, about one and a half inches from its tail. The distance between the two was measured and a third cut was made in the centre. Two further cuts were made; one between the centre and the head, the other between the centre and the tail. The cuts closest to the head and tail of the book were to receive the kettle stitch only and consequently were not deep. The three centre cuts were in fact more like channels, or kerfs, and the process for creating them was quite different. Unlike the simple, straight recesses for the kettle stitches, the kerfs for the cords were made by slanting the saw first to one side and cutting and then to the other side and cutting, thereby creating a kerf which was wider at the back of the book. The size and depth of the kerf depended on the size of cord to be used and, to some degree, the binder's judgment. As in raised-cord sewing, the measurements for sawing could be marked up in pencil beforehand. Larger books would require a greater number of kerfs. The sewing was completed in much the same fashion as raised-cord sewing. It began through the kettle stitch at the head or right-hand side of the first section. The binder's left hand, resting inside the centre of that section, received

the needle and thread and pushed it out, this time on the right-hand side of the cord. The right hand simply took the thread over the cord and pushed it back inside the section on the cord's left. The thread never encircled the cords as such; it simply passed over them, leaving the majority of it visible on the inside of the sections only. Future sections were added and sewn in the same way, and linked together at head and tail by means of the kettle stitch as used in raised cord sewing.

'Flexible Not to Show' Sewing

Sir Ralph Esher: or Adventures of a gentleman of the court of Charles II. Leigh Hunt. 1832
'Flexible not to show' sewing on cords.

Virtually a cross between raised and recessed cord sewing, the 'flexible not to show' method was devised in the 19th century. It involved marking up the back of the book as in recessed-cord sewing. The spine, however, was then sawn only very lightly, such that the grooves did not pass entirely through the sections. The book was then sewn onto thin cords, the thread encircling them in the flexible manner as in raised-cord sewing. If the cords extended beyond the level of the spine once sewing was complete, they were knocked into the back of the book during the backing process. 'Flexible not to show' sewing had some distinct advantages. A book sewn in this manner resulted in the same bandless spine as that of traditional recessed–cord binding, a look which was becoming increasing popular. Yet it had the strength typically associated with a raised-cord binding, since its sections had not be sawn and consequently damaged to the extent of a normal recessed-cord binding.

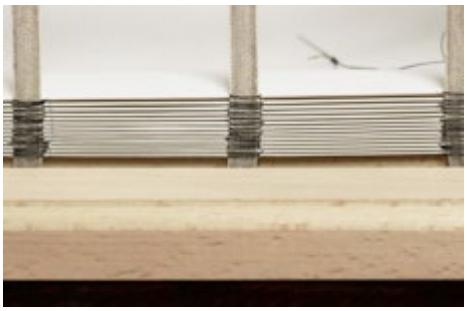
Sewing on Tapes

Buki Tabu 'ena Dobu. British and Foreign Bible Society. 1935
Sewing on cotton/linen tapes.

The use of tape in sewing rapidly overtook that of cords in the 19th century. The method resulted in a book with a level back, and it offered great flexibility, provided the tapes used were proportionate to the size of the book. Quality unbleached linen tapes were favoured over cotton for their pliability and they came in a variety of widths. Three tapes were considered adequate for most octavo volumes, whilst a tape spacing of approximately one and half to two inches was recommended for larger books.

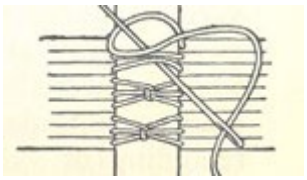
To 'mark up' a book for sewing on three tapes, the binder first squared its head and spine. Using a triangle and pencil, they marked, across the folds, the position of the kettle stitches – usually about

half an inch from both the head and tail. The position for the middle tape was centred between the two, where a pencil mark was made slightly wider than the width of the tape to be used. The final two tapes were positioned in the middle of the centre and the respective kettle stitches. Again the spaces were marked up slightly wider than the tape width.



Setting up the sewing frame for tapes required a different set of brass keys to those used for cords. These tended to be more rectangular in shape and included a straight bar over which the tape could be passed. The binder cut three pieces of tape to a length which allowed ample working space between the frame's crossbar and its bed, usually twelve inches. The cord was then friction-tied to the brass key which, in turn, was pushed through the slot of the frame bed. The other end of the tape was pulled over the crossbar and secured tightly with a pin. Once all three tapes were in place the last signature (or the back endsheet section if this was to be sewn in) was placed face down on the frame. The needle and waxed thread was pushed through the first kettle stitch mark at the head of the book, leaving a tail of thread behind. The binder's left hand, resting inside the centre of the section, received it and pushed the needle and thread back out on the right-hand side of the first tape. The thread was then passed over the tape and pushed back inside the section on the left-hand side of the tape. This process was continued until the thread was pushed out through the tail kettle stitch mark. The next section was placed on top, the binder's left hand opened it to the centre of the fold and the right hand pushed the needle through its kettle stitch mark. The section was then sewn all-along again. When the binder reached the head kettle stitch mark of the second section it was knotted to the first using a kettle stitch. When the last signature had been sewn, it was fastened off in the manner as described for raised-cord sewing. The tapes were cut loose from the sewing frame, leaving sufficient length on either end to gently pull them taut to eliminate any puckering. These tapes would later be used to attach the boards for the book's cover.

Reducing the Swell on Tape-Sewn Bindings



When sewing on tapes, any excess swell on the back of the book can be reduced by an additional loop of thread which 'catches' several sections together. When three of four sections have been sewn, the needle, after it comes out of the right-hand side of the tape, and before it goes across the tape, is pushed eye-end down under the three or four threads below it and is then inserted into the loop formed by this procedure. The thread is then pulled up tight, forming a knot in the centre of the tape, before being drawn back into the middle of the section.

Sewing 'Two-On'

This method of sewing brought together two book sections at once, minimising the amount of thread used. Although it could be performed on either raised cords or tapes, it really was reserved for books where sewing 'all-along', around every cord, would result in way too much swelling of the book's back. Books comprised of a great many sections, where each signature was made up of just two or four leaves, were most at risk of this 'swell'.

In this method, the sewing frame was strung up with the desired tape or cord, the back of the book marked up as required, and the thread inserted as usual in the lower, right-hand side kettle stitch. When it was brought out on the left-hand side of the first cord, however, the needle was not reinserted into the same section. Instead a new section was placed on top of the first section and the needle pushed into the right-hand side of the first cord of section two. The needle was then brought

out on the left side of the next cord and the thread inserted on the right side of the section below, and so on along the length of the book. Importantly, the first and last two sections of the book were still sewn in an all-along method to give added strength and support to the book. The work was then removed from the frame in the manner as for flexible raised-cord sewing.

Although it might appear a complicated method of sewing, once mastered its benefits were obvious. For a book sewn on five cords, there would only be three stitches of thread inside each section, as opposed to six for a book sewn all-along. It essentially reduced the amount of swelling in the back of the book by half.

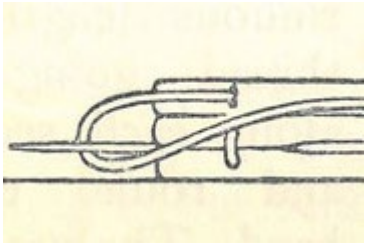
Additional Sewing Methods

In addition to the sewing methods discussed here, there are many others used in the bookbinding process. These included: stabbing, a 16th-18th century method in which leaves were held together by passing thread through holes made near the back folds; overcasting, an 18th-19th century method in which single sheets were sewn together through holes not more than 3mm from their edges; sewing on double cords or split thongs, a method typically used for large and heavy books; French sewing, a method requiring neither tape nor cord, the sections instead simply linked to one another with linen thread, plus many more.

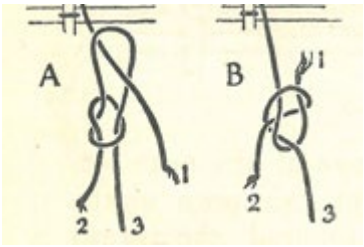
It is the responsibility of the binder to select the most appropriate sewing method for a book. Although it may not appear obvious to the untrained eye, there's always a reason why a binder chooses one sewing method in favour of another. A book may not be held together by the thread alone, the spine linings, boards, headbands and covering also playing their part in the strength of the structure, but the sewing system does provide the foundation upon which the successful accomplishment of all subsequent binding operations depend.

The Kettle Stitch

The 'kettle stitch' is one of the most frequently used stitches in book sewing. The term 'kettle' is a corruption of the German word 'ketteln', meaning to 'catch up a stitch'. Essentially a knot, the kettle stitch is made at the head and tail of a section to join it to the preceding one. It locks the sewing thread after each complete pass along the spine of the book, giving it strength and durability. Here's how the kettle stitch appears at the tail of the book.



The Weaver's Knot



If a strand of sewing thread comes to an end before the book has been sewn in its entirety, another must be tied to it with a weaver's knot. Sewers must think carefully about where to join the two threads. If the knot is too close to the next hole it may jam there and cause a slack in the sewing system. Once made, it should be pulled inside a section, so as to avoid any unsightly lumps in the outer covering.

Bookbinder's Awl

Sewing a book is one of the more complex steps in the bookbinding process. Sewing can be simplified considerably by using an awl to pre-pierce sewing holes into the sections. This small, wooden-handled tool has a sharp metal point for placing precise holes in signatures

once they have been marked up, and before sewing. It can also be used to push holes through card and board.

Thread Tension

Whilst sewing, it is vital to keep the tension of the thread even throughout the book. If the sewing is too loose the sections will sag; too tight and the thread will strain. Similarly, the two kettle stitches must be tightened evenly so as to avoid one end of the book appearing broader than the other. Where the back of the book begins to swell too much, a loaded stick (a wooden stick loaded with lead at one end) can be used on top of the sections, between the cords or tapes, to gently tap down the paper. Some swell is required in order to 'round' and 'back' the book successfully in future binding operations. However, a book with too much swell will have a tendency to take on too much round, making it difficult to open. Its back may also break when the reader attempts to force it to lie open. A book with too little round will open easily but its back will have a tendency to cave in.

Caoutchouc Bindings

400 pictures of our people: Sketches from 'Punch'. Charles Keene. 1888.
Caoutchouc binding, showing typical degradation of the rubber.

Binding single leaves had always been a little tricky. So, in 1836, when a man by the name of William Hancock (brother to Thomas Hancock, founder of the British rubber industry) came up with a solution, he was quickly granted a patent. His invention, the caoutchouc binding, removed the need for sewing altogether. A tenacious and rather gummy adhesive, caoutchouc was obtained from the milky sap of plants growing primarily in South America and Asia. It was applied to the roughened backs of the assembled leaves and left to dry. A second coating was then applied, followed by a strip of caoutchouc cloth in a warm, sticky state and the pair finally rubbed down.

The first book thought to be bound using this method was Leitch Ritchie's 1839 *Versailles; Picturesque and romantic*. At the foot of its spine were the words, blocked in gold, 'Hancock's Patent'. Masses of books, many folio-sized, with numerous plates on heavy paper, were bound using this method during the 19th century. Over a relatively short period of time the rubbery adhesive became brittle and today, all but a lucky few caoutchouc bindings have fallen apart. No amount of care in opening such a binding has prevented its pages from detaching from the cloth. Hancock's invention caused a great deal of uneasiness in the binding trade at the time and conservators still lament his invention today. Ironically, this method of attaching the leaves was known as 'perfect binding'.

Caoutchouc vs Gutta-Percha

19th century Gutta-percha picture frame.

The substance used in a caoutchouc binding is often referred to as Gutta-percha. Whilst both of these materials are formed primarily from the sap of trees, that's really where the similarity ends. Caoutchouc is a natural rubber which is harvested in the form of latex, mostly from the Pará rubber tree (Hevea brasiliensis), which is native to South America. The sticky latex is drawn off of the tree by making incisions in its bark and collecting the fluid in vessels. It is then refined into rubber. Importantly, it can also be vulcanised, that is, heated to improve its resistance and elasticity. The uncured rubber finds its way into cement, adhesives, insulation and friction tapes; the vulcanised rubber has many more applications, its flexibility useful for tyres, hoses, balls, balloons, even printing press rollers. Gutta-percha, on the other hand, refers to the evaporated latex of the trees of the genus Palaquium, which grow almost exclusively in the Islands of the Malay Archipelago. From these trees, the latex does not flow as freely as it does from the rubber tree, so the Malays tend not to incise the bark but fell the whole tree, removing entire circles of bark in the process. The latex is removed and converted into 'gutta' or gum by boiling over fire. Gutta-percha's ability to soften in warm water and harden again in cold has seen its application in everything from root canal therapy to electrical insulation. It has been used to make ornaments, knife handles, jewellery and even furniture – a few examples of which were shown at the 1851 Great Exhibition.

Wire 'Stapled' Bindings

Entsiklopedicheskii slovar. Ivan Efimovich et al. 1890.
Wire "stapled" binding.

This peculiar style of binding was common to German binderies, Hugo Brehmer having invented the wire book-sewing machine in 1875. George Stephen's described the process in his 1910 book, *Commercial bookbinding*: "The machine was fed automatically from spools by small steel rollers and at each revolution as many U-shaped staples are produced as are requisite for each section. A section, having been placed on an oscillating table, is brought into position for being sewn. The staples are driven from the inside of the section through the fold and through the tapes or open fabric which is stretched and firmly held by clasps directly opposite to each staple binder and inserter. The projecting legs of the staples are clinched over, thus producing a firm connection between the section

and the tapes or fabric, whichever is used. In order to reduce the swell in the back of the book which would be caused if the staples in the various sections were all inserted in a corresponding position, the machine is so constructed that each staple forming apparatus has two or three shifts whereby the staples in adjoining sections are inserted in different positions so that there appear on the back two or three times as many rows of staples as there are staples in each section."

Unfortunately, wire was prone to rust, rotting both the paper and the fabric lining to which it was secured. In time, the binding would become brittle, eventually breaking down altogether. Conservation of these volumes was challenging since every single fold needed to be repaired first and then resewn. This meant that only the rarest and most valuable books were deemed worthy of conservation.

On display in this cabinet were the following sewing supplies:







Lee Hayes
May 2018