Connecting Tai, Kam and Li Peoples Through Weaving Techniques[1]

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Abstract—Textiles produced by Tai-Kadai peoples are widely admired and much studied, but to date there has been no comparative survey of weaving techniques. Looms and techniques are transmitted between generations in a conservative manner, and have the potential to reveal deep connections between different groups. In this article I present a survey of loom and patterning techniques, using a mapping approach, combined with comparative analysis similar to that used by linguists. The results trace Tai migration routes, and parallel the findings of linguists in many respects, with some significant differences. They also highlight the important contribution made by Tai-Kadai weavers to the development of the complex patterning systems (drawloom systems) that eventually found their way to the silk weaving industry in Europe.

Introduction

This article presents a survey of the looms and patterning techniques used by Tai, Kam-Sui and Li weavers in south-western China and Southeast Asia. I compare their techniques, and investigate what light this can shed on connections between various groups. I will try to identify which aspects might be considered characteristic, and whether a unified weaving identity emerges from this. As I will show, there are important features shared by Tai and Kam traditions, consisting in part of loom designs, but more particularly of complex patterning systems, including some unique and influential innovations that trace aspects of their migration history. Li weavers on Hainan use a fundamentally different and much older loom versus the mainland groups, and there is little obvious connection, in terms of technique at least, with Tai and Kam weaving.

To date, the only attempt to address Tai weaving culture as a whole is Gittinger and Lefferts' study, *Textiles and the Tai Experience* (1992). Their work was largely based on fieldwork in Thailand and Laos, since information from other regions, particularly the diverse groups in China, was lacking at that time. Their approach was thematic, examining the roles of different types of textiles in Tai societies. In contrast, the question of weaving technique has received relatively little attention, despite its fundamental importance to the practitioners of weaving, and its potential (as I will show) to uncover aspects of shared history.

[1] This article is based on a paper delivered to the 13th International Thai Studies Conference, Chiang Mai, 15-18 July 2017. All photographs, maps and drawings are by the author. Textiles are from the author's collection.

Definitions of 'ethnicity'

An individual or a group of people may be subject to multiple categorizations that relate to ethnicity, some given by outsiders (exonyms) and some by themselves (endonyms or autonyms). Academic writing tends to favour definitions based on language, expressed in the commonly used term 'ethnolinguistic group', and ethnicity and language are sometimes treated as synonymous. This assumption is questionable: for example, I regard myself as British and I speak English, but the first of these is not a language and the second defines no ethnic group. 'Tai ethnicity' ought, in principle, to be a multi-faceted notion, including language, but extending further to incorporate material and social culture. This approach was advocated by Terwiel (1978), but there has been little follow-up of his ideas, and in practice most working definitions of Tai groups, such as those listed at www.ethnologue.com, are based exclusively on linguistic work.

The groups that I have surveyed are categorised by linguists as belonging to the Tai-Kadai (Kra-Dai) language family.[2] The first comprehensive overview of their languages was attempted by Li (1977); since then, numerous linguists have contributed to studying this family. The prevailing view is of a Tai-Kadai family with three major linguistic branches: Tai, Kam-Sui and Hlai (Li), with the Tai branch further subdivided into Northern, Central and South-western branches (Figure 1). Most authors assume the existence of a proto-Tai language spoken in what is now southern China around 2000 years ago, with the bulk of Tai migration into Southeast Asia taking place after that date. This implies a relatively young language group; proto-Indo European (for example) is thought to have a time depth in excess of 5000 years. Looking further back in time, the existence of a proto Kra-Dai language is also implied by this grouping, although this putative 'proto-language' has not been systematically reconstructed.

The greatest diversity of Tai languages, and their assumed region of origin,[3] is found near the border between Vietnam and Guangxi province in China. Most Tai peoples are (or have been, in the recent past) wet-rice farmers by preference, occupying lowland areas and level land in valley floors, though some groups also engage in swidden farming in upland areas. Their expansion seems to be linked with the development of intensive wet-rice agriculture (Guedes 2011; Luo et al. 2000), which enabled suitable land to be farmed more intensively and with more likelihood of agricultural surplus than was previously possible. To the east of their homeland they found themselves in competition with Sinitic peoples with similar preferences, limiting the possibilities for expansion, but to the west they found no such barriers, and consequently more opportunities for founding new settlements. The process of Tai expansion seems to have proceeded via a mixture of migration coupled with assimilation. The labour-intensive work of farming rice paddy, coupled with the promise of agricultural surplus, seems to have driven the partial assimilation of many existing groups that the expanding Tai encountered.

[2] In addition to the groups that I have surveyed, the Tai-Kadai linguistic grouping includes Kra and Be speakers amongst others. These groups are now restricted to a relatively small number of speakers. From what little is known of their weaving-related cultures they seem to resemble their geographic neighbours and retain little of their (presumed) original weaving traditions.

[3] But see Holm 2010.

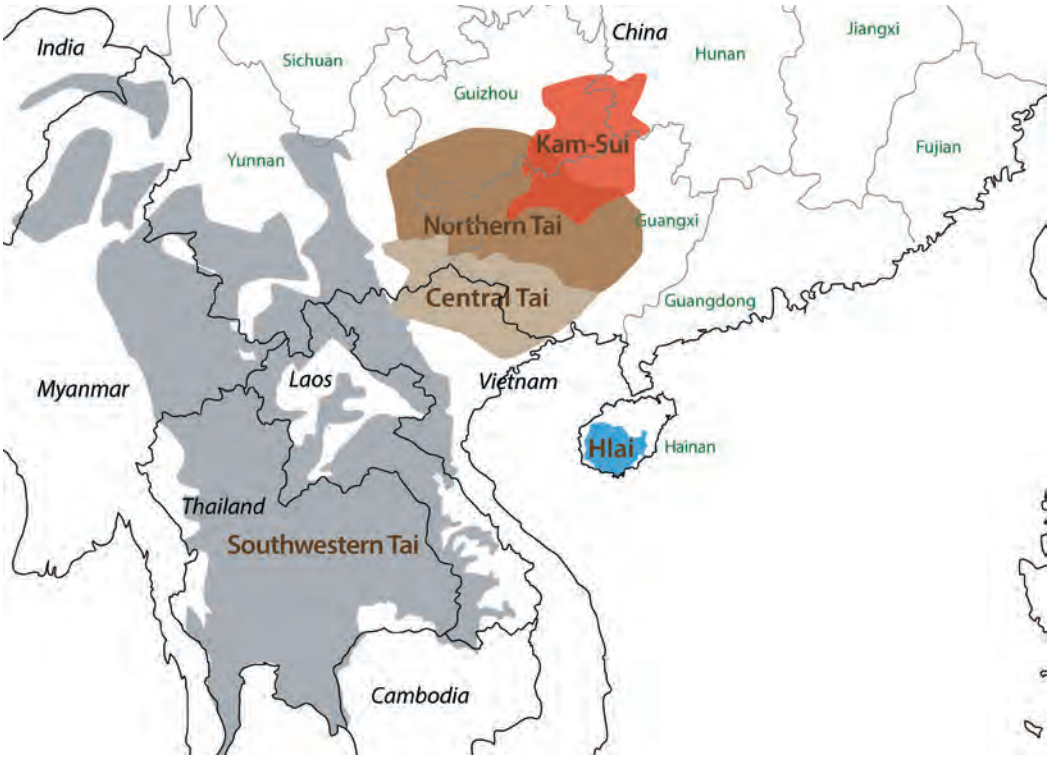


Figure 1. Map showing the distribution of Kam-Sui, Hlai and Tai language speakers.

There is a substantial literature that attempts to link present-day distributions of languages with historical records of Tai migrations, particularly Chinese sources and Tai legends, and also with archaeological findings. Linking language and ethnicity with ancient texts is challenging, however: early Chinese writing (the source of most of the information about the earliest periods) provides useful data on military manoeuvres and government in border regions, but is notoriously imprecise as regards the ethnicity of 'barbarian' tribes (Man, Yi, Lao, etc.) that the emerging Han state encountered, since Chinese bureaucrats and military officers had little interest in such distinctions. Baker (2002), Evans (2016) and Chamberlain (2016) provide good reviews of this area.

From the standpoint of both weaving and language, the basic 'cultural unit' differs in type and scale according to region, but in rural areas it is usually a group of villages sharing the same dialect and customs, within which members tend to intermarry. Ideally, we would like to study culture at this level of detail, but it is unfeasible to study the Tai peoples in their entirety in such detail. For my purposes, I will take a pragmatic approach, using the data that is available, together with Ethnologue definitions of linguistic groups, which define broader groupings, as a starting point. However, I will not assume the relationships that the Ethnologue hierarchical classification implies. This allows me to build an 'alternative' picture of the relationships between Tai peoples, based on technique and textile forms, which I will briefly compare with the linguistic picture at the end of this article.

'Textile culture' includes a broad range of things and activities that are of potential interest to a researcher. To explain my choices for this survey I will first introduce a

classification scheme for material culture. This places phenomena along an axis that runs from 'Tradition' to 'Fashion' (Figure 2). The 'Tradition' end of the axis is defined as things that are passed mainly from an older generation to a younger one ('vertical' transmission). These aspects are conservative and tend to change slowly over time, and they are often strongly linked to ethnic identity. The other end of the scale is defined as 'Fashion', in opposition to 'Tradition'. It consists of things that are learned mainly from peers or from media ('horizontal' transmission). Fashion is, by definition, ephemeral, related to personal expression, enjoyment, and other kinds of identity such as peer group and gender. This is, of course, not the only way that one might classify cultural 'things', but it is useful for this discussion.

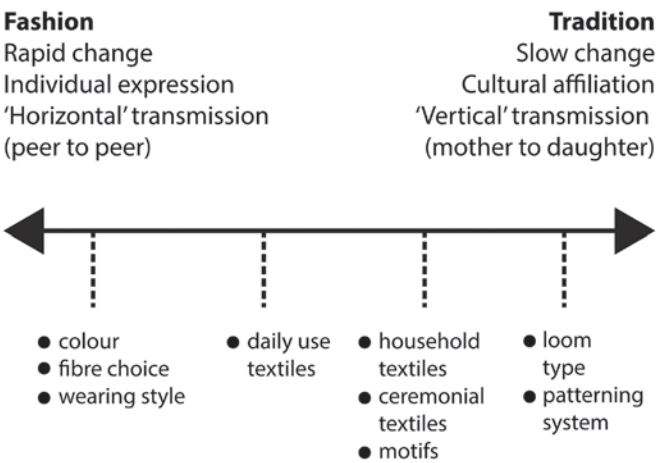


Figure 2. Classification of cultural phenomena along an axis running from 'Tradition' to 'Fashion'

Real cultural phenomena are neither pure 'Tradition' nor pure 'Fashion' in nature, but embody aspects of both in varying proportions, represented by their position on the axis. Clothing worn by professional office workers, for example, may embody traditional elements, but are also subject to changes in fashion, albeit more slowly than (for example) clothing worn for leisure at the weekend. Ceremonial textiles marking important life events tend to be more conservative, as do textiles such as bedcoverings that are for use inside the household. Indigenous weaving techniques and looms are amongst the most conservative of all aspects of material culture, positioned closest to the 'Tradition' end of the scale. Novice weavers learning technique generally learn from an older relative (usually mother or grandmother). They are expected to follow traditional practices closely and they are not expected to alter them (Boudot and Buckley 2015). This is, in part, related to the difficulty and complexity of weaving on a loom.

My choice of loom design and technique is related to this conservative aspect. Loom designs are subject to the slowest rates of change (relative to other aspects), and therefore are more likely to reveal deeper connections between peoples. I will use this data in a similar way that linguists use cognate forms: identifying shared, innovative features (homologies) that shed light on group ancestry, and distinguishing these from borrowings

and chance resemblances.[4] There is some evidence that the most conservative aspects of loom technology may have greater time-depth and less susceptibility to acculturation than basic vocabulary. For example, the Maonan of Guangxi and Guizhou provinces (Kam-Sui speakers) have a great deal of borrowed vocabulary from Han Chinese, but retain a distinctive loom that is not used by their Han, Miao and Yao neighbours. Another line of evidence is the very wide diversity in looms used by different peoples worldwide: apparently similar problems have been solved with radically different technologies that have remained distinct, despite migration and extensive contacts between peoples. I will also consider a few selected types of textiles, particularly multi-panel bedcoverings decorated with supplementary weft, that embody conservative styles that may also reveal links between Tai groups (Howard and Howard 2002: 100), but I will leave a detailed consideration of textile forms for a subsequent study.

Data sources

To map and characterise looms I have used recent fieldwork that I have carried out in Vietnam, Laos and Thailand, together with primary studies on technique by Boudot and Buckley (2015), Li et al. (2011, 2013), Long (2011, 2012) and McClintock (2013). I have supplemented these with general works on textile culture that provide illustrations of looms, including publications by Cheesman (2004), Conway (1992, 2002), Howard and Howard (2002) and McIntosh (2009). For mapping the distributions of looms, I have also made use of unconventional sources, including newspaper reports and online travel blogs. These are usually not detailed enough to characterise a loom, but they are often good enough to allow the mapping of the distributions of types already identified. Coverage is reasonably good in Guizhou, Guangxi (due largely to fieldwork carried out by Eric Boudot), and in Hainan, North Vietnam, Laos and North Thailand, but is patchy in Yunnan, Myanmar and Assam, where I have not been able to do fieldwork (to date), but have relied mainly on the published sources.

Types of loom used by Tai weavers

Woven textiles are made of two components—warp and weft—interlaced at a right angle. A loom is essentially a device for arranging and tensioning warp yarns, and for facilitating the raising of groups of warps so that wefts can be inserted. Basic loom setups allow the lifting of one group of warps then the opposite group (called shed and counter-shed) alternately, so that plain-weave (tabby) can be made. Various aids may be added to this basic setup to facilitate the lifting of more complex sequences of warps, in order to make patterned textiles, or to make the weaving process faster or more convenient. I will look at the loom types first, then move on to consider patterning methods.

[4] The analysis I present here is based purely on the structural and functional aspects of weaving tools, not on their names. The comparison of the names used for weaving tools may also give useful insights, but this is a different question and a project for another day. My (incomplete) table of the names of loom parts is available on request, and I would be happy to assist linguists and others who are interested in extending and improving it.

There are five major types of loom (Figure 3) used by Tai weavers, which have distinct geographical distributions (Figure 4). These loom types delineate four major regions with distinct weaving traditions (Figure 5). The loom types are as follows:

1. Frameless, foot-braced body-tensioned loom

This loom is used by Li people (Hlai speakers), on Hainan (Figure 6). The basic loom is extremely simple, consisting of a warp beam braced behind the feet, a cloth beam secured at the weaver's waist with a backstrap, a rod that retains the natural shed (shed stick), and a heddle for opening the counter-shed. To this setup a coil rod is usually added: this is a rod that the warps turn around and are tightly bound to, which helps keep the warps in their proper order. Both the warp and the fabric that is woven from it are in the form of a tube ('circular warp'), the warp being moved around the warp beam and cloth beam as the weaving progresses, and then cut when the finished piece is taken off the loom, to make a flat piece of fabric. The weaver may wind several turns of the warp and finished cloth on the cloth beam, which allows a longer cloth to be woven (so that the length of cloth is not limited to the distance between the weaver's waist and feet). The weft is beaten in place with a wooden 'sword', a multipurpose implement that facilitates opening sheds in the warp, as well as the beating-in of weft.

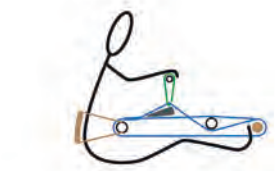
Similar foot-braced looms are used by a few isolated groups, including Austronesian speakers on Taiwan, and Austroasiatic speakers (such as Katu and Maa speakers) in southern Laos/Vietnam. The Austroasiatic looms are closest to the Hainan variety, whereas the Taiwan looms show some innovative features in warp beam design not found elsewhere. This loom is also attested in the archaeological record from the late Neolithic period in south-east China, and from the Iron-age Dian culture at Shizhaishan in present-day Yunnan. Given the wide geographic spread, and its usage by three (possibly four) major language families, we can assume that this loom was once widespread in the southern part of East Asia. What we see today are remnants of this distribution, the origins of which probably predate the emergence of most of the major language families mentioned.

2. Half-frame, body-tensioned looms

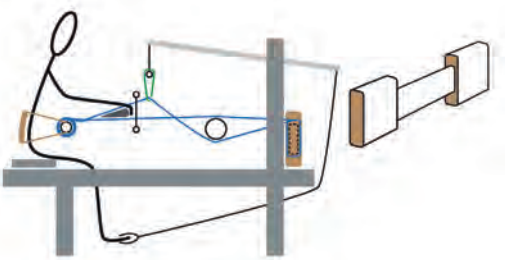
These looms have a frame that holds the warp beam, but not the cloth beam. The weaver sits on a raised seat, with the cloth beam attached to her waist with a backstrap (as with the frameless loom). Instead of being circular, the warp is 'flat', meaning that it is wound onto the warp beam as a flat sheet, and unwound as the weaving progresses, the finished cloth being wound onto the cloth beam. This allows a long piece of cloth to be woven, around ten to twenty metres being the norm.

Most half-frame looms also incorporate two other technical advances: a reed, which serves to space warp yarns and keep them in order, and a system for raising one or more heddles using the feet,[5] which frees the weaver's hands for weft insertion. There are two major types of half-frame loom in East Asia. They are not unique to Tai weavers, but they have distinct geographical distributions amongst Tai peoples:

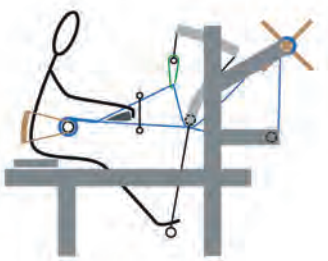
[5] Heddles are sometimes called 'shafts' in weaving literature. I reserve the term 'shaft' for a heddle that is attached to a treadle in a manner similar to a European frame loom.



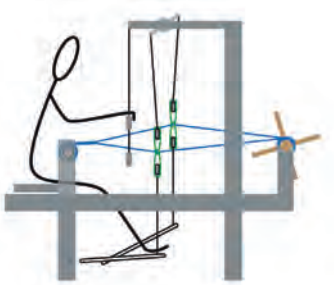
Simple, foot-braced body-tensioned



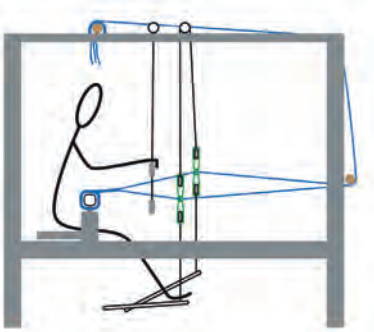
Half frame, long Y-rocker heddle (drawing of paddle-shaped warp beam to the right of the loom)



Half frame, short rocker heddle



Full frame, cantilever



Full frame, cuboidal

Figure 3. Major loom types used by Tai-Kadai weavers

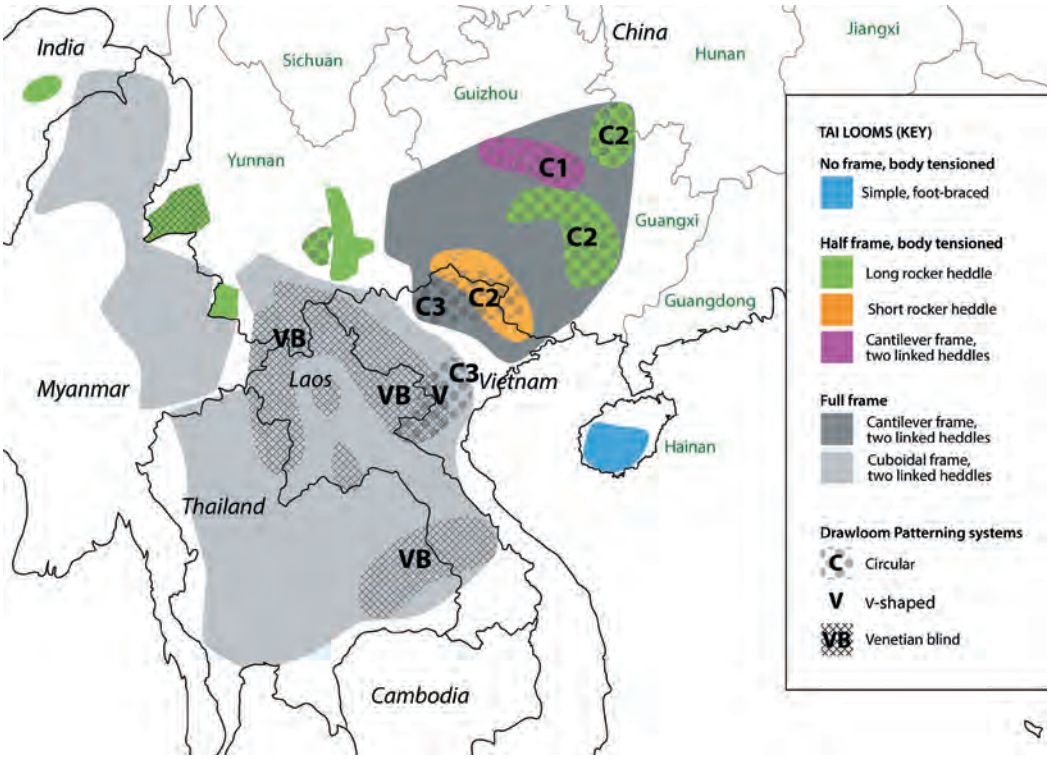


Figure 4. Distribution of loom types and patterning systems amongst Tai-Kadai weavers

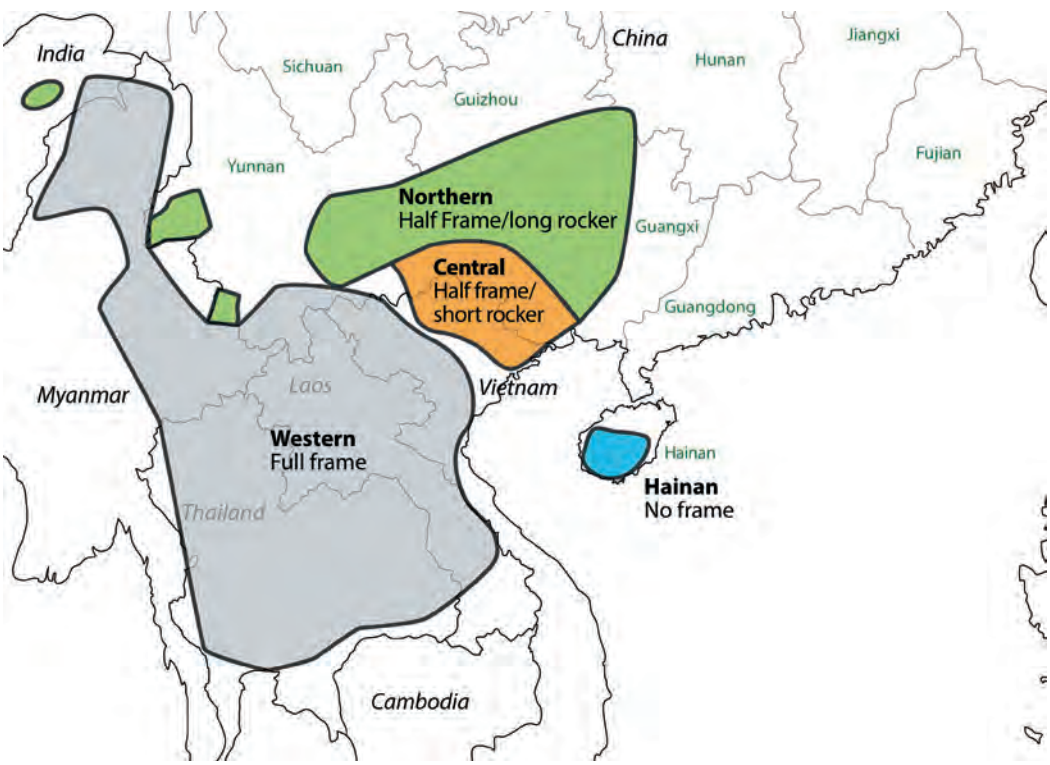


Figure 5. Major Tai-Kadai weaving zones, defined by the oldest loom present in each region

Figure 6. Simple foot-braced, body tensioned loom used by Li weavers on Hainan

Long Y-rocker-heddle loom

This half-frame loom has two distinctive features. The first is a long rocker above the warp (usually Y-shaped or V-shaped), to which the ground-weave heddle is attached, which connects (via the back of the loom) with a cord around the weaver's foot. The second is a large paddle-shaped warp beam, which is lodged at the back of the loom. The warp beam is removable, so that the weaver can remove her work at the end of the day and roll it up (Figure 7). The earliest evidence for this loom comes from wooden parts found in a tomb in Jiangxi province, dating from the Eastern Zhou dynasty (771-220 BCE), that are on display in the provincial museum. It seems to have been a common domestic loom during the Han dynasty (206 BCE – 220 CE), judging from tomb remains and engravings, including finds in Guangxi province in south-western China (Boudot and Buckley 2016). Archaeological remains of this loom have generally been misidentified, since the practice seems to have been to inter the loom owner (presumably female) with the removable parts of the loom (only). These parts are easily mistaken for the components for a simple, frameless loom, particularly if they are crudely made facsimiles, which is often the case with burial goods of this period. However, the distinctive, warp beam with its large 'paddles' (not found in the archaeological remains of simple looms) is a diagnostic characteristic.

The long-rocker loom seems to be an evolution from the frameless loom, since it retains many of its features, including a natural shed opening that is held open with a shed stick or tube inserted in the warp. It has a very wide distribution in Asia, consistent with it being one of the oldest types. It is found from Assam in the west, where it is used by Tai Phake weavers, to Japan and Hokkaido in the east, where variants are used by

Ainu and Japanese weavers (jibata loom). It is also used by Tai, Hmong-Mien, Sinitic (Han) and Korean speaking weavers, and it is often associated with the weaving of bast fibres (hemp and ramie).

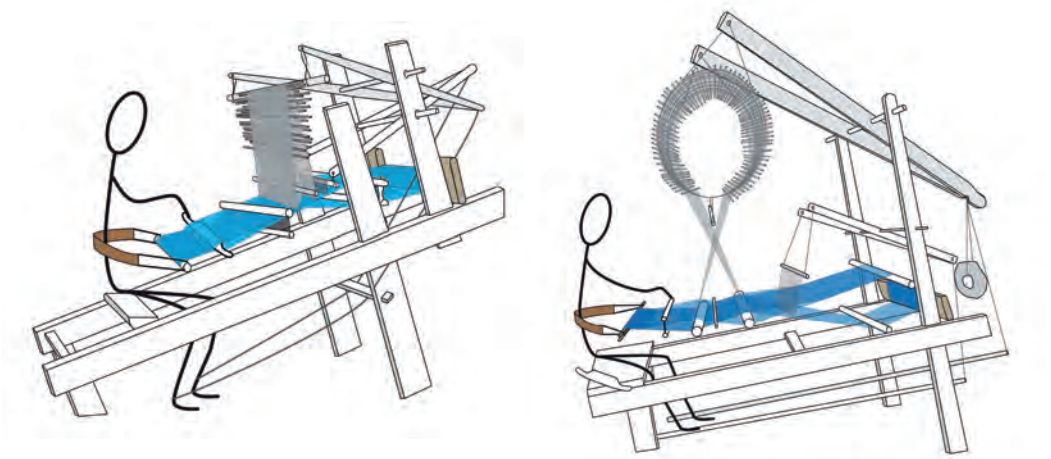


Figure 7. Examples of half-frame, long Y-rocker heddle looms used by Kam (Dong) weavers in the Tongdao area of Hunan province (left) and Maonan weavers in Guizhou (right). Both looms have drawloom pattern heddles of the C2 type, which are also attached to long rockers, worked by cords at the weaver's feet or treadles.

Amongst Tai weavers this loom is used by Kam weavers in Hunan, and by northern Zhuang, Maonan weavers in Guangxi, Tai Nua, Tai Ya, and Tai Hongjin weavers in Yunnan, as well as the Phake, as mentioned. Some of the Yunnan variants have simplified frames that have lost the horizontal component, a trait commonly seen in looms in upland regions. It seems to have been formerly used by Mulao weavers in Guangxi, though, to date, I have not been able to find this loom (it may be extinct). Where it is used by Tai-Kadai peoples, it is usually associated with the use of a complex patterning system of a circular type (discussed below), attached to a second long rocker, used for making cloth with supplementary weft patterning, particularly for decorated bedcovers. Its present day distribution amongst the groups mentioned is patchy, and in most areas in which it occurs it has been partly replaced by full-frame looms of more advanced design. Kam weavers, for example, use the long-rocker heddle loom with a patterning system for weaving traditional bedcovers and baby-carrier cloths with supplementary weft decoration, but for weaving plain fabric they use a full-frame loom of the cantilever type. As far as I know, the half-frame loom is not used by Sui speakers in Guizhou, who use a full-frame loom of the cantilever type for weaving plain tabby cloth.

The distribution of this loom defines the 'Northern' group of Tai-Kadai weaving traditions. This is not the same as the Northern group of Tai languages, since it includes Kam, Maonan and Mulam weaving traditions, as well as Tai Ya, Tai Hongjin and Tai Nua speakers in Yunnan, who are grouped with the South-western Tai languages by linguists.

Short rocker-heddle loom

This is also a half-frame loom, but of a different design (Figure 8). Instead of a tube in the warp, the natural shed is held open by rods fixed in the loom frame. The single

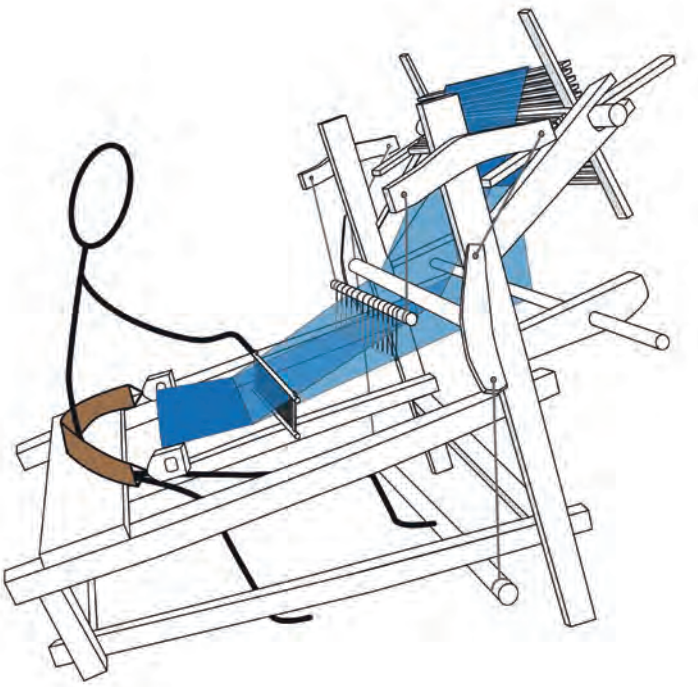


Figure 8. Short rocker heddle loom, used by some Nung weavers in northwestern Vietnam

heddle is raised by a cord attached to a transverse treadle. The heddle raising mechanism incorporates a second bar placed on top of the warp that is pulled down as the counter-shed is opened, facilitating the opening of a wide counter-shed. A reed is also present; this may hang loose in the warp, or it may be suspended from a pair of lightweight curved spars above the warp. This loom is used by a few Nung and southern-Zhuang speaking groups distributed on a north-south axis along the Vietnam – Guangxi border, but not (as far as I am aware) by Nung living further west in the Lao Cai area, who use a full-frame loom.[6] In most cases, the loom is used for making plain fabric, or stripes and checks, but in the Longzhou area of Guangxi province, it is used with a *huaben* (complex patterning system) to make bedcovers decorated with complex supplementary weft. As with the long rocker-heddle loom, this loom seems to be in the process of being replaced by full-frame looms of the cantilever type, and what we see today probably represents the remnants of a wider distribution in former times.

The distribution of this loom defines my Central group of Tai weaving traditions. This corresponds roughly, but not exactly, with the Central Group of Tai speakers.

Variants of this loom are also used by Sinitic (Tujia) weavers and by Han weavers in rural areas, mainly in central and southern China. It seems to be related to a loom

[6] James Chamberlain has pointed out that the Nung are in fact a heterogenous group. The Western Nung, who refer to themselves as the Nung Cheuang, arrived after the Nong Zhigao rebellion and differ from other Nung in the border region. At present there is not enough detailed information on Nung loom styles to attempt a comparison with their known history and linguistic subgroups: this would make an interesting topic for future study.

that was also in common use in a domestic context in the Han dynasty, based on tomb engravings (Boudot and Buckley 2015), and has a history of at least 2000 years.

In addition to these types, an unusual half-frame loom is used by Buyi weavers in the Libo area in Guizhou. This is a loom with a cantilever frame, with a pair of linked, clasped heddles (Figure 9). It seems to be a forerunner of full-frame looms with the same basic shape and shed opening arrangement, which are now widespread in China. Based on similarities in textiles, this loom may have been used by other Buyi groups in the same region, to the south of Qiannan.

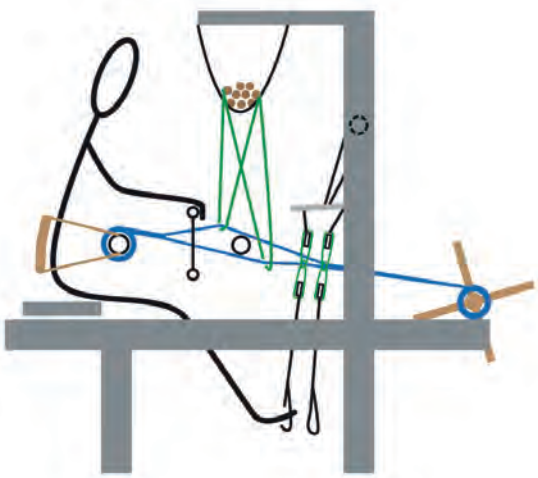


Figure 9. Schematic drawing of half-frame loom used by Buyi weavers in the Libo area, Guizhou province.

3. Full-frame looms

These looms have both cloth beam and warp beam fixed into the frame (in other words, they are not body-tensioned). The development of this type of loom seems to have been linked to the development of paired clasped heddles,[7] linked to treadles (the complete assembly being called a 'shaft'), for opening plain tabby weave sheds (Figures 3 and 9). The shed opening arrangements used for most body-tensioned looms rely on the weaver being able to adjust the tension in the warp with her own body to facilitate switching between sheds. Paired clasped heddles eliminate this requirement, by allowing the weaver to pull a warp both up and down with a single heddle. These heddles are usually, but not always, found as a linked pair, pulling in opposite directions. This invention proved so successful that it is now the basic shed opening device on most frame looms used worldwide. Because it is so widespread, its origin is difficult to pinpoint, although East Asia seems to have been important in its development, indicated

[7] In previous publications, I have called this a 'bidirectional' heddle. I am using the term 'clasped' heddle here, based on input from practising weavers.

by the number of rare variants that are found in the region, of which the Buyi loom mentioned above is one example.

There are two kinds of full-frame looms used by Tai weavers:

4. Cantilever loom

In China and north-eastern Vietnam, the characteristic loom (Figure 10) uses a cantilever to support the heddles (and, in many cases, the reed too). This loom is used by most Tai-Kadai groups in China, Tay north-eastern Vietnam as well as some Hmong-Mien and Sinitic weavers. It seems to be in the process of gradually replacing older, half-frame designs.

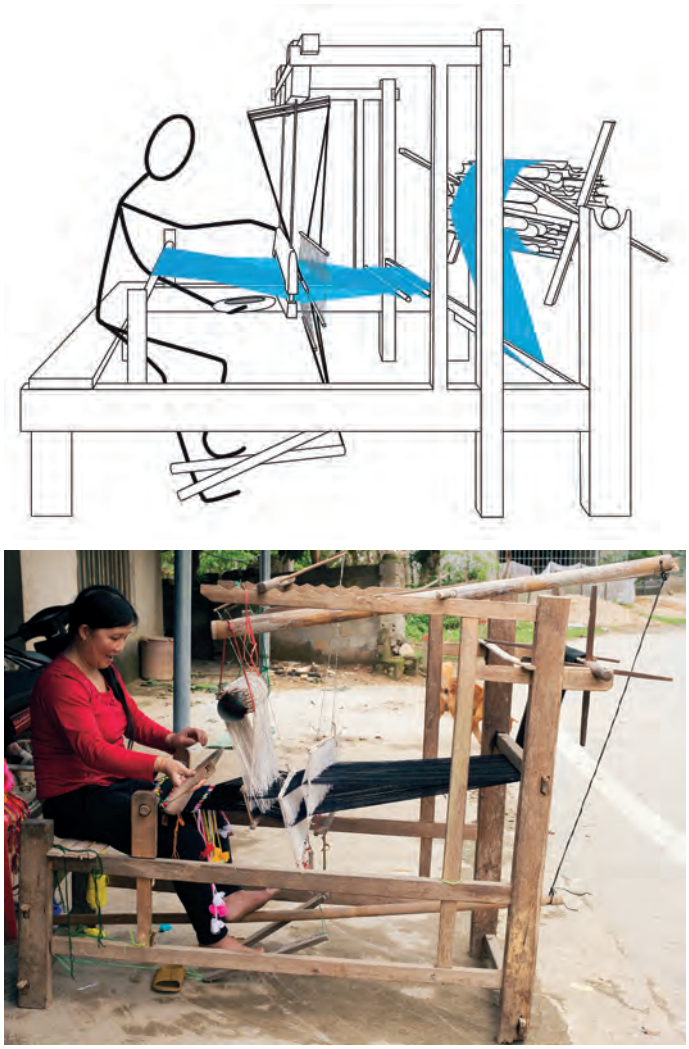


Figure 10. Full-frame, cantilever looms used by Buyi weavers in the Wangmo area of Guizhou province (above) and Tay weavers in central northern Vietnam (below). The Tay loom also has a drawloom pattern heddle attached to a long rocker.

5. Cuboidal frame loom

In the west (north-western Vietnam, Laos, Thailand, Myanmar), a cuboidal frame loom (Figure 11), with the end of the warp held tied in a loose knot to a beam over the weaver's head, is used by Tai weavers across a broad region. This loom seems to be a distinctively Tai technology, rarely used by other ethnicities, and was probably developed by the Tai themselves. To the south, Khmer and Malay weavers use a loom with a similar overall shape (that they may have acquired from the Tai), but with a different warp fixing arrangement.

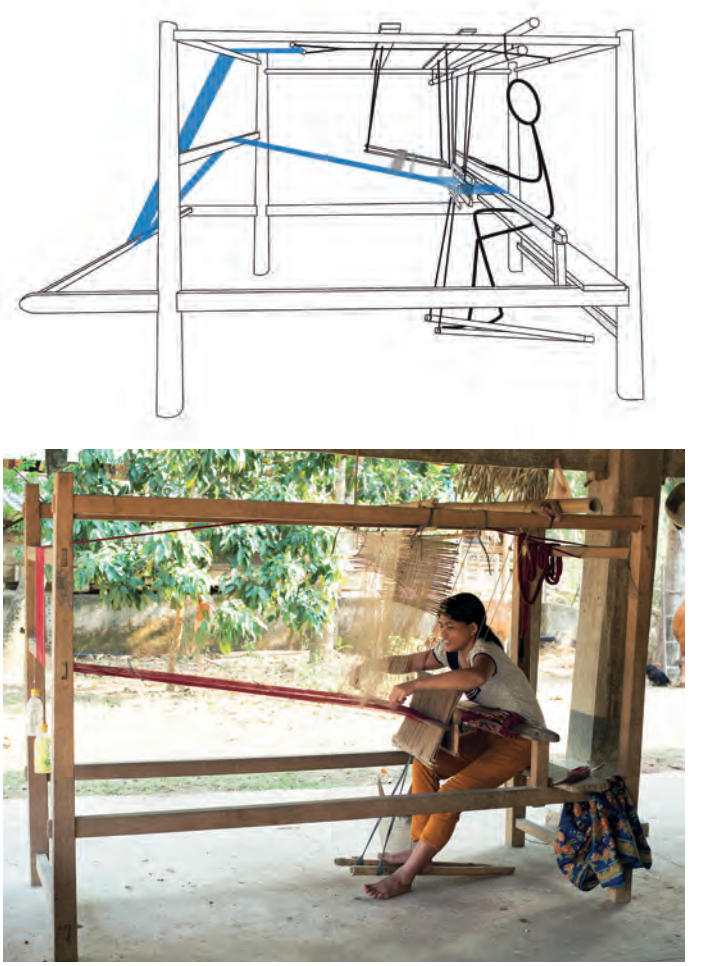


Figure 11. Full-frame loom, cuboidal type. Above: drawing of a loom used by a Tai Lao weaver in Vientiane, set up to weave a supplementary weft skirt hem, using a series of individual pattern heddles suspended above the warp. Below: a weaver in the Quan Son district of northern Vietnam, using a similar loom with a V-shaped pattern system.

The distribution of the cuboidal frame loom defines a Western group of Tai looms and weaving traditions. In most areas this group of weaving traditions corresponds with speakers of South-western Tai languages, although as mentioned it excludes some Tai in Yunnan, who use the older half-frame loom. The sharp dividing line between cuboidal and cantilever types, which mirrors linguistic divisions, is intriguing.

In addition to these five widespread types, there are two more rare types of full-frame loom (Figure 12). One is a loom of unique design used by a few Kam-speaking weavers in Guizhou, in the Zhaoxing area. Despite their language affiliations, these weavers regard themselves as Miao and are officially classified within China as Miao (Hmong-Mien). Their loom seems to be related to an ancient type that appears in Han dynasty tomb engravings, but is otherwise unknown today. The other is a loom that is apparently used by both Tai and Muong weavers in the Mai Chau district of Vietnam, near the border with Laos, for weaving narrow warp-patterned bands. There are several versions of this loom, most of which have a cuboidal frame, with a single heddle attached to a treadle, for opening the counter-shed, and a shed stick retaining the natural shed.[8] The loom is otherwise similar to cuboidal frame looms used elsewhere in the Western region.

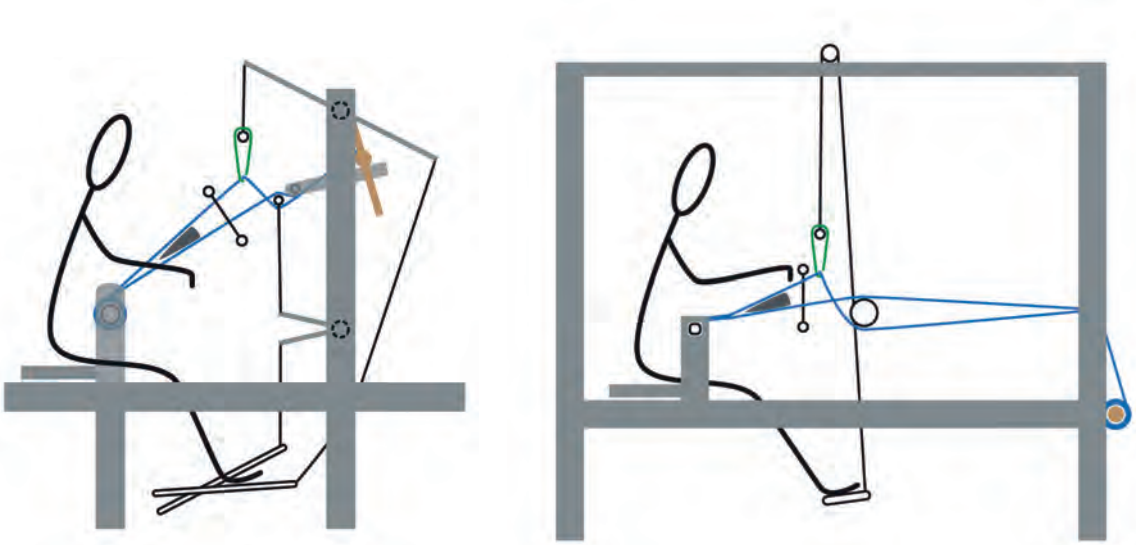


Figure 12. Rare types of full-frame loom used by Tai-Kadai weavers. Left: loom used by 'Miao' weavers speaking a Kam dialect in the Zhaoxing area of Guizhou province. Right: loom used by Tai weavers in the Mai Chau region of northern Vietnam, for weaving warp-patterned skirt waistbands.

Although the precise chronology of these looms is not known, there are clear patterns in their development, which seem to have proceeded down a number of branching pathways. This is apparent "by inspection", and has also been demonstrated by a phylogenetic analysis and comparison with the archaeological record (Boudot and Buckley 2015; Buckley and Boudot 2017). The frameless looms are the earliest type. The half-frame looms represent a later line of development, probably beginning around 3000 years before present (given that they appear in well-developed form during the Eastern Zhou period). The full-frame versions probably made their appearance sometime before the Han dynasty, more than 2000 years ago.[9] Importantly, more sophisticated forms

[8] Some versions of this loom have a single clasped heddle attached to a treadle, instead of a shed stick in the warp.

[9] A full frame loom of relatively advanced design was recently discovered in a Han dynasty tomb at Tumen, near Chengdu, providing evidence that looms of this type were already a mature

have only partially replaced earlier types, and all of these forms continue to be used to the present day.

Patterning systems

Patterned textiles can be made on a loom by raising groups of warps to make a more complex interlace. If the warps are of contrasting colours this is called 'warp patterning', if the wefts are of varied colours the result is called 'weft patterning', but in each case the basic task (raising warps and inserting wefts) is the same. This can be done by selecting warps by hand, using a pointed stick or a hook, and this is often the way patterning is added, but if the same sets of warps are to be raised repeatedly, weavers use a variety of labour-saving inventions to 'record' the warp lifts and reduce the effort involved, as well as the possibility of mistakes. Some of these inventions, particularly the most complex, are uniquely associated with Tai weaving, and with particular regions and sub-groups of Tai. In order of increasing complexity, the pattern-saving methods that are used by Tai weavers are:

1. Sticks inserted in the warp

A single stick inserted into the warp can isolate a group of warps, and the weaver can bring it into play by pulling the stick upwards and inserting a sword or flat stick to widen the shed. A group of such sticks can record an entire pattern. The usefulness of this method is limited, however, by the need to remove each stick completely before the next stick in sequence can be used, so that the saved information can only be used one time. Nevertheless, this method is commonly used to make mirror-symmetrical patterns: the first half of the pattern is picked out by hand, and a stick inserted behind the working area for each warp lift; the sticks can then be used and removed in the reverse sequence to make the second half of the design. This method is widely used in the Western region, but is not used (as far as I am aware) in the Northern or Central regions.

2. Simple pattern heddles

A group of heddles[10] (consisting of leashes gathered in a bunch or supported on a rod, also called a 'harness') can be used to record the warp lifts for a pattern. Such heddles are usually kept in a group behind the ground weave heddle and shed stick, and are selected and pulled up by hand when the weaver needs them. They can be used as many times as they are needed, and in any order. This system is used by the Li of Hainan, Zhuang in the Jingxi area of southern Guangxi (though it is uncommon in the rest of the Northern region), and Tai Daeng and other Tai groups near the Lao-Vietnam border, where they are used for making skirt borders decorated with supplementary weft. They are also used in for making warp patterned bands. There are limits to the number of individual heddles that can be employed, however, because of the space they

technology by the Han period.

[10] I use the term 'leash' to denote a single cord attached to a warp, and 'heddle' to denote a group of leashes that are lifted together, usually attached to a rod.

take up on the loom and difficulties with handling a large set. Groups of 10-30 pattern heddles are common, but it is rare to find more than this.

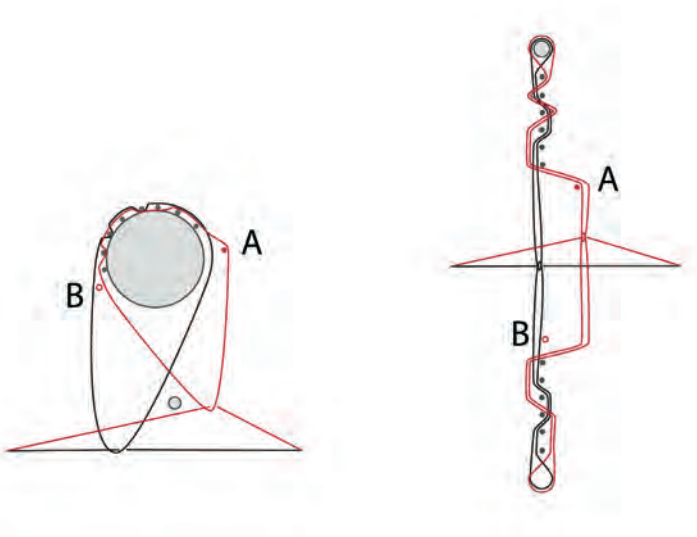


Figure 13. Drawloom pattern heddles (pattern harnesses) used by Maonan and Zhuang weavers (C2 type, left) and by Tai weavers in Laos and northern Thailand (VB type, right). These systems consist of tens or hundreds of pattern sticks controlling heddle cords. In these diagrams one active cord (red) and one passive cord (black) is shown. In each case, a pattern stick is pulled forward in sequence to position A, pulling the 'active' heddle cords forward with it, raising the corresponding warp (also shown in red). With the shed still open, the pattern stick is removed from A and replaced at B, pattern weft(s) are inserted in the warp opening, then the next stick in sequence is employed similarly.

3. Complex pattern heddles (huaben or drawloom systems)

In these systems, instead of recording warp lifts with multiple heddles, the lifts are recorded on sticks (or cords) embedded in a single, complex heddle, also called a 'pattern harness' (Figure 13). This is similar to the terms used by most Tai weavers for these systems, which translate as 'pattern heddle' or 'flower heddle', the qualifier 'pattern/flower' being used to distinguish them from the ordinary type of heddle (usually called *khaw* or a variation on this term) used for the ground-weave. The weaver uses each pattern stick in turn, pulling it towards herself to separate a group of 'active' leashes that will raise a group of warps. She inserts a flat blade (resembling the 'sword' used on simpler looms) into the warp opening and twists it through ninety degrees to make a wider shed (Figure 14). With the shed still open, she removes the stick that she has pulled forward and replaces it in a complimentary opening that is created in the heddle by the action of pulling the active group forward. This preserves the pattern so that it can be used as many times as she needs.

A loom with multiple sticks or cords that encode warp-lifts, located in single pattern harness, is called a 'drawloom'.[11] This term is usually applied only to very large and complex looms, but for consistency it should be applied to any loom that uses this system. These pattern harnesses are a permanent record of the design that they encode, and they can be stored separately and mounted on a loom when needed, and swapped between

[11] The term 'drawloom' is used inconsistently in weaving literature. Some writers use this term to mean any large and complicated-looking loom, including looms with patterns recorded on multiple shafts (heddles). Such looms are not drawlooms, according to my definition.

Figure 14. Weaver in the Ky Son area, northern Vietnam, using a VB type drawloom heddle to make a skirt cloth patterned with supplementary weft designs.

looms. I call these systems 'drawlooms', a usage that is unfamiliar in the context of rural Tai looms, in order to highlight the fundamental similarity between these looms and more complex commercial drawloom looms. In contrast to multi-harness systems, the number of warp lifts (sticks) that can be inserted in a single complex pattern harness is virtually unlimited. Weavers in domestic settings use patterns with a dozen up to a few hundred sticks, but commercial workshops may employ thousands of sticks or cords.

Types of drawloom pattern heddles

There are several distinct types of drawloom pattern heddle used by Tai weavers (Figure 15). A type used by Buyi, Maonan, Kam and Zhuang weavers in China (Figure 7) and some Tay weavers in north-eastern Vietnam has circular (strictly speaking, cylindrical) form, in which all the pattern sticks are arranged in continuous circular cords that sit above the warp. As each stick is pulled forward by the weaver to create an opening in the warp at the front of the loom, a corresponding opening (counter-shed) is created at the back of the loom, into which the stick is reinserted after use. The

heddle is then rotated and the next pattern stick in sequence is pulled forward. This type of pattern heddle can be rotated continuously in one direction to make a repeating design. In practice, however, only Maonan (and presumably Mulam weavers, based on the similarity of their textiles) use the pattern heddle this way. Other groups reverse the direction of the heddle after using the full set of sticks, producing a design with an axis of reflection symmetry along the weft direction.

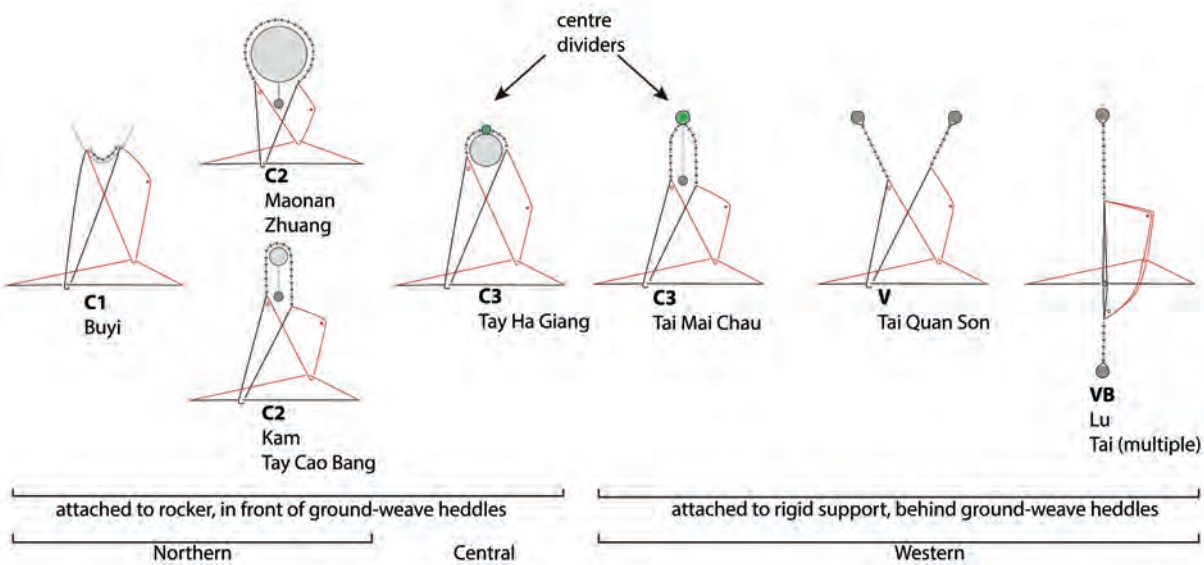


Figure 15. Classification of drawloom pattern heddles used by Tai weavers. In these diagrams the cloth beam and weaver (not shown) are situated on the right hand side.

In the simplest type of pattern harness, used by Buyi people, the pattern sticks are supported in a loose bunch by a couple of cords (C1 system).[12] In more sophisticated designs the pattern sticks are held in a loop around a cylinder (C2 system, used by Maonan, Kam, southern Zhuang, north-eastern Tay). In most of the C2 systems, the pattern harness is attached to a long rocker, worked by a cord loop around the weaver's foot. This makes it easier to manipulate, since the weaver can alter the tension in the heddle cords to facilitate opening and closing pattern sheds.

As noted, Zhuang weavers in the Longzhou area near to the Guangxi-Vietnam border also use this system on a short-rocker heddle loom, with the pattern heddle suspended from a roof beam or other ad-hoc arrangement (no rocker or treadle linkage).

A modified version of this system (C3) is used by Tay weavers in north-central Vietnam (Figure 10), and by Tai weavers in the Mai Chau (Figure 16, also described by McClintock 2013) and western Nghe An province in Vietnam. This system resembles C2, except that the heddle has a central rod at the top and cannot rotate, obliging the weaver to employ it in 'reversing' fashion.

All of the patterning systems described so far, up to and including the Tay systems,

[12] I introduce the terms C1, C2, etc. for convenience in distinguishing these patterning systems.

Figure 16. Weaver in the Mai Chau area, using a modified circular drawloom heddle (C3 type). Instead of using the warp lifts from the heddle directly, Mai Chau weavers use them to insert a set of pattern sticks in the warp (visible below the heddle system). The weaver then sits back down by the cloth beam and uses the sticks in the warp to insert wefts, removing each stick as she does so.

are located in front of the ground-weave shafts, close to the weaver. The Mai Chau version, which has been adapted to a full-frame loom of cuboidal shape is different in that the heddle is fixed to an immobile bar at the back of a cuboidal frame loom (rather than on a long rocker, which would be difficult to operate in a loom with this type of frame). Instead of using the warp lifts directly, the weaver leaves her seat and uses the pattern system to add sticks to the warp, marking the pattern sheds. She then returns to her seat and uses the pattern sticks in the warp to weave one half of the design, repeating the process in reverse for the second (symmetrical) half. This rather cumbersome procedure highlights the challenges weavers seem to have faced in adapting a circular pattern system developed on a half-frame loom to a cuboidal, full-frame loom.

Figure 17 V-shaped patterning system, in-use on a loom near Quan Son, north Vietnam

V-shaped patterning system

A further interesting and significant form (V) is used by a small number of Tai weavers in the Quan Son area, near the border with Laos (Figures 11, 15 and 17). This system, which has not previously been published as far as I am aware, has pattern sticks held in cords that form a 'V' shape above the warp. The pattern heddle is located behind the ground-weave shafts (i.e. furthest from the weaver), like the Mai Chau system. The weaver uses all the sticks from one side of the V, removing them and replacing them in the other side of the V as she does so, then reversing direction when she has used the full set. With the patterning heddle divided into two halves in this way, it is a relatively short step from this system to the VB form, described next.

Figure 18. Tai Dam weaver, Dien Bien Phu district, northern Vietam, displaying a cotton quilt with a cover made of two panels of continuous supplementary weft.

The VB patterning system

The best-known Tai patterning system, reproduced in many publications on weaving and used by Tai in the Lao-Vietnam border region, as well as by Lao-Tai, Lu, Phu Tai weavers, and commercial workshops in Vientiane, Luang Prabang (Laos) and Surin (Thailand), is the 'Venetian Blind' (VB) system (Figure 14). In a VB system, there are two heddle loops for each warp, one above the warp and one below the warp. They are linked together at the warp, each warp passing through the 'eye' where the two halves are joined (in other words, this is a type of 'clasped' heddle). To use this system, the weaver pulls a stick or cord forward, opening a pattern shed. After using the opened shed she removes the stick and replaces it in the corresponding heddle cord on the other side of the warp, reversing this process when she has used all the sticks. In most cases, the VB system occurs on looms equipped with a pair of clasped groundweave heddles. The VB system uses the same warp-attachment arrangement as the ground-weave heddles, which is surely not coincidental.

Figure 19. Bedcover made by a Maonan weaver in Guangxi province. Silk supplementary weft on a cotton warp and weft ground.

In all of the looms with VB pattern heddles discussed so far, the pattern system is fixed to the loom frame, and is located *behind* the ground-weave heddles (i.e. nearer to the warp beam), as with the V system and the C3 system of the Mai Chau loom. The exception to this is an isolated group of Tai weavers in the Dehong area of Yunnan, who use the VB system on a half-frame loom, attached to a long rocker and treadle and located *in front* of the ground-weave shafts. In all other respects, the Dehong loom resembles half-frame looms with circular patterning systems used by Tai groups in south-western China, rather than full-frame looms used by Western Tai weavers. It seems likely that Dehong weavers acquired their patterning system from weavers to the south, in Xishuangbanna, applying it to their existing loom.

The patterning systems that I have described are uniquely associated with Tai weavers, being found in no other looms, except for the looms of the Muong people and Chinese drawloom. Muong weavers, living in the foothills of the Red River Delta in northern Vietnam, speak an Austroasiatic language related to Vietic. The Muong loom is a full-frame type with a distinctive design that seems to be unique to this group.

Figure 20. Bedcover made of two panels of cotton supplementary weft decoration on cotton ground. Dehong area, northern Yunnan province.

However, both the patterning system (C3 type), used by Muong weavers, and their textiles and clothing styles are strikingly similar to neighbouring Tai groups, and it is very likely that the Muong acquired the patterning system from Tai weavers at some point in the past, transferring it to their own loom.

Regarding the time-depth of these patterning systems, the first textual reference is found in the writings of Yang Quan, who lived in Zhaoxing (present-day Zhejiang province, China). Writing in around 280 CE, he described a weaver who 'activated treadles with her feet, while her hands operated a basket-cage'.[13] This is a fair description of the versions of this loom used by Zhuang and Maonan weavers, which use a large, cylindrical bamboo cage to hold the heddle cords and pattern sticks.

Patterning systems, such as the ones described, are usually associated with the weaving of complex supplementary weft designs, although they can be used equally

[13] 杨泉: "足闲踏蹑，手习槛筐" Quoted in 蜀锦（黄能馥) 2006: 21. (My thanks to Eric Boudot for pointing out this reference to me.)

Figure 21. Bedcover made by a Kam weaver in the Tongdao area of Hunan province. Three panels of indigo cotton supplementary weft on a cotton ground.

well for warp patterning: for example, one such system is used by Tai and Muong weavers in the Hoa Binh region for making warp-patterned waistbands for tubeskirts. Many (but not all) Tai groups use these systems for making long cloths with repeating designs in supplementary weft in cotton or silk on a cotton ground, typically used for bedcoverings (Figure 18). These are arguably the most characteristic of all Tai textiles and the form that unites the largest number of Tai weaving groups. In most cases, the designs are limited in number and rather conservative, which seems to be linked to the use of patterning systems that may be saved for generations, and which weavers are reluctant to modify. For example, nearly all Maonan bedcovers, woven in silk supplementary weft on a cotton ground, are variations on a single basic type, consisting of motifs of animals and birds on a geometric field (Figure 19). Zhuang bedcovers are similarly conservative in design. Various Tai groups living along the northern Lao-Vietnam border also make remarkably similar bedcoverings. The most extreme example of conservatism is, perhaps, the bedcovers made in the Dehong area (Figure 20), with a handful of designs, most of which are minor variations on a basic design

of stylised birds and geometric figures. These designs may be very ancient, although exactly how old is difficult to determine. Kam (Dong) weavers in the Tongdao area of Hunan province make bedcovers that are strikingly similar to Tai examples, despite their lengthy separation in time and distance (Figure 21).

Patterning systems are not universally used by Tai weavers, however: they are uncommon amongst the Shan in Myanmar, and Thai speakers in central and southern Thailand (apart from recently arrived immigrant groups and commercial workshops, as mentioned). Tai Yuan weavers, for example, produce intricate hems (*tin chok*) for their characteristic tubeskirts by picking warps by hand. Generally, loom technology is less sophisticated in southern Thailand and Myanmar, with fewer loom-based patterning techniques and more reliance on embroidery, appliqué and on cloths purchased from northern Thai and Khmer weavers, and from workshops further afield in India (Conway 1992, 2002). The reasons for these differences versus other Tai groups are unclear, though they may be related to recent migration and consequent cultural upheaval that these groups experienced, and the influence of Indian cultural prototypes on early kingdoms in the Southern region.

The development and spread of complex patterning systems

The geographical distribution of patterning systems, from Circular in south-western China, through modified Circular and V forms to the Venetian Blind version, appears to recapitulate their sequence of development (Figures 15 and 22). The simplest surviving form is the 'loose bunch' (C1) form found on the Buyi loom. The addition of a central cylinder (C2), such as the large basket found on Maonan and Zhuang looms, allows a larger number of sticks to be held and organised. As they moved westwards, taking their patterning systems with them, weavers figured out how to divide the system into two parts and then to modify it for use on full-frame looms without a rocker heddle (C3 and V forms). The VB form was, presumably, the last to be invented and originated on a full-frame loom with paired ground-weave heddles, since it depends on the crucial insight that two heddles, above and below the warp, can be linked together with the warp passing through the 'eye' of the linkage ('clasped heddle').

The diversity of patterning systems at the Lao-Vietnam border, with three different forms (C3, V and VB) and several loom frame designs being found in a relatively compact region between Mai Chau and Quan Son, together with the fact that weavers in some villages in this region are able to use the V and VB forms interchangeably, suggests that key developments in the history of looms and patterning systems took place in this region, or nearby. It is also clear from reviewing the sequence of complex patterning systems that they have been transferred from one type of loom to another, from half-frame long rocker heddle looms to short rocker heddle looms and then to full-frame looms (both cantilever and cuboidal varieties) and that they have their own lines of development that are separate from that of looms. As Tai-Kadai weavers migrated from the region that is now China, through northern Vietnam into Laos and beyond, they left a 'trail' of patterning systems along the route that they (presumably) took (Figure 22). We can be sure that weavers along this track did not invent these

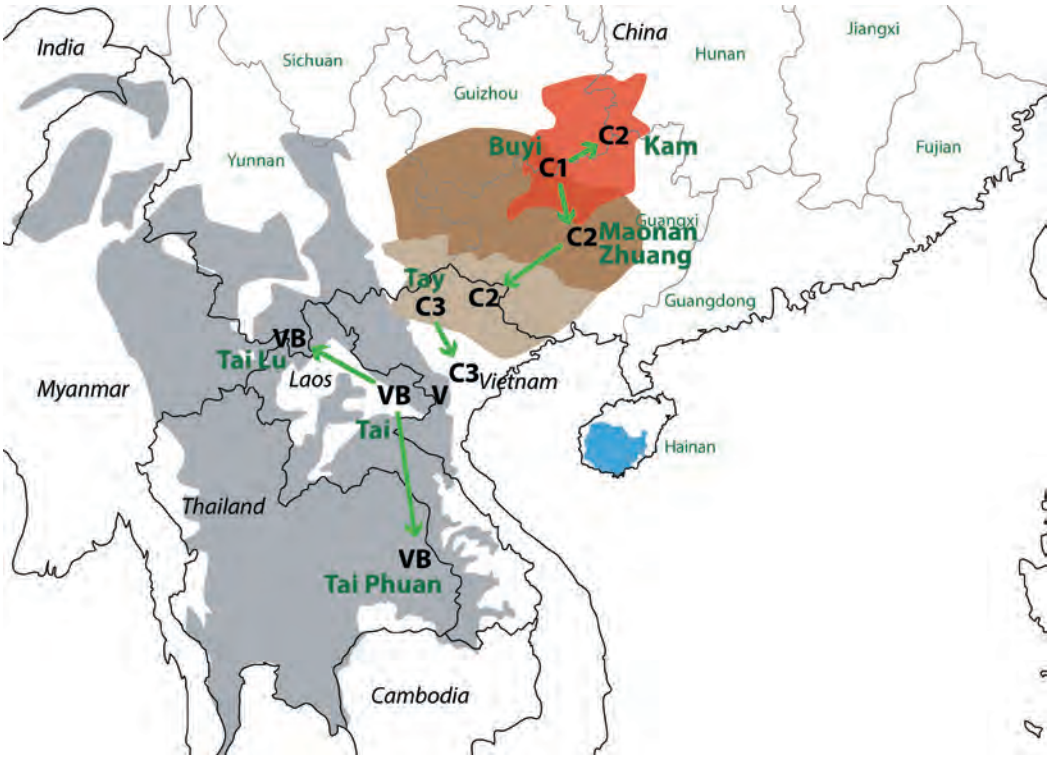


Figure 22. Southerly Tai migration routes, inferred from the development and distribution of patterning systems

systems independently, because of their extraordinary complexity, to the extent that it is difficult for a casual observer to trace the various cords and interconnections and to comprehend how these systems work. As I discuss below, silk drawloom systems used in commercial workshops in East Asia, far from being invented independently, seem to owe their existence to Tai prototypes.

Looms, patterning systems and migration

Weavers, who use complex pattern heddles, often possess several sets of patterns, which can be rolled up and stored when not in use, and passed from mother to daughter and transferred between looms. The maker of a patterning system is an experienced weaver (it is not a skill possessed by all). In contrast, when making a new frame loom the services of a carpenter are needed. The carpenter must have an existing loom to copy, since he is almost certainly not a weaver and probably knows little or nothing about the subject (Boudot and Buckley 2015). This aspect, together with consideration of the distributions of looms and pattern systems of the Tai-Kadai described, leads to some useful generalisations:

- Looms and complex pattern systems are passed intergenerationally, within cultural groups. Weavers are reluctant to modify them, and consequently changes occur slowly.

- Pattern systems are made by weavers, and are portable. Complex frame looms are made by carpenters, and are less easy to transport.
- Migration that is rapid, or over a long distance, tends to lead to loss or simplification of looms and techniques.

These principles account for why Tai-Kadai groups in the east, such as the Kam, Maonan and Zhuang, preserve half-frame looms representing very ancient types: these groups have not moved far since they acquired or developed these looms and have consequently never lost them. Dai/Tai in Yunnan, who have presumably migrated westwards from Guizhou/Guangxi, also use half-frame looms, but with some losses of patterning systems, and simplification of the loom frame, probably triggered by their migrations. Other groups, such as the Tay in northern Vietnam and all of the Western Tai weaving groups, who presumably moved to their present locations relatively recently, use full-frame looms, though preserving portable patterning systems that may be much older. In the west, nearly all Tai weavers use the same basic cuboidal frame loom, which is not closely related to looms in the east. They brought their patterning systems with them as they migrated, but as they settled in new areas they tended to adopt the looms of their neighbours and previous migrants, transferring their patterning systems to the new loom and modifying them as needed. Since looms are difficult to transport, when weavers migrate they tend to lose their older designs, and adopt the looms of neighbouring groups and other recent migrants.[14] This leads to more uniformity of loom design in areas that have seen migration recently, such as the Western group of Tai weaving traditions (corresponding mainly, but not precisely, to speakers of South-western Tai languages).

These principles can also be seen at work in the distribution of looms in the Asian region generally. Simple, portable types (such as the Austronesian body-tensioned loom with an externally braced warp beam) travelled very long distances. Half-frame looms also travelled widely in the Asian mainland, but arrived in some of the more remote regions in simplified form. Large and complex looms (such as the Chinese drawloom, discussed in the next section) tend to have specific, localised distributions.

The influence of Tai patterning technology on the Chinese drawloom

Aside from the looms already mentioned, the other loom in the East Asia region that uses a pattern heddle, consisting of cords embedded in heddle loops to record warp lifts, is the Chinese drawloom (Figure 23), famed for the production of patterned, luxurious silks for the imperial court. At the heart of the system is the same device as the circular pattern heddle (C2 type) of the Tai, although the Chinese drawloom incorporates an extra loop between the pattern system and the warps (Figure 24). This allows each lift to be (optionally) transmitted to several warps, which reduces the effort required to make pattern repeats across the weft direction. By raising the patterning system some distance

[14] Boudot and Buckley (2015), researching in south-west China, found that in cases where the loom has been lost, the ability to weave is also lost, and is not regained without outside help. Such is the complexity of most full-frame looms that they cannot be recalled from memory alone with sufficient detail to instruct a carpenter to make a new one.

Figure 23. Working drawloom at the Suzhou Silk Museum, China. The weaver (at left) inserts the weft and works a set of treadles (shafts) that produce groundweave and satin effects. The drawperson (at top right) manipulates the pattern harness, which consists of pattern cords embedded in loops that connect with leashes. The lifts are transmitted to the warp via the set of vertical leashes below the drawperson. In some loom setups one pattern loop may connect with several leashes, making pattern repeats along the weft direction.

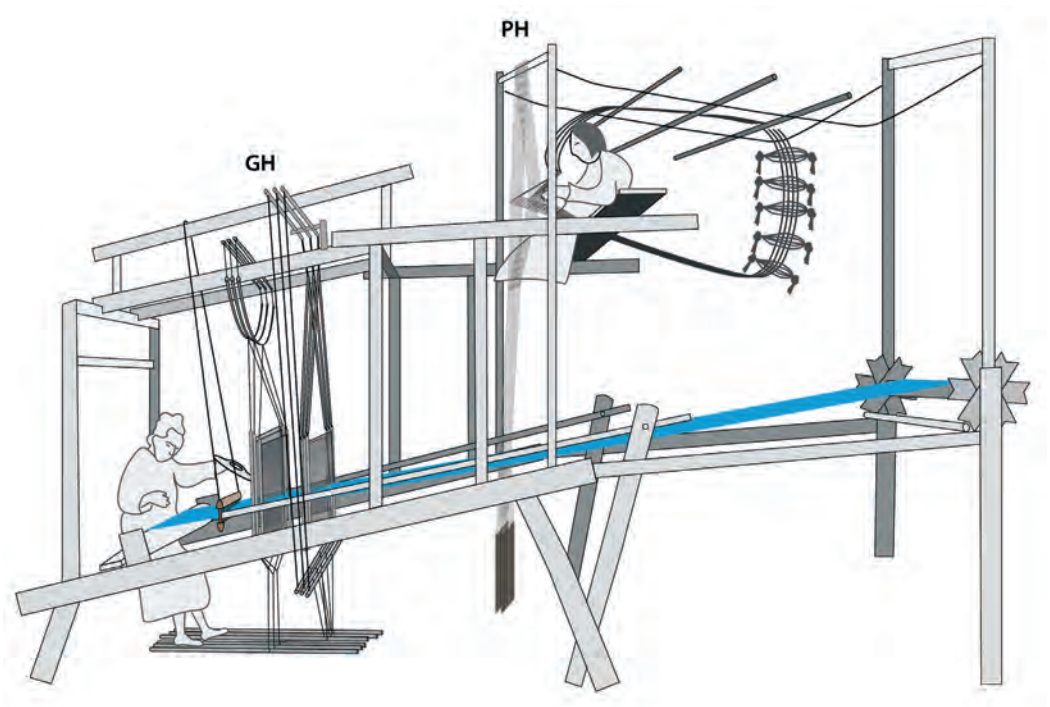


Figure 24. Schematic drawing of the drawloom in Figure 23, showing the interconnections of the groundweave heddles (GH) and the drawloom pattern system (PH).

above the warp, it also allows more pattern cords to be incorporated, allowing larger designs to be made.

There are no pattern harness (drawloom) systems comparable to Tai systems amongst rural Han Chinese looms, and, in fact, supplementary weft patterning of any kind is rare or absent. Most rural Han weavers make plain tabby, stripes and checks, and some warp patterned bands. Given the lack of Han antecedents for either weft patterning or drawloom patterning systems, compared with numerous Tai versions, it is likely that these systems were first acquired by the Han from Tai weavers.

The importance of drawloom systems in the global history of weaving, and of technology in general, is hard to overestimate. They are the first 'programmable' devices, in which a coded set of instructions can be mounted on a mechanical device, executed, and swapped for another set at will. A version of the Chinese drawloom had arrived in Italian weaving workshops by the 15th or the 16th century, with a patterning system that is basically identical to that of the Chinese loom called the Lesser Drawloom.[15] The basic concept of recording a pattern as an endless loop of instructions inspired the Jacquard loom, which was re-exported to China and India at the end of the 19th century. Chinese weavers were quick to understand and adopt the Jacquard version, unsurprisingly, since the loom was substantially the same as their existing looms. More generally, devices which can execute looped instructions sets are now universal in the modern world: in conceptual terms, all of these devices probably owe a debt to a patterning system developed by Tai weavers in southern China around 2000 years ago.

Weaving technology and Tai migration history

The present-day distribution of weaving technologies records, amongst other things, aspects of their history of differentiation and migration. The Li in Hainan, who are isolated to some degree by their island location, retain the simplest and oldest type of loom. The Li appear to have been genetically distinct from their mainland cousins for at least 20,000 years (Li et al. 2008). This does not rule out influences from the mainland, but it does suggest a degree of continuity over a long period. The simple loom used by the Li is absent amongst Tai-Kadai groups on the mainland, so no clear link can be discerned between the Li and mainland groups based on weaving technology alone. Another notable absence from the entire inventory of Tai-Kadai looms is the simple ground-level loom with a warp beam fixed to an external point, the type that is used by Malayo-Polynesian speakers in East Nusa Tenggara, as well as by Tibeto-Burman speakers in upland regions of Southeast Asia and the Himalayan foothills. It seems unlikely that this loom was ever used by the Tai-Kadai, a fact that casts doubt on the linkage between Tai-Kadai and Austronesian proposed by some linguists.

The Tai and Kam-Sui of the Northern and Central regions on the mainland have the greatest variety of loom types today, with half-frame types (of at least three different kinds) used alongside more recently developed full-frame looms, many with complex

[15] Several drawloom designs, such as the jala and adai systems, are also used by weavers in India; however, the interconnections of the patterning systems are different to the Chinese drawloom.

Figure 25. Bedcover made by ‘Zhuang’ weaver in the Napo area, Guangxi province. Hemp and natural dyes.

patterning devices. Amongst the Tai in the Western region, a single type of full-frame loom (the cuboidal frame loom with a pair of clasped heddles) is the dominant form across a wide area, consistent with these groups having migrated to their present positions more recently than groups living in the east.

The picture of the emergence and differentiation of the Tai that emerges from the distribution of weaving technologies is similar to that which can be deduced from the patterns of language distribution, although there are some differences. At the earliest time (before 1000 BCE), the simple, foot-braced loom was probably widespread in southern China, including most of the mainland coastal region. Despite the uniformity in weaving technology, cultural diversity in this region was probably at least as great as it is today. After 1000 BCE, more complex looms were developed by mainland groups, while the Li retained their older form.

Most models of Tai development are based around the idea that there once existed a 'proto-Tai-Kadai' people with shared language and material culture, encompassing both the mainland and Hainan. Given the isolated situation of Hainan, the genetic data indicating continuous occupation for a long period, and the lack of clear connections in weaving technologies, it seems doubtful to me that such a culture existed. It is more likely that what we now recognise as 'Tai' culture is a phenomenon with origins on the mainland, which began amongst the patchwork of groups in Southern China who shared some trading links and tastes in material goods, including fine woven textiles. The introduction of wet-rice agriculture brought together some of these groups in the labour-intensive activity of farming irrigated paddy, and the success of this enterprise and the surplus that it produced (signalled in part by the wearing and display of complex textiles) attracted more participants. Frame looms and patterning systems ensured that these important textiles could be made consistently and reproducibly. In contrast, the weaving practices of more remote and resource-poor groups (such as Tibeto-Burman and Austroasiatic speakers in upland areas, as well as the Li on Hainan) retained older and less resource-intensive technologies. Despite the lack of obvious connections in loom designs between the mainland and Hainan, there are connections between these regions in textile forms and decoration. These are probably the result of exchanges that took place at later time periods.

The ancestors of at least some of the Nung, living on the Guangxi-Vietnam border, seem to have become differentiated and geographically separate from other Tai-Kadai groups at a period before the development of half-frame looms (i.e. before circa 1000 BCE), since they acquired a different loom from their northern neighbours. This distinction extends to textiles: Nung and some 'southern Zhuang' produce very simple, bast-fiber bedcovers (Figure 25) with simple patterning, quite different from those made by other Tai groups. The information available is incomplete, however, and deserves further study. The Tay in northern Vietnam seem to have arrived in their current positions more recently: their looms and patterning techniques suggest links with both the 'Zhuang' of Guangxi and with the Tai of the Western group.

To the north, Buyi weavers (who retain the simplest C1 patterning system) became distinct from the Kam, Maonan and northern Zhuang traditions (using the C2 system). A significant amount of exchange must also have occurred during this period with

Miao-Yao and Sinitic speakers, because of similarities between the half-frame looms used by all these groups today. Complex patterning systems were an exception: these continued to be a distinctively Tai-Kadai feature. The lack of exchange of patterning systems with other cultural groups suggests that this technology was jealously guarded by Tai weavers.

The looms and patterning systems used by Maonan and Zhuang weavers are remarkably similar, despite their languages being placed in different branches by linguists.[16]

Most Tai/Dai groups in Yunnan province are linked by linguists with the South-western Tai language group; however, apart from the Lu in the far south of the province (who use the full-frame cuboidal loom), most Dai use half-frame looms similar to those found further east in Guizhou and Guangxi. This suggests that these weavers and their looms arrived as a result of separate migrations through China that took place before the expansion of the Western group of weaving cultures.

The final stage of Tai expansion was marked by the development and expansion of a new loom (the full-frame cuboidal loom with paired heddles) and new patterning systems (C3, V and VB forms) that were used on this loom. The critical region for these developments was northern Vietnam, subsequently spreading to Laos, southern Yunnan and northern Thailand, and beyond. The North Vietnam/ Lao border region retains an astonishing variety of loom designs, patterning systems and textile forms, evidence of its importance as a formative region for Western Tai weaving culture. The critical formative region probably included much of the Red River delta at one time, and included exchanges with non-Tai groups, such as the ancestors of the Muong, the evidence for this interaction being preserved in the 'Tai-like' weaving traditions and patterning technique of this group. These interactions probably began before 0 CE, as Tai-Kadai groups migrated into northern Vietnam from Guangxi. The significance of this region has also been recognised by linguists (Chamberlain 1972).

One of the most important pieces of evidence in this region is the loom of the Tai in the Mai Chau region. This loom has a mix of features of the Western region including cuboidal form, combined with features that are characteristic of looms from the Northern and Central regions, including a warp beam with four spokes at each end, and a circular patterning system (C3). In some respects, the Mai Chau loom (and several other looms that are used in this region) is a link between Tai weaving traditions in the Western region and older traditions in the Northern and Central areas.

Comparison of looms and languages

As noted, the distribution of loom technologies and languages tell broadly the same story, of origins and differentiation in the east, and migration to the west, though with differences in detail. The differences do not necessarily imply 'conflict' in the data, since we would not expect perfect correlation between languages and weaving (or any

[16] Steven Frost informed me that the Maonan and Zhuang also share other cultural similarities, such as aspects of ritual and pantheon, with Zhuang characters occurring in Maonan ritual manuals, for example.

other pair of cultural traits, for that matter), and such correlations that do exist would be expected to gradually diminish over time.

A full discussion of the similarities and differences with linguistic data is beyond the scope of this article. However I will highlight a few points of interest:

1. The Kam, Maonan and Mulam share similar looms and patterning technologies with the 'Northern Zhuang', suggesting close relationships (or a lengthy period in close proximity) between these groups.
2. The Buyi are often linked with the 'Northern Zhuang' by linguists, but the differences in looms and textile styles between the Northern Zhuang and the Buyi in the Qiannan area (for example) suggests a separate line of cultural development for these groups.
3. In Yunnan, most Tai (Dai) speakers, including the Tai Nua, Tai Ya and Tai Hongjin, are included in the South-western linguistic group. In terms of loom technology however, they retain the half-frame looms that place them with the Northern cultural group. The loom of the Tai Nua in the Dehong area is an oddity: it incorporates the Venetian blind patterning system that is otherwise only found on more advanced looms further south.
4. The looms and weaving techniques of most Tai in Assam (such as the Ahom) are similar to those of Shan weavers in Myanmar, which supports accounts of their history that suggest that they migrated there from Myanmar. The loom of the Tai Phake is an exception, however: this is a body-tensioned, half-frame loom of an older design to other looms found amongst Tai in Assam. This loom is not found amongst Tai in Myanmar, as far as I am aware, although it is used by some Chin weavers in Kachin state. Its presence in Assam suggests that at least some Tai arrived by a different route and at a different time to the Ahom, probably via a more northerly route through Yunnan. It would be interesting to investigate Phake culture to see if there are any other indications of this.
5. Several key inventions that characterise the Western group of Tai weaving cultures (corresponding partly with the South-western Tai linguistic group) seem to have arisen in the region that is now the border between northern Vietnam and northern Laos, that probably also included the Red River delta area. There is evidence for technological innovations in loom frame design and patterning systems, and for interaction with Vietic speaking groups (Muong) in this region.
6. Some Nung/Zhuang in the China-Vietnam border area use a distinctive half-frame loom of an ancient type, which is quite different to the looms used by neighbouring Tai and Tay groups. More study is needed to understand the distribution of this weaving complex and its correlation with the history of the Nung.

Conclusions

Tai-Kadai peoples use a range of weaving tools that is arguably the most complex and varied of any in the Asian region, spanning the range from the simplest type on Hainan to large looms with frames, incorporating drawloom patterning systems that code hundreds of warp lifts. A progression in loom designs (from half-frame to full-frame versions) can be traced from east to west, and a similar, but separate, progression in the development of patterning systems can be seen along a route from south-western China, through North Vietnam, to Laos and Northern Thailand. These routes trace probable migration paths of weavers, who took their looms and patterning systems with them. More extended migrations, to southern Thailand and Myanmar, seem to have resulted in the loss or simplification of some aspects of the complex Tai repertoire, however.

Many Tai-Kadai loom designs are shared with neighbouring groups, but their complex drawloom pattern recording systems are a uniquely 'Tai' feature, which enabled them to reproduce patterned cloths, such as bedcoverings, for generations with little or no alteration. Alongside the pattern systems, these domestic textiles remain the most characteristically 'Tai' textiles, in the sense that they are made by nearly all groups. The Tai seem to have guarded their patterning systems carefully and did not share them with neighbouring Hmong and Tibeto-Burman speaking weavers; however, there is a connection between the system employed in south-west China (C2 heddle) and the Chinese drawloom, which embodies the same principle at its heart.

Northern Vietnam emerges as a critical region in which the technical innovations that characterise 'Tai' weaving (particularly speakers of South-western Tai languages) emerged. This story is a complex one, and involved exchanges with Vietic speakers, evidence of which is preserved in loom designs used in this region.

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