CHAPTER 6

A Survey of Tibetan Paper

History of Paper in Central Asia and Tibet

The historical origins of Tibetan papermaking are difficult to determine. Our knowledge about the invention and transmission of papermaking in Central Asia and Tibet in the first millennium is very selective and fragmentary. Vorobieva-Desiatovskaia dates the beginnings of papermaking in Tibet back to the eighth century,[1] while the *Tang Annals* mention an even earlier date, 648, in the report of the Tibetan emperor Songtsen Gampo's request of paper, ink, and other writing utensils from the Chinese emperor. Yet, until the middle of the eighth century, most Tibetan official documents were written on wood. The entry for the years 744–745 in the *Old Tibetan Annals* records the transfer of official records from wooden 'tallies' (*khram*) to paper.[2] Thus, it appears that by the time writing appeared in Tibet, the technology of papermaking was already known in the Far East and Central Asia.

The invention of paper is traced back to China. The year 105 CE is often cited as the date for the inception of paper technology. According to historical records, the technique of making paper was reported to the Eastern Han Emperor Ho-di by Marquis Cai, an official of the Imperial Court. However, archaeological records contradict this claim, suggesting rather that paper had already been known in China in the second century BCE. Soon after its invention, paper was widely used in China and spread to the rest of world via the Silk Road. In the east, the art of papermaking reached Korea, where paper production began in the fourth century CE. According to traditional accounts, sixty years after Buddhism was introduced in Japan, a Korean monk named Don-cho brought papermaking to Japan, sharing his knowledge at the Imperial Palace in ca. 610 CE. Archaeological records suggest that along the Silk Road, paper was introduced to the Xinjiang area soon after its invention.

Crucial for the later dissemination of papermaking to Tibet, Nepal, Bhutan, Burma and Thailand was the migration of Chinese communities that prepared paper for their own needs. The development of papermaking in these countries was spurred by Buddhist monks who copied vast religious literature. The westward spread of papermaking through Chinese Turkestan along the Silk Road

1 Vorobieva-Desiatovskaia 1988: 334.

2 See: Uebach 2008: 57–69; Dotson 2009: 52–53, 124.

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has been widely investigated, but its migration to the south towards Himalayas including Tibet and Nepal to India remains unrecognized. Although paper had already been widely known by then, most of the Chinese documents discovered in Nia in Kroraine (dating from the third and fourth centuries) are written on wooden tablets and bamboo sticks and silk, which continued to be used alongside paper for a long time. Manuscripts written on paper found at sites in Kaochang, Loulan, Kusha, Kotan, Dunhuang, and Turfan date as early as the third century. The technology eventually reached Tibet most probably around 650 CE and from there spread to India. Thousands of manuscripts written in Tibetan language from before the tenth century have been discovered at Dunhuang in the Gansu province. Most estimates date these manuscripts to the time of Tibetan occupation of Dunhuang that occurred in c. 781–848 CE, but recent research by Géza Uray, Takeuchi, as well as Dalton, Davis, and van Schaik has dated the large portion of these manuscripts to the tenth century.[3]

According to written sources, after 751 CE, paper production spread westward to Arabia via Samarkand. There is a story about Chinese papermakers who were captured by the Arabian army as prisoners of war in the battle of Talas and later settled in Samarkand. The Arabs learned the craft from Chinese prisoners and built the first paper industry in Baghdad in 793 CE Yet this account oversimplifies the matter—in fact, papermaking may have been practiced in Samarkand decades before that battle. Around that time, papermaking spread west of the Pamir, but probably not because of one singular event but rather through a gradual transmission by many routes. The craft continued to spread gradually from Islamic Asia to Europe and, from there, around the world.

By the seventh century, papermaking was already a highly refined art and it may be asserted beyond doubt that paper had always been a material of great value. For example, in Tibet, paper had never been used for mundane purposes such as writing personal notes. Because of its costliness, it was important to find ways to save it. One of the methods of saving paper and ink was using small wooden planks or tablets (varying in size, but usually about 35 × 15 cm) with a hollowed out black-inked writing surface instead of paper as described in chapter 3.

We do not know if these few early dates singled out from written records are truly the turning points of paper history. There exist no written records of papermaking in Central Asia in any of the languages of the region. Yet what we have available are books and documents from that time. This chapter surveys the types of information these sources provide. By expanding the scope of inquiry from the study of their textual content of these documents to an exploration of their material characteristics, we move beyond legends to a

3 See: Uray 1988: 515–528; Takeuchi 2012; Dalton et al. 2007.

more precise understanding of the history of papermaking, its spread, and its defining developments.

As a rural and regional tradition, Tibetan papermaking features abundant local plant and fiber resources. Papermakers developed methods that reflected the unique qualities of their raw materials. As a result, the paper products used as writing supports for Tibetan books over centuries have distinctive properties and features; the place of origin of particular papers used as the support for texts is traceable when compared to the distribution of papermaking plants in the Himalayas and Central Asia.

The demand for paper usually inspired the creation of workshops; training sessions were most likely dispersed as the demand was not limited to one central location. Although the data is scarce, we may surmise that many small paper workshops existed in the Himalayan region, sometimes limited to one family, sometimes involving an entire village, and, in exceptional cases, extend to an entire region; as a result, particular families, villages, or regions became famous for paper production. Every large project, such as editing the Tibetan Buddhist canon stimulated the paper industry. The largest monasteries involved in book editing must have stimulated the growth of local paper manufactures. Unfortunately, there exist very few historical documents that could support this hypothesis about the state of papermaking; moreover, even these few available resources have not been explored with respect to papermaking. Yet, as Holmberg et al. argue, the eighteenth-century villagers of Bomthang, Nepal had an obligation to supply paper to the government administration offices of the Ranas in Kathmandu.[4] The village archive contains information about the regions of raw-material gathering, granted officially every few years depending on harvesting needs. This, as many other papermaking reports, shows that paper could be traded for long distances, but harvested raw material has always been exploited locally. This is why the best way to determine the place of origin of a paper or book is to link it to local plant resources.

This administrative aspect of paper production ought to be studied more closely in Tibet. It must be noted, however, that in today's China, finding Tibetan village archives might be an extremely difficult task. However, despite the fact that during and after the Cultural Revolution papermaking gradually died out, the tradition of making paper by hand is still an important part of Tibetan material culture, and it has recently been revived on the basis of local tradition. In the absence of any systematic study and the fact that such a local papermaking tradition constantly disappears, existence of papermaking

4 Holmberg et al. 1999: 44–45.

workshops in Himalayas in specific regions of Tibet should be documented as soon as possible.

A number of reports on papermaking methods in Tibet and the surrounding regions are available.[5] Perhaps the earliest is the account by the British official Samuel Turner of papermaking in Bhutan in the mid-eighteenth century.[6] The recently reported large centers of papermaking in central Tibet were near Dakpo, bordering on Kongpo, in the district of Nyemo west of Lhasa, and near Gyantse. In Eastern Tibet they were originally in Kham, specifically near Derge (*sde dge*), Pelyül (*dpal yul*) and Garzé (*dkar mdze*), in Pemakö (*pad ma bkod* near present-day Loyül and Metok), in Dagyab near Chamdo, and in the Kongpo region.[7] Such reports are very informative concerning the methods and technology of papermaking, as those have not changed since the beginning of papermaking to such a great degree as, for example, in Europe or in China.

Documentary materials found in remaining archives of Himalayan villages would be an extremely valuable source of knowledge about local paper production—they provide information essential to tracing a past history, clarifying, among other things, the economic factors shaping the production. Nonetheless, even without access to these archives, we can still reach the past through the study of material artefacts such as books and documents written on the paper. Careful attention to paper in microscopic scale reveals the secrets of its production. By characterizing the paper optic and identifying the fiber composition, we may recover the history and geography of papermaking. In the Tibetan culture of papermaking, the variations of production methods, raw materials, and treatment of the paper surface may allow us to recover the time and place of production. The books written in Tibetan language are composed of a variety of materials, not all necessarily from Tibet itself. The results of paper analyses can help us recognize their regional origin, date them or reveal links between groups of objects with the same distinguishable features. However, it is necessary to deepen our current understanding of Tibetan paper technology, going beyond simplistic statements about the origins and category 'Tibetan paper' itself, which is too general to cover the vast territory of the Tibetan cultural realm and the variations in materials and technology available to people within it.

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5 Tschudin 1958; Sandermann 1968; Rischel 1985; McClure 1986; Koretsky 1986; Helman-Ważny 2001.

6 Turner 1800: 99–100; Schaeffer 2009: 8.

7 Weber 2007: 111.

Himalayan Papermaking Plants and the Localization of Tibetan Paper and Book Origins

Tibetans created a unique type of paper but their technology came from the Chinese. The high altitude of the Tibetan Plateau and the extremes of its climate make the vegetation distinctive from all other areas of Asia. In other words, the range of plants available for papermaking in Tibet was significantly different than in other places. As far as the physical conditions are concerned, the world's highest mountain is just one of the Tibetan distinctions. The average altitude is about 3,000 m in the south and 4,500 m in the north. Several major rivers—such as the Yangtze, the Yellow River, the Indus River, the Mekong, the Brahmaputra River, the Ganges, the Salween and the Yarlung Tsangpo River—have their source in the Tibetan Plateau (mostly in present-day Qinghai Province). The climate is severely dry nine months of the year, and average annual snowfall is only 18 inches, due to the rain shadow effect whereby mountain ranges prevent moisture from the ocean from reaching the plateaus. Western passes receive small amounts of fresh snow each year but remain traversable all year round. Low temperatures typical throughout these western regions, poor vegetation beyond the size of low bushes, and wind swishing unchecked across vast expanses of arid plain determine western Tibet. The Indian monsoon affects eastern Tibet; northern Tibet is subject to high temperatures in the summer and intense cold in the winter. All these geographical features have influenced greatly all aspects of people's activity and life, including vegetation and, concomitantly, the production of paper.

The distinctive features of Tibetan papers are their texture, thickness and color, which result from the technology of sheet making and writing surface preparation, and, to no lesser degree, from indigenous Tibetan and Himalayan raw material. The latter factor allows us to distinguish between Tibetan and Chinese types of paper through analyzing paper fibers in ancient books. Since the earliest stages in the development of the craft, Chinese papermakers had used all manner of plants suitable for papermaking. They developed most affordable methods and found the most economical materials in the time and area.[8] According to written sources, hemp was the earliest known plant known to have been used for papermaking in China before the Christian era; the paper of Cai Lun was in fact distinguished according to the material used as paper made of tree bark, remnants of hemp, rags of cloth, and fishing

8 Tsuen-Hsuin Tsien offers an exhaustive account of the development in usage of raw materials in China. See: Tsien 1973: 510–519.

nets.[9] This was followed by paper mulberry from the early second century CE. Rattan was especially popular for making the best paper in southeast China from the third to about the twelfth century, when the supply of the raw material was exhausted. Bamboo then gradually replaced both rattan and hemp as the chief material for papermaking since the latter part of the eight century. In the eighth century CE the Chinese were using a variety of raw fibers that included the rags of hemp and flax (ropes), bark of mulberry, a ramie called Chinese grass and several other types of grasses. In addition, other materials were being used in making special kinds of paper in different parts of China, such as rice and wheat straw, the bark of sandal wood and other trees, stalks of hibiscus, seaweed, and certain other plants were also used. It remains unresolved whether silk or cotton have ever been used. However, Berthold Laufer mentions that before Cai Lun's time, as early as third century BCE, felt-like paper was being made by the Chinese from 'silk-waste,' which Cai Lun supposedly replaced with vegetable fibers.[10]

Notably, Tsien, Laufer, and others fail to mention plants from the Thymelaeaceae family—among them *Daphne, Edgeworthia* or *Stellera* sp.—as significant resources used in China for making paper. Yet Floyd Alonzo McClure writes about a kind of paper called 'cotton paper' (Min Chi), which was supposedly made of 'cotton paper plant,' *Edgeworthia gardneri* or *Wikstroemia indica* (Min Chi Shue).[11] It is not clear and rather baffling why paper made from plants of the Thymelaeaceae family was called 'cotton paper.' McClure opines that this type of paper was unique, made in the Kiangsi province on the 'primitive woven screen' and used principally to make firecracker fuses. The only kind of paper that resembles 'cotton paper' is made of *Stellera* sp. fibers, which, due to the flat and ribbon-like shape of fibers in cross-section, looks very similar to cotton fibers. Nevertheless, this explanation does not clarify the puzzling terminology sufficiently.

Originally, Tibetan paper was made from shrubs belonging to the *Daphne* and *Edgeworthia* species (*shog shing* or *dung loma* in Tibetan); these plants still provide the basic materials for paper made in the Himalayan regions (Figure 109). However, very special Tibetan paper was also made from the roots of both the *Stellera chamaejasme* species (*re lcag pa* in Tibetan) and, rarely, *Euphorbia fisheriana* or *Oxytropis* sp.[12] The *Stellera* is a small genus of less than ten species, found growing in comparatively dry conditions on sunny and sandy slopes in

9 Laufer 1931: 15.
10 Laufer 1931: 12.
11 McClure 1986: 37, 80–81.
12 Trier 1972: 56; Dawa 1999: 156–159, 320–321.

FIGURE 109 Edgeworthia gardineri *growing in the Khumbu region, Nepal.*

FIGURE 110 Stellera chameajasme *found in Kyirong, Western Tibet.*

areas such as Central Asia, Iran, Bhutan, Mongolia, Nepal, Russia, and parts of Tibet.[13] It is widely distributed along the Himalayan range, where it is found at altitudes of 2,700 to 4,500 meters (Figure 110). This plant was reported first by Nikolai Przhevalsky in 1873, and subsequently by Hossie in 1910, along with some other 'plant hunters,' botanists and geographers.[14]

The production of paper from these roots is practiced in the highest places in the world, where practically nothing else grows. The altitude range of *Daphne* reaches 3600 m above sea level so the root paper production is practiced in the highest places in the world. This plant is closely related to *Daphne;* however, whereas the bark from branches of *Daphne* is used for papermaking, it is the root bast of *Stellera chamaejasme* that is the raw material (Figure 111). Although the quality of root paper (especially from *Euphorbia*) is not as good as the bark paper, the presence of poison in the paper makes it resistant to damage caused

13 The most common places of its occurrence in China according to the Harvard University Herbaria are: Gansu, Hebei, Heilongjiang, Henan, Jilin, Liaoning, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan. See: Flora of China, http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200014523 (January 15, 2011).

14 Information from Herbarium of L.H. Bailey at Cornell University, Department of Botany, College of Agriculture, Ithaca NY, USA (sample of *Stellera chamaejasme* collected on June 10, 1922); see also: Kingdon-Ward 1934: 64.

FIGURE 111 *The root of* Stellera chamaejasme *shown by a former papermaker in Dobe Shang, Western Tibet.*

by insects and, ultimately, more lasting than other types of paper. The root of the *Euphorbia fisheriana* is thought to be best when it grows in the soft sandy soil of a black beach.

These root bast fibers create a very specific soft type of paper, which is considered to be of lower quality than bark paper. The roots are especially difficult to harvest, which places a serious limitation on quantity of paper that can be produced. They additionally require a longer time for processing, and an extra step in the papermaking process. Thus in general they are only used in papermaking when other sources are not available. On the other hand, the poisonous properties of these plants make the paper resistant to damage caused by insects, meaning that it may ultimately be more durable than other types of paper. In principle, it should not be difficult to determine the relative importance of each of these different fibers in the early history of Tibetan papermaking. *Stellera chamaejasme* fibers are distinctive in the fiber examination of historic papers, and can be clearly differentiated from *Daphne* and *Edgeworthia* despite the fact that all plants belong to the Thymelaeaceae family. Species of *Oxytropis* (Leguminosae) were also used as an addition for making paper in some regions of Tibet. However, its anatomical features in paper have not been described yet.

In Nepal, *Daphne* sp. (*D. cannabina, D. bholue* and *D. involucrata*) and *Edgeworthia gardineri* were used and mostly known under the local names *lokta* or *kāgate* (Figure 109).[15] Jute (*Corchorus* sp.) was also used in Nepal; however, as a raw material for paper making, it is most typical of India, where sunn hemp (*Crotalaria juncea*), roselle (*Hibiscus sabdariffa*), and ramie (*Boehmeria nivea*) were also used. In Kashmir, the waste cocoons of silk were used to make a paper that is smooth, soft, and strong.[16] Kashmiri paper was considered the finest among Indian papers and was a prestigious gift exchanged by sultans.[17] In Japan, the papers made from *Edgeworthia papyrifera* and *Wikstroemia sikokiana* were known under their Japanese names *mitsumata*, and *gampi*, respectively. According to written sources, the oldest usage of *mitsumata* in Japan dates back to 1591 CE.[18] Both of these plant species belong to the Thymelaeaceae family and are very similar to those identified in the paper of Tibetan and Nepali books. The Thymelaeaceae family includes shrubs or small trees that are rarely herbal, evergreen, or deciduous. This family of plants is characterized by a hard, fibrous bark. Because the phloem contains very strong

15 Trier 1972: 50–59; Holmberg et al. 1999: 47.
16 Agrawal 1984: 132–137.
17 Field 1995: 24.
18 Bell 1981: 77.

fibers, the bark of many species is suitable for the manufacture of high-quality paper such as that used for banknotes. The stems are extremely supple and difficult to break and are commonly used as a substitute for string. Most species are poisonous; some have medicinal qualities.[19]

From the Tibetan perspective, there are three different classes of material for manufacturing paper: the best material (*shog shing* or *dung loma*), the mid-quality one (*a ga ru*) and the lowest quality (*re lcag pa*).[20] These plants used in the manufacture of paper of the other classes all belong to the Thymelaeaceae family. Because of that, fibers in ancient papers are extremely difficult—sometimes impossible—to distinguish. The material described by Tibetans as the conch shell tree *dung loma* (which is supposed to be *Daphne* sp. [*D. bholue*?] plant), is considered to be the best material for manufacturing paper in Tibet. The phloem of *Daphne* and *Edgeworthia* shrubs is the most common material in the foothills of the Himalayas.[21] The bast of *Edgeworthia* is usually whiter and softer than that of *Daphne*, but paper made of *Daphne* generally is considered the best. Due to its length and flexibility, the fibers of *Daphne* sp. allow for easy defibrilation and for control over the thickness of the paper sheet during the papermaking process—allowing for the production of thin sheets. Yet, Tibetan paper could hardly be described as thin. Quite the contrary—thickness was one of its distinctive features. The high resin and starch content of the inner bark tissue of Thymelaeaceae family plants often yielded a slightly glossy surface on the final paper product. The paper made from *Daphne* is also known among Tibetans as *dug shog*, 'poisonous paper,' because the bark of this tree contains a substance that repels insects.[22] The bark is naturally resistant to insects and deterioration and is even thought to have medicinal properties.[23] Among its other uses, *Daphne* is recommended for fighting high fever.

It is also worth noting that Tibetans determined the quality of their paper, among other things, on the basis of the quality of the soil in which the plants grew. Following those standards, for the best quality *Daphne* paper, the tree should not grow in eroded soil, among juniper trees, in clay, or among boulders. The 'paper tree' which grows in sand or in red slate is considered to be of slightly lesser quality because it contains hard (i.e., difficult to cook)

19 Flora of China, http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=200014523 (accessed January 15, 2011).
20 Tsundru 2010: 54.
21 For a detailed discussion of characteristics of plants used for papermaking in Nepal and other references for papermaking in Central Asia, please see Trier 1972: 50–59.
22 Imaeda 1989: 410.
23 Upreti 2004: 236–243.

substances and it can be recognized by its distinctive yellowish color. According to Tibetan papermaking standards, the poorest material for making paper is a tree that has thick bark or is infected with insects.

Much more rare paper made of eaglewood bark *Aquilaria agallocha* (*aga ru*) also from the Thymelaeaceae family (genus: *Aquilaria*, species: *agallocha*) is considered medium quality.[24] The main feature of the paper made of agalloch eaglewood bark is its thickness, which is said to be the best for traditional Tibetan scriptures (*dpe cha*). This plant is very rare; primarily native to the mountains of Silhet and some eastern provinces of Bengal, it later spread to other parts of southeast Asia, such as Vietnam, Malaysia, Thailand, Laos, Indonesia, and parts of India. The bark of this tree was also used in unprocessed form sometimes, similar to palm leaves. Aquilaria trees reach 120 feet in height with trunks with twelve foot circumferences; they can live up to thousand years. Its wood is pale white in color, light, soft, and porous, and contains the precious oleoresin, known in the East as aggur or uggar, which forms dark-colored veins of oleoresin within the wood, in the interior of old trees.[25] *Aquilaria agallocha* or agarwood is considered a pharmacological product formed as the result of a fungus disease resulting from wounds on the trunk or by insect activity.[26] The oleoresin is procured by crushing these portions of wood in a mortar, and boiling them in water, which makes the aggur rise to the surface. Traditionally old-growth Aquilaria trees were indiscriminately cut down for the oleoresin, but only a few very old trees actually contained the substance deep inside them. Today in many countries of southeast Asia where the tree was once native, it has become very rare because of intensive harvesting. Oleoresin is extremely valuable because of its significance for a variety of Buddhist and Islamic ceremonies as well for traditional medicine, perfume production, incense, and for the beautiful grain of its wood, which takes a high polish and was used for setting precious stones. Under its pharmaceutical name *Lignum Aquilariae*, Aquilaria has been also used to enhance cerebral function, balance the mind/body connection and the nervous system. Its anti-asthmatic, antimicrobial, digestive, and stimulant properties are also well documented. Aquilaria has been used in numerous kinds of medication

24 The plant is known under its common names, such as Agar wood, Lign-aloes wood, Eaglewood, Agalloch and also Lignum Aloe, Aguru, *chenxiang* (沉香), Ch'Ing Kuei Hsiang, Chi Ku Hsiang, Huang Shu Hsiang.

25 See specimen collected in 1927 by J.A. Lörzing preserved in Herbarium of L.H. Bailey at Cornell University, Department of Botany, College of Agriculture, Ithaca, NY, USA.

26 Aloeswood extract paint: file entry for characteristics of aloeswood, http://www.aloeswood.com.cn January 2009.

as well as in insect repellants.[27] Works from the seventh century CE such as Xuanzang's travelogues and the Harshacharita, composed in Northern India, describe the use of agarwood products such as 'Xasipat' (writing-material) and 'aloe-oil' in ancient Assam (Kamarupa). Today, Aquilaria is not typically mentioned as a raw material for making paper, probably because the tree has become too rare and valuable. However, it is possible that the tradition of making writing materials from Aquilaria bark is still practiced in Assam. As far as Tibetan books are concerned, I have not detected Aquilaria fiber in the manuscripts I have examined.

Papermaking Methods in Tibet Traceable in Books

The actual method of making paper in Tibet seems to have evolved very little over the centuries, with each sheet of paper dried on individual molds (Figure 112). This mold type is called 'floating' because it is placed on a water surface such as lake, pond, river or puddle. The other main type of paper mold is usually known as a 'dipping' mold, and is thought to have developed subsequent to the floating mold. The dipping mold allows faster paper production because it is possible to remove a wet sheet of paper directly from the sieve just after its shaping. This means that papermakers do not need to wait until the paper has dried before re-using the mold to begin the next sheet. The main difference between the two types of mold is in their construction. The floating mold is built of wooden frame with a woven textile attached to it. In the dipping mold, on the other hand, a movable sieve made from bamboo, reed or another kind of grass is attached to the wooden frame. Modifications to this technology have been reported, including a floating mold resembling a wooden box with movable screen. In this case I would continue to classify this type of paper as laid based on its sieve print.

Independent of the particular technique used for sheet formation, every papermaking sieve will make an impression that is specific to the construction of the mold and sieve. This impression is unaffected by most aging processes, and can be read centuries later. The impression of a textile sieve made of cotton, hemp, or flax can be distinguished from the impression produced by a movable sieve from a dipping mold made of bamboo, reed or other grasses. However, to date or identify the origin of a particular paper, this information alone is insufficient. According to Dard Hunter, in the southwestern regions of

27 Raintree Nutrition (Tropical plant database): file entry for Aquilaria (*Aquilaria agallocha*), http://www.rain-tree.com/aquilaria.htm (accessed January 2009).

FIGURE 112 *Drying process during papermaking in the Kullu Valley, Himachal Pradesh, 1940s. The papermaking molds with newly made sheets of paper are left until the sheets are dry. Photo 523/1(154), © The British Library.*

China and in the Himalayas, the floating mold was the often used; in more eastern regions, the dipping mold with a bamboo sieve was developed.[28] However, both types of molds were used simultaneously during the first millennium for making paper along the Silk Road, and we have to take into consideration that papermaking workshops were not limited to either method and could have employed both types of mold.

Papermaking Tools and Technology

Traditional papermaking in Tibet began to disappear in the 1950s when Tibet was annexed by China and modern paper mills were built in Lhasa. Papermakers lost their customers and production was practically stopped. Additionally, many kinds of paper from China and the West were introduced in Tibet and became widely available. The traditional craft was, nonetheless, popularized by emigrant papermakers in other countries such as Nepal, Bhutan and India, where traditional papermaking techniques are still preserved. Another factor that has limited hand-made paper manufacture since the 1950s is the development

28 Hunter 1978: 84; Schaeffer 2009: 8.

of machine-made paper technology, which almost entirely superseded handmade paper not only in Tibet, but also in other Himalayan regions.

Tibetan papermaking technology had always been very basic, and was not much different from that originally invented in China. The specificity of Tibetan papermaking lies in the properties of native plants, the living conditions of peoples dwelling on the world's highest plateau, and aspects of Tibetan culture that together create a distinctive craft. The need to make paper arose with the invention of the Tibetan alphabet in the seventh century and with the formation of the administrative apparatus. The demand for paper spurred the creation of workshops, which were most likely dispersed as the demand was not limited to one central location. Although the data is scarce, we may surmise that many small paper workshops existed in the Himalayan region, sometimes limited to one family, sometimes to the village and in exceptional cases to the region, which thus became famous for paper production. Every large project, such as editing the Kanjur or Tanjur (Tibetan Buddhist canon) stimulated the manufacturing of paper. That is the reason why paper manufactures must have been located close to the largest monasteries involved in book editing. Unfortunately, there exist very few historical documents—which have, moreover, not been explored with respect to papermaking—that could support this hypothesis about the state of papermaking. Yet as Holmberg and March argue, in the eighteenth century, the villagers of Bomthang, Nepal had an obligation to supply paper to the government administration offices of the Ranas in Kathmandu.[29] The village archive contains information about the regions of raw-material gathering, granted officially every few years depending on harvesting needs. This administrative aspect of paper production ought to be studied more closely in Tibet. It must be noted, however, that in today's China, finding Tibetan village archives might be an extremely difficult task.

According to standards of Tibetan papermaking, the best quality paper is evenly thick and not torn or pierced. It is free from any impurities even though it is smoothened by a polishing stone; it retains its flexibility and softness and holds the ink well. It is even sometimes believed by Tibetans that ink stays on the best paper despite water soaking in rainy weather. A book written on Tibetan paper does not harm the eyes during long sittings. The thickest type of paper, often laminated or comprised of glued layers was used for writing and printing Tibetan traditional books (*glegs bam, dpe cha*).

In the following section, I describe in detail the stages of the traditional papermaking process with a general distinction between the production of 'bark paper' and 'root paper.'

29 Holmberg et al. 1999: 44–45.

Collecting and Preparing Raw Material

Traditionally, the production of paper took place in particular villages and involved most of their inhabitants in the harvesting of the raw material, which was the first step of the production. Since the trees were not cultivated, harvesting might require workers to travel sometimes even for days in search of proper plants. Ideal plants were typically two to three years old and measured at least one meter in height. The longest branches were cut at about ten centimeters above the ground so that the plant could regenerate.[30] The layer of phloem that separated from the wood included a thin layer of bark, which was removed at the initial stage. This step had to be done when the bast was still fresh, as the task becomes harder as the material dries. Sometimes, the collected *Daphne/Edgeworthia* sp. tree strips of bark (phloem) were dried and stored for a period of time and later washed and rinsed in running water; in this process, the outer bark would be removed and the inner bark would be separated by scraping out the bark in the workshop. The higher the bark content of the wood, the darker the paper, and the weaker its strength. The content of outer bark particles has become the paper's most recognizable feature and significant value at the perception of paper at the social and cultural level.

Next, the raw material used for papermaking is the *rte* root of *Stellera chamaejasne*. This is usually harvested in the fall. In order to obtain the right substance for paper manufactured from root material, the lignified root of the *Stellera chamaejasme*[31] must be dug out, and the outer bark and the kernels of the roots removed. The upper part of the plant is cut off, and the root is stripped of its outermost layer for cleaning. Only the middle layer of the root, which resembles tendon, is useful for papermaking.

Considering other raw materials, green bark of *agalloch* eaglewood was the same as *Daphne* peeled away, the middle layer of the tree is removed and boiled for a while. After boiling, the liquid is drained off leaving the pulp for further processing. The process of boiling, beating, and stirring is the same as for *Daphne* paper.

Boiling

Before starting the preparation of fiber pulp, the phloem was soaked for several hours in order to separate the fibers from the surrounding tissues. Sometimes

30 Trier 1972: 70.

31 The paper made of *Stellera* sp. was sieved on the river Nanjoon, using a form floating on the surface of the water. The prepared pulp would scatter over the surface of the water and then settle on the fabric as the form was lifted off the surface of the water. This is described in: Koretsky 1986: 3.

the bark was left to soak in water for two hours, sometimes it was left to soak overnight. As recently as twenty years ago in the Nuntala papermaking village in Nepal, I observed a large wooden tank with running water standing in the open air, which was used for this purpose. The soaked fibers swell and their structure loosens up, which results in a higher degree of fiber separation. For a better result, the material prepared in this way was usually cooked for six to eight hours in water filtered through ashes from a fire.[32] Boiling performs two functions: it removes the interconnections between fiber bundles and it neutralizes the poisonous substances present in plants used for papermaking (especially in *Stellera* paper). Unless the bast of the paper tree is boiled well, it is difficult to soften it.

Burned *acacia catechu* (*ja do*) was added to ice cold water and stirred until the consistency of the liquid is similar to buttermilk. It is ready when it achieves a taste similar to sal ammoniac,[33] if cooked longer, the substance will lose its lightness and sharpness. The strips of the inner bark of the paper tree would be boiled in this liquid after it had been cleared of all the sediment. The material for paper was also prepared by boiling in a solution of roasted barley flour (*thel chin*). The middle layer of the *Stellera chamaejasme* or *Euphorbia fisheriana* were boiled additionally in the mentioned *thel chin* until it became soft and loose as wool. Since this layer of the root contains hard poison, it is necessary to add one dose of myrobalan (*Terminalia chebula*) to the mixture to neutralize the toxic substances.[34]

While observing paper preparation at the Nuntala factory, I noticed that this technological stage was omitted. The reason for this omission of the cooking stage could be an effort to quicken the production, with an impairment of paper quality, possibly singular accidental thing. The omission may also constitute a means of cold processing of fibrous material much like in the case of flax production derived from plants.[35] I based this hypothesis on my

32 Rischel 1985: 15–16. According to Trier the cooking stage took two to six hours (on the base of reports from five different Nepalese papermaking places) depending on ash or chemicals used during the process: Trier 1972: 69–92.

33 Sal ammoniac is a rare mineral composed of ammonium chloride, NH_4Cl. It forms crystals in the isometric-hexoctahedral class that are colorless from white to yellow-brown.

34 Myrobalan—so called ‘Buddha’s herb,’ known also as *Fructus chebulae* (pharmaceutical name) or *Terminalia chebula* Retz. (botanical name). The fruit from this herb is among the ‘triphala’ (combination of three herbs) of Ayurveda. It is useful in asthma, sore throat, vomiting, eye diseases, heart diseases, hiccup, etc.

35 In flax processing, a procedure called ‘sprinkling’ is used. This is a biochemical process causing gradual disintegration of some of the substances comprising the structure of the

observations of large quantities of humid bark stored in the vicinity of tank with running water.

Beating

At this stage of paper-pulp preparation it was necessary to separate individual fibers. In the early periods of the papermaking craft, fibers were separated manually: the pulp was beaten by hand and mixed with water. The bark strips were beaten on a stone mortar until they were transformed into pulp similar to dough. The paper would never become smooth if it was not beaten well. If the stone mortar was not placed firmly or cleaned properly, the color of the paper could change.

Nowadays, traditional papermaking workshops use a simple mixer of the Hollander type to crush fibers drawn from water. The relative shortness of the fibers observed during the microscopic examination of a few samples taken from the analyzed artefacts is an indication that they were ground to a great extent. On this basis, one might surmise that a grinding mill was used for making the paper; this would suggest that the paper was produced in a fairly recent period. This also raises questions about the precise time when grinding mills replaced simple hand-maceration in the Himalayan region.

Molding

Adding water to fibers that have been separated by hand or with the use of a mixer produces a fiber pulp that is ready for paper molding. The paper-pulp stock (the measured quantity of fiber pulp) is poured into a flat mold floating on the surface of a stream, puddle, pond, lake or, in some cases, a vat (Figure 113). The papermaker waits until the fibers are distributed evenly on the sieve and then makes several parallel movements from left to right; he/she then lifts the mold from the water surface, making several perpendicular movements—pushing the mold away and pulling it back until all the remaining water is removed (Figure 114). The mold with the damp layer of pulp is then propped up diagonally until the pulp dries and can be peeled off as a sheet of paper (Figure 115).

Tibetan paper, as well as Chinese paper, was produced with floating molds according to the most traditional papermaking technique, which originated in China.[36] The Tibetan papermaking mold called *shok bre* (a tool for shaping

plant. Fiber cells are held together with plant glues (pectins), which are the first to decay under the influence of microorganisms. See: Białousowa et al. 1958: 139–142.

36 The traditional papermaking methods in the Himalaya were studied by many authors during the last century, but Dard Hunter still remains the best authority on papermaking

FIGURE 113 *The process of making paper in the Kullu Valley, Himachal Pradesh, 1940s. Paper pulp prepared by beating upon a stone with a wooden mallet is being poured onto a 'floating' type of mold on the surface of a puddle. Photo 523/1(151), © The British Library.*

FIGURE 114 *Process of shaping a sheet of paper in the Kullu Valley, Himachal Pradesh, 1940s. The papermaker stirs up a quantity of pulp by moving the frame in the water until it covers the surface of the mold completely and evenly; he then tilts the frame until the water drains off. Photo 523/1(153), © The British Library.*

FIGURE 115 *Drying process during papermaking in the Kullu Valley, Himachal Pradesh, 1940s. The papermaking molds with newly made sheets of paper are left until the sheets are dry. Photo 523/1(154), © The British Library.*

paper) is comprised of a wooden frame made of four pieces of wood, and a piece of cloth stretched on the frame that is thin enough to serve as a screen. This mold fulfilled the function of a sieve—a type of the floating mold called also the 'woven' type of mold (because of the 'woven type of screen'). The size of the paper is determined by the different sizes and shapes of frames (Figure 116). The largest Tibetan papermaking molds were approximately door size. Valrae Reynolds reported seeing a mold measuring one and two-thirds by two-thirds meters—a wooden frame with a woven cotton center, as used at Gyantse, in southern Tibet, during the middle decades of the twentieth century.[37] Papermaking molds are frequently constructed out of two pairs of slats joined perpendicularly to form a frame across which a cotton cloth is secured. The pulp is divided into piles of equal size and height, and each pile

in general: Hunter 1943: 77–203; Tschudin 1958: 679–689. More recent studies: Koretsky 1986: 2–6; Rischel 1985: 7–18; Imaeda 1989: 409–414; Dąbrowski and Siniarska-Czaplicka 1991: 30–48.

37 Reynolds 1991: 22.

FIGURE 116 *A large size 'floating' mold, constructed with a wooden frame and attached woven textile, placed in water (a stream) in Gyantse, c.1910–1920. Photo 1112/2 (139), © The British Library.*

is placed in a container filled with water (vat). In such case, the paper sheets were formed from the entire amount of paper pulp in the tank.

The process of shaping the paper sheet using this method requires meticulous adherence to technicalities. The thickness of the paper could vary if the *shok bre* is turned in one direction only while stirring the water. Even if the paper pulp is stirred very conscientiously and the mold is taken out of the water with care, the paper could still tear very easily because it is very fragile until it dries. Allowing the sheets of paper to dry on molds would not only prolong the already very time-consuming papermaking process but also limit the size of the production because the number of sheets of paper a papermaker can produce is determined by how many molds he owns. This is limitation encouraged the popularity of the alternative method of the dipping type of mold that is used in East Asian countries, such as Korea and Japan.

Finishing

The dried sheets of paper require further processing: the edges of the sheets have to be evened out and the surface of the sheets must be polished. Prior to removing stains and cleaning the paper, tiny hairs from the surface are carefully removed with the use of a snow-white stone.