"The back of the rattan paper from Thai-chou can be written on, since it is smooth and hairless. It is the best in the world and can never be matched. It was also used for making bags to preserve tea-leaves after roasting, because its firm texture prevented loss of flavour."

Since the rattan plant grew naturally in a limited area and its growth was slow as compared with that of hemp, which can be harvested in one year, or of paper mulberry, in three years, the supply of rattan was gradually exhausted. However, the process was gradual, and when rattan was exhausted in Shan-chih during the Sung dynasty, the centre of production shifted from the western to the eastern part of Chekiang. Rattan paper made in Thien-thai, known as Thai-theng, then became popular, as well as that of Yu-chhiian. After the Sung there followed a gradual decline of the use of rattan; this was due to several reasons. One was the growing use of bamboo which replaced rattan and hemp as the chief raw material for paper-making after the middle of the T'ang dynasty. Another was simply the exhaustion of the supply of the material due to excessive cutting without proper cultivation. Many writers lamented this, and a T'ang scholar-official, Shu Yuan-Yu (d. 855), satirised people who frequently wrote millions of worthless words, thus killing the growth of rattan.

(iii) Paper mulberry and mulberry

Paper mulberry (ka, cho, or kon; Broussonetia papyrifera) is a shrub which grows naturally in many parts of China (see Fig. 1066). Chinese records reveal its cultivation, manufacture, trade, and use for making cloth from very early times; indeed, Su-ma Ch'ien says in the Annals of Yin that 'mulberry and paper mulberry were grown together.' Poems mentioning paper mulberry written in the -9th or -10th century are included in the Book of Poetry. In commenting on this classic, Lu Chi (4th or 3rd century) says:

Paper mulberry was called ka sang by people in Yu-chou (in North China); ka in Ching, Yang, Chiao, and Kuang provinces (in South China); and cho in Chiang-chou (in Central China). Both mulberry and paper mulberry were grown together during the T'ang-Yung period (1270-1368). Nowadays, the people in the south of the Yangtze River use its bark to make cloth and also pound it into paper,

called paper mulberry paper (ka phi chih), several tens of feet in length, pure white and shining.

The earliest reference to the use of tree bark for papermaking is found in the biography of T'ai-lu Lien in the History of the Later Han Dynasty. It does not specify what kind of tree bark, but Tung Pa of the early 3rd century said that 'The Eastern Capital (Lo-yang) has the paper of Marquis T'ai-lu, which was the paper made by T'ai-lu Lien; that made of hemp is called hemp paper; that of tree bark ka chih (paper mulberry paper); and that of used nets net paper.'

The earliest literature which described the methods of planting and harvesting the shrub and the treatment of its bark is included in an ancient work on agricul-
tecture and farming by Chia Ssu-Hsüeh (fl. +533–5), a magistrate of Kao-yang district in modern Shantung. The chapter on planting the paper mulberry says: 

The *chù* (paper mulberry) should be planted in very good ground along the streams in a valley. In the autumn, when the fruits of paper mulberry are ripe, collect them abundantly, wash, clean, and dry in the sun. Till the ground thoroughly. In the second month, after the soil is ploughed, sow seeds of the tree mixed with those of flax and smooth the ground with labour. In the autumn and winter, the flax is not to be cut to keep the paper mulberry warm. [If this is not done, the tree will in most cases die of cold.] In the first month of the next year, cut the twigs close to the ground and burn them. Thus the trees will grow taller than a man after one year. [If not burnt, it grows leaner and slower.] The tree can be cut for use after three years. [If cut in less than three years, the skin will be too thin and not suitable for use.]

The method of cutting: The best time for cutting is in the twelfth month, or the next best, the fourth month. [If cut at other times, the paper mulberry usually withers and dies.] In the first month of every year, burn the ground with fire. [The dry leaves on the ground will be enough for burning. If not burnt, it will not grow luxuriantly.] In the middle of the second month, select and weed out the weak ones. [Weeding is to enrich the trees and to preserve enough strength and moisture in the ground.] Those transplanted should also be planted in the second month and cut every three years. [If not cut by three years, there will be loss of money and no profit.]

If the trees are sown on the ground, labour is saved but profit will be less: selling the bark after boiling and peeling is more laborious but profitable. [The wood is useful as fuel.] If the bark can be used for making the paper by oneself, the profit will be even higher. Those who plant 30 m² can harvest 10 m every year, thus the field can be rotated every three years and make an annual income equal to one hundred phil of silk.²³

This short passage points out that paper mulberry was domesticated by farmers who planned the tree primarily for producing raw materials for papermaking and that the process of boiling and peeling the tree bark was the first step in making paper. It was a highly profitable farm subsidiary to combine planting the tree and then for the farmer to manufacture paper as a handicraft. The use of paper bark for papermaking may have been influenced by acquaintance with its earlier use in China for making bark cloth.³ Mulberry paper was very popular in the Chin dynasty and continued in the Thang and later times, since many of the manuscripts discovered in Tunhüan and Turfan are reported to be made of *chù* bark.³⁴ It was the chief paper used for paper money, known as *chù* *chhao,* for clothing and furnishings, for mounting windows, for book covers, and for other uses in all ages.

Mulberry (*sang,* *Morus alba*) is a native of China chiefly cultivated for the culture of silkworms. Marco Polo said that paper money was made of ‘the bark of certain trees, in fact of the mulberry tree’.² Breuschneider argued that ‘He seems to be mistaken. Paper in China is not made from mulberry-trees, but from the *Broussonetia papyrifera.*’²⁵ To prove that bark of the mulberry tree, as well as that of paper mulberry, was used as a material for papermaking, Lauffer cited a number of authorities to prove that ‘Marco Polo is perfectly correct: not only did the Chinese actually manufacture paper from the bark of the mulberry-tree (*Morus alba*), but also it was this paper which was preferred for the making of paper money’.²¹

Chinese sources testify that the mulberry tree was and is still used for papermaking. Su L-Chien (+937–995) said that paper was made from the bark of the mulberry tree (*sang-phi*)²² by the people in the north.²³ The History of the Ming Dynasty also specifies that paper money was ‘made of mulberry fibre (*sang jang*)²⁴ in rectangular sheets, one foot long and six inches wide, the material being of a greenish colour,’²⁵ and a levy of some two million catties of mulberry bark for manufacture of paper money in 1644, apparently because of inflation, almost provoked the peasants into rebellion.²⁶ Sung Ying-Hsing (c. 1600–60) mentions that ‘mulberry fibre paper (*sang jang chih*), made from the bark of mulberry trees, is extremely thick and smooth; that produced in east Chekiang is necessary to the silk producers in the lower Yangtze region for repositories for silkworm eggs’.²⁷ Even today, the mulberry is described as ‘produced in all provinces in China and its bark is a very good material for papermaking’.²⁸

(iv) Bamboo

This plant was extensively cultivated in China, except for the extreme northern part of the country (*Fig. 1867).* In ancient times it was grown probably as far north as the provinces along the Yellow River, but was later driven much farther south by change of climate or by deforestation. It is now abundantly grown in the Yangtze valley and the provinces to the south, especially Chekiang, Chekiang, Fukien, and Kiangtung. Because of its long fibres, rapid growth, and low cost, it has been a major source of raw fibres for papermaking ever since the middle of the Thang dynasty.²⁹

² Yule (18), p. 443.
²² Breuschneider (100), vol. 1, p. 4.
²³ Lauffer (14), pp. 350–1; citing among others S. Jüten, Ahmed Shihab Edris, Aarne Stora, J. Weitzen, and some Chinese works to prove that ‘good Marco Polo is cleared, and his veracity and exactness have been established again’.
²⁴ Wén Feng Shih Pš (TSHC), p. 53.
²⁵ Ming Shih (ESSST), II, B, 1.
²⁶ Ni Wen-Chang, Kung Wu Pš (TSHC), p. 60, Jh Chih Li (TSHC), ch. 1, p. 119.
²⁷ T’ien Ťin Ch’ing Wu (KCHC), p. 219; cf. Su & Sun (1), p. 296; Lauffer (14), p. 581, n. 1–2; quotes 8. Jüten that ‘according to the notions of the Chinese, everything made from hemp, like cord and burlaps, is banished from the establishments where silkworms are reared; and adds ‘There seems to be a sympathetic relation between the silkworm feeding on the leaves of mulberry and the mulberry paper on which the cocoons of the females are placed’.²⁸
²⁸ Yü Ching-hung & Li Yin (11), p. 57; pl. XXXIV.
²⁹ A theory that bamboo paper existed in Chin dynasty (+1695–46) is generally considered invalid. It is based on a statement, in T’ang Ťin Ch’ing Wu Ch’ao Hsi Shih (8, 1:1049), that ‘genuine’ speciments of the work of the famous calligraphers Wang Hsi-Chih and his son Wang Yin-Chih were written on bamboo paper with horizontal scroll marks, made in Kuei-ch’i of modern Chekiang. But the same author mentions later in the same work that these ‘genuine’ speciments from the two Wungs were no longer extant in his time. Thus the speciments must actually have been imitations made later.²¹
The earliest reference to the use of bamboo for making paper in China is found in a book by the Thang historian Li Chao (fl. 806–20), who said that "bamboo paper (da chieu) was made in Shao-chou (in modern Kuangtung)." His contemporary Tuan Kung-hu (fl. 890) also mentioned the use of "bamboo membrane paper" produced in Mu-chou (modern Chekiang). Since the first use of the material must have been earlier than the recorded date, it is assumed that bamboo was first used in papermaking not later than the middle of the Thang, or the second half of the 8th century. Apparently it was developed as a substitute for hemp, which was a chief material for textiles, and for rattan which, as we have just seen, was almost exhausted at the end of the Tang dynasty.

The use of bamboo probably originated in Kuangtung, where the plant grew abundantly in the warm and humid climate. The method spread to Chekiang and Chiangpu by the Sung dynasty, but the technique of making bamboo paper seemed to be still in the initial stage of experiment and the product was not by then perfected. As Su I-Chien said, paper was made of young shoots of bamboo in the Chiangpu and Chekiang area in his time, but no one could fold it if written with small characters, as it would break when touched, and could not be refolded. The

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(v) Other materials

Besides the major materials discussed above, many other plants were used. The most common fibers were from the stalks of rice and wheat. The process of making straw paper (thuan chieu) was much simpler than that for other materials. Since these fibers are tender, less time was required for beating in preparation. A Sung author said straw was used in Chekiang, and produced the best paper if mixed with rattan. Sung Ying-Hung mentions the mixing of rice stalks with bamboo fibers to make wrapping paper. It is said that the straw first receives a preliminary pounding and then, after saturation in a lime solution, is buried in a trench. When properly disintegrated, the straw is removed and placed in porous cloth bags, which in turn are suspended in a running stream so that the fibers may be cleansed of all particles of lime. Straw is still one of the raw materials most used for making paper for wrapping, burning, and sanitary purposes.

The blue sandalwood (Pseudeleia tartarica, Maxim.), known in Chinese as chihng thuan (Fig. 1088), was the major material for making the famous Huian chieu for painting and calligraphy. It is made from the bark of the thuan tree grown primarily in the Huian-chheng area and manufactured in Chin-hsien; both were under Huian-chou in the Tang dynasty. The quality of the paper depends upon...
the proportion of the raw material, which may either be pure bark or contain one-half or seven-tenths bark, with rice stalks making up the remainder. The more the bark the better the paper." A legend of the present-day Chin-hien area, where *Hsin chih* was made, relates that a certain Khung Tan of the Later Han dynasty found by accident the bark of a *than* tree which had turned rotten and white after being soaked in a stream. Since no older specimen is known of than bark and no earlier record mentions its use, it seems unlikely that the than bark was used in that early period.

Another fibre often mentioned as raw material for papermaking is the bark of the hibiscus (*Hibiscus mutabilis*), known in Chinese as *fu jing phii*. It is generally believed that the famous stationery designed by the courtier Hsieh Thao (+ 768–851) of Szechuan was made of hibiscus bark. Sung Ying-Hsing reports that "The bark of the hibiscus is cooked to a pulp, and aqueous extract of powdered hibiscus flowers petals is added. This process was probably first devised by Hsieh Thao and has been known by that name down to the present day. This paper is famous for its beauty, not for the quality of its material." 5

The use of seaweed (*Algare marina*), for making intricate filament paper, known as *the li chih*,6 appears frequently in early Chinese literature. Wang Chia7 of the +4th century said: 'When Chang Hua (+ 232–300) presented his work *Pe Wu Chih* to the emperor, he was granted ten thousand pieces of *thi* li paper, which was sent as tribute from Nan-Yüeh (modern Vietnam). The Chinese pronounced *chih*8 as the

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6 By error. Since the people in the south used seaweed (*hai that*!?) in the making of paper with intricate and crooked lines, it was so called. Many other authors of later times continued to make reference to the use of seaweed in papermaking. Su I-Chien (+ 957–955) said that paper was made from *thai* in the south, and since seaweed contains long, strong, viscous filaments, it is possible that this material was used for making paper. It is also possible that it was used for sizing, and thus the intricate hairy filaments appeared on the surface of the paper as a decorative pattern.

Although cotton produces the best fibre of all, it has not been used as a major material for paper, and even modern paper manufacturers abstain from using raw cotton, probably because of its importance in the textile industry. A certain variety called cotton paper (*mien chih*) was not actually made of cotton but of paper mulberry. Sung Ying-Hsing said: 'Torn lengthwise, the strong, hard-sized bark paper will show ragged edges resembling cotton fibres, hence it is called "cotton paper." Cotton stems have been used more recently for papermaking, but 'cotton paper' is certainly not made from raw cotton.

Whether silk has ever been used as a raw material for papermaking is uncertain. Mention of the use of silk fibres is based primarily upon philological speculation without sufficient evidence. It was thought that, since the character chih9 for paper bears the silk radical at its left, chih before T'ai-Sun's time must have been made of silk fibre. It is true that silk cloth was written on before the invention of paper, and the word chih is thought to be derived from one for silk, but the material of chih was not necessarily made of silk fibres. Technically, as many experts have said, silk fibres do not possess the colloidal properties which contribute so essentially to the entanglement and binding of the vegetable fibres. At present, no actual paper made of pure silk fibres is known to exist, nor is there use documented in literature.

It is possible, however, that silk fibres have been used in a mixture with other fibres, or that these silk from silk cocoons has been used. Several references have been made to the use of silk cocoon paper (*tsueh chien chih*10). One mention, in the early +8th century, says that the famous calligrapher Wang Hsi-Chih (+ 721–790) used silk cocoon paper in writing. The Chin-su paper made in Soochow from
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+ 1068 to 1094 for copying the Tripitaka was said also to have been made of silk cocoons. Sung Ying-Huang said that entangled or broken cocoons cannot be reeled into ordinary silk, but are made into wadding known as ‘pot-bottom silk’ (luo min), used for quilted garments and bedding. It is likely that silk waste or floss silk was used to make silk paper, since cocoons contain a gum which would serve to bind the fibres, but which is removed when pure silk is reeled.

The use of fresh plant fibres as raw material was apparently unknown to European papermakers when the craft of papermaking was introduced to Europe in the middle of the +12th century. For over five hundred years after the introduction, all paper of occidental origin was made from linen and cotton rags or a mixture of these second-hand fibres. After the beginning of the 18th century, as rags gradually became less plentiful and no longer economic material, European scientists looked for substitutes in order to meet the increasing need of the paper industry. A great variety of vegetation, including hemp, bark, wood, straw, vines, seaweed, and grain husks, was tested and examined, even though such materials had already been in use in China for many centuries. Finally, wood pulp was widely adopted and has become, since the beginning of the 19th century, the chief raw material of the modern paper industry. Because of limitations of forest resources in China, where most wood had to be used for construction, it was little utilised for paper, and even today, use of other materials than wood is encouraged.

(2) The Invention of the Screen Mould

(i) Functions of the mould

When the disintegrated fibres are floating in water, they can be lifted up from it in a thin layer or sheet. The formation of such a layer of fibres supported on a piece of cloth or a mat was the very inception of the whole idea of papermaking, and the invention of an implement capable of picking up these matted fibres and yet permitting the water to escape was the key to the whole process. Subsequent improvements with specially designed screens resulted in an advancement of the technique, for the mould has remained throughout the centuries the essential tool in making of paper by hand, and the very principle upon which the modern paper-machine is founded. Indeed, the entire development of papermaking is so closely

* See Ch'ìn Fu Ch'un She (TSRSRC), pp. 1-17, for Chin-Chi Hsing (36), p. 2-7, says in his text it was not made of silk but of plant fibres.
* See Hunter (4), pp. 32-40.
* The use of wood for papermaking was suggested by the French academicians Réaumur in 1719 and printing on paper from wood by a German, Breckmann, in 1727-30; wood pulp was commercialised in England in 1804 and patented on 16th April 1807.
* See Yü Ch'eng Hsiung & Li Yin (2), p. 1.
* 高氏請

connected with mould construction that it is only through a careful examination of moulds that the origin and evolution of paper can be understood.

The mould could have been used in two distinct ways. In one, it was dipped perpendicularly into the water upon which the macerated fibres floated, and was brought up horizontally under them, lifting the matted fibres as in a sieve, allowing the water to drain through the cloth. The other way was to hold the mould flat and then pour the floating fibres on it. The woven material retained the fibres in a moist sheet and at the same time allowed the water to drain through its interstices. In this case the thin deposit of matted and felted fibres adhering to the mould was placed in the sun to dry.

(ii) Floating type of screen

It is generally believed that the floating or woven type of mould was the earliest form used by the ancient Chinese, and that the technique used was the one of pouring the disintegrated fibres on to the mould. During his travels in China in the 1930's, Dard Hunter found that this kind of woven mould was still in use in Kwangtung province (Fig. 106g). The woven screen is said to have been composed

* See Hunter (4), pp. 32-40. An experiment in making paper with this kind of primitive mould was successfully conducted by the Institute of the History of Science, Academia Sinica, Peking, as the Chou Chi Hsing (5), pp. 55-7.
* A mould of woven material from Foshan, Kwangtung, is kept in the Paper Museum, Appleton, Wisconsin. F. A. McGuire (2), pp. 113-19, found two villages near Canton where paper was still being made by the old process with woven screen.
of ramie or China grass fastened to a square bamboo frame and stitched with slender bamboo strings which ran through the cloth and around the frame bars. After the moisture had evaporated from the sheet, the paper was easily stripped from the mould. The warp and woof of the mould and the stitches could have left impressions in the paper, in the same way as watermarks are formed in handmade paper today. There is some evidence to justify this assumption, derived from observation of such primitive moulds in modern south China.

Chinese sources are silent about the construction of the mould in ancient times, but the old definition of chih (paper) throws some light on the mould’s form and the material of which it was made. As we have mentioned earlier, the character chien (mat), in the Shuo Wen Ch’u Tzu, includes the radical for grass and, according to the early commentators, means a kind of cloth for covering (kai) made of woven rushes (jien man). It is possible that this early mat used in Han times was made of some kind of grass woven into a cloth which would support the matted fibres and yet let the water escape through its meshes; such an appliance could have retained the primitive form without much change in its basic construction. Hunter noted with special interest that the locality where these woven moulds were found is not more than 200 miles from Lei-yang, where T’Shii Lan was born.\(^4\)

When Hunter made this statement he said that no 2nd century paper of the woven type, showing the impressions of the woven fabric upon which it had been formed, had ever been discovered in Asia.\(^5\) It is true that no specimens found before that time bear clear screen marks, but the Pa-chia paper discovered in 1937 and other old specimens found in recent years, are reported to have fabric impressions on the surface. If this be true, it may very well support this theory of the earliest form of mould used in Han times.

(iii) Dipping type of screen

On the other hand, all those specimens of later periods examined show that another type of mould was used. This so-called dipping or laid type of mould, dipped into the vat of suspended fibres (Fig. 1070), must be a later invention. The idea of a mould from which the sheet of paper could be removed while still moist was a most important advance in papermaking, but the transfer of the wet substance from the mould to a board without damage required the construction of a very smooth and firm screen from which the moist sheet could be easily freed. For this purpose the screen was made of thin strips of rounded bamboo side by side, horizontally or vertically, and fastened together at regular intervals with strings of silk, flax, or hair from animal tail.

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\(^4\) See discussion on pp. 35 ff. above.
\(^5\) Cf. Hunter (3), p. 75. It is said that fibres from the stems of the daily flax are still used for making the screen mould in the Hopi area, see Pan Chi-Hsiang (2), p. 45, n. 5.

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(iv) Impressions of screen marks

The bamboo strips in the screen left impressions in the paper, in the same way that watermarks are formed today, and these marks are useful for the determination of how the mould was made in early papermaking. It is reported of the paper specimens of the Han dynasty recently discovered in Pa-chiahsia, Lopnor, and Chih-yen that the screen marks are not clear. The same is true of such papers of the 3rd and 4th centuries discovered in Chinese Turkestan and elsewhere, but thousands of papers of the Tang and later times clearly indicate the construction of the mould at the time of their manufacture. On papers of the late 3rd and 4th centuries onwards, screen marks are clearly visible, and many paper specimens from...
Tunhuang are reported to have two distinct types of screen marks. Those of the Chin and Six Dynasties (+255-581), as well as those of the Five Dynasties (+907-960), have broad horizontal marks, while papers of the Sung and Thang periods (+961-977) show fine, close screen lines. Hunter reports some of the Thang papers he examined that there were twenty-three impressions of bamboo strips to every inch, and the hair stitchings of the mould were spaced at intervals of approximately one and one-sixteenth inches.

The construction of the bamboo screen may have varied in different localities. One source from the Sung dynasty indicates that the screen was transversely laid in north China, so that the northern paper showed a horizontal grain, while in south China the matting was vertically laid, so that southern paper showed a longitudinal grain. This theory has been used as a guideline for examination of old papers by artists and collectors since then, but recent analysis of surviving specimens of this period shows it is not necessarily true. There is no such record for later times, though actual specimens exist for examination, showing that almost all papers from the +9th century are horizontally marked.

One may conclude that the woven type of mould made of cloth was used before the +3rd century, while the laid type of screen mould made of bamboo strips was introduced in the +4th century. In the former case, paper was dried directly on the woven mould and no couching was needed. For the laid mould, sheets were formed and dropped on the board without interleaving cloths between them, as has been the practice of Western papermakers. Since the damp fibres did not stick to the smooth bamboo screen-mould as they did to the coarse cloth, the new appliance made possible the continuous use of the same mould to make unlimited numbers of sheets without waiting for each one to dry on it. This was certainly the most significant step in the technique of papermaking.

(3) Processes of Papermaking

Paper was made mostly by hand with the aid of natural resources, tools, stamps, and chemical agents. The workshop was usually operated in a site near a mountain, where the supply of raw materials and fuels was most convenient, and by a stream so as to make use of the water necessary for soaking, pounding, and washing the materials. The methods of papermaking varied slightly according to materials, periods, and locations, but the basic processes were more or less the same throughout the centuries.

Much of the earlier literature describes the quality and format of the paper for various uses, but none of it discloses details of how paper was manufactured, until

(i) Preparation of raw materials

The making of bamboo paper is a craft of the south, especially popular in Fukien province. After the bamboo shoots have started to grow, the topography of the mountain area should be surveyed. The best material for papermaking is the shoots that are about to put forth branches and leaves. During the season of nung-chang5 the bamboo on the mountains are cut into pieces from five to seven feet long. A pool is dug right there in the mountain and filled with water in which the bamboo stems are soaked [Fig. 1071b]. Water is constantly fed into it by means of bamboo pipes to prevent the drying up of the pool.

After soaking for more than one hundred days, the bamboo is carefully pounded and washed to remove the coarse husk and green bark. This is called "killing the green" (a ching).6 The inner fibres of the bamboo, with a hemp-like appearance, are mixed with high-grade lime in a thick fluid and put into a pot to be boiled over a fire for eight days and nights. The pot for boiling bamboo, four feet in diameter, is enclosed in a wooden cask, measuring fifteen feet in circumference and more than four feet in diameter [Fig. 1071b]. The pot is attached to the cask with the aid of mud and lime and has a capacity of some ten catties of water. The cask is covered for boiling for eight days.

After the fire has been put out for one day, the bamboo fibres are taken from the cask and thoroughly washed in a pool with clean water. The bottom and four sides of the pool are lined securely with wooden boards to keep out dirt. [This is not necessary in making coarse paper.] When the fibres have been washed clean, they are soaked in a solution of wood ashes and put again into a pot, pressed to flatten the top, and covered with about an inch of rice straw ashes. When the water in the pot is heated to boiling, it is poured into another cask and strained with the solution of wood ash. If the water cools off, it is boiled again to repeat the straining. After some ten days of such treatment, the bamboo pulp naturally becomes odorous and decayed. It is then taken out to be pounded in a mortar [water-powered pestles are available in mountain regions] until it has the appearance of clay or dough, and the pulp is then poured into a vat for use.


5 A lunar term, 'Grain in Ear', about the sixth day of the sixth month.

6 This is an old term for removing the green skin of bamboo in preparing it for writing. Apparently this term was incorect for this purpose since in both cases the process was part of the preparation of material for writing.

4 采薇
5 天工開物
6 采薇
solution is made from a material similar to the leaves of the peach-bamboo and has no definite name as it varies locally. When the paper is dried, it will turn brilliant white. The screen is made of a mat woven of finely split and polished bamboo strips. When it is open it is supported by a rectangular frame. The screen is held with both hands and submerged in the vat to stir up the suspended fibres [Fig. 1071c]. When it is lifted up, the fibres are caught on top of the screen. The thickness of the paper depends on the way in which the screen is manipulated. Shallow submerging results in a thin sheet, while a deeper dip produces a thick one. Water from the pulp drains off around the screen’s edges and back into the vat. The screen is then inverted and the paper is dropped onto a wooden board until many such sheets have been piled together.

When the number is sufficient, the sheets are covered with another board and the boards are tied with rope with the aid of a pole placed over the top board, as in a wine press, and all the water is thoroughly squeezed from the sheets [Fig. 1071d]. Then each sheet is lifted by means of a small pair of tweezers.

To dry the paper, a double wall of earthen bricks is erected, with the ground between the two rows covered with bricks. Holes in the lower part of the wall are left by the spaced omission of bricks. A fire is lighted at the first hole and the heat travels through the apertures and spreads to the wall surfaces where the bricks become hot. The wet sheets of paper are spread on to the wall one by one, baked dry, and then taken off as finished sheets [Fig. 1071e].

(iii) Steps in making bamboo paper

About two centuries after Sung Ying-Hsing, an eyewitness description of the processes of making bamboo paper was again given by a scholar, Yang Chung-Hsi1 (1850–1900), in a supplement to his collected notes. His description is somewhat similar to that of Sung Ying-Hsing, except for a few remarks which may be useful to supplement Sung’s account. Yang said that from the cutting of twigs to the drying by heat, the raw paper material changes hands seventy-two times before it becomes paper. A proverb in the paper trade says: ‘A sheet of paper does not come easily; it takes seventy-two steps to make.’

Yang also said that a man named Huang Hsing-San2 of Chien-thang visited Chih-hang-shan3 (in modern Chekiang), where people on the mountain told him that the craft of papermaking required twelve major steps. The following is Yang’s record of the processes according to the twelve steps given by Huang:

1) Cutting the shoots. The young and tender bamboo that has not yet sprouted twigs is selected. Its shoots are snapped off and, over a month, chopped into short pieces.

2) Refining the fibres. They are thoroughly soaked in lime until the bark and bunch are sloughed off completely and only the fibres remain, tangled up like hemp. This is the stuff for papermaking.

3) Steaming. The fibres are broken in two, arranged in bundles, and again soaked. Then they are put into a pot and subjected to very hot steaming.

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1 See Yang Chung-Hsi (1), ch. 5, pp. 392–396.
2 This process is to extract the fibres and to remove impurities from the material.
3 Chih-hang-shan
§ Calking. Afterward, they are washed and cleansed with water. When the cleansing is done, they are sunned.

5) Sunning. The sunning must be done on a flat area of several acres, paved with pebbles and sprinkled with green vitriol to inhibit the growth of weeds. For this reason, the area for sunning paper may not be cultivated.

6) Soaking with ashes. After sunning they are soaked and steamed three more times, until the yellow turns white. For these soakings the seeds of the tan tree or wood ashes of the yellow thorn *Vitis negundo*, known in Chinese as the *kuang-ching*، must be used for whitening.

7) Poundling. The fibres are then put under water and pounded. In a day three catties can be made and the fibres turned into a pulp.

8) Purifying. If the pulp is not pure, it is poured into a fine-meshed cloth bag and lowered into a deep stream. A board is projected into the bag to stir it occasionally. In this way the ashes are got rid of completely and the pulp is rendered as white as snow.

9) Making the mould. The tank is made of chiselled stone. It should be slightly larger than the sheet of paper.

10) Weaving the screen. The bamboo is woven into a screen, the size of which is measured by the size of the tank. The craft is extremely exact, and is practised only by a Thang family in the mountain, who do not allow it to be taught to others. When the screen is ready, the paper pulp is poured into the tank, and water is added, mixed with gum and the sap of the *mu-chung* (*Hibiscus syriacus*) for binding. Two men lift the screen from the pulp and stir it up as it forms into a sheet of paper.

11) Repelling the water. The sheet is then placed on top of a stone. After a hundred sheets are piled up, they are pressed together to squeeze out the moisture.

12) Drying by heat. The sheets are then lifted and dried by heat on a wall. The centre of the wall is heated and a fire is placed in it. The men holding the paper place the sheets closely together on the wall. By the time the next one is ready, the previous one is dried. The process of straining and drying require varying degrees of timing, but once the technique is mastered it can be carried out easily.

(iv) Methods of making bark paper

For making paper of paper mulberry bark, Sung Ying-Hsing describes the cultivation of the plant and the mixing of the bark with bamboo and rice stalks. Except for describing the cutting of paper mulberry, he gives no details of separate steps of the process, which apparently were similar to those for making bamboo paper. He only added:

In making bark paper, sixty catties of paper mulberry bark are added to forty catties of very tender bamboo. They are soaked together in the pool, mixed with fluid lime, and boiled in a pot to be macerated. Recently, a more economical method uses seventy per cent of bark and bamboo mixed with thirty per cent of rice stalks. With a proper formula added to the pulp, the paper can still be brilliantly white.

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* Only one person is required if the screen is small.

1) *Yuen King Chih Hsü* (*TMODC*), p. 219; C. C. Sun & Sun (5), p. 230.
2) 黄册
3) 本缩

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9) Phant Chu-Hsing (8), pp. 18-19.
10) 佳能冬香

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A similar method of making bark paper is given by Dard Hunter from his personal observation of the method of papermaking in China. He says that before the bark pulp can be moulded into paper, a mucilaginous gum made from the leaves of deciduous trees is added. In general, the treatment of tree bark is a more arduous and painstaking process than that of prepareing bamboo for papermaking.

(4) TREATMENT OF PAPER

Before the formation of a sheet of paper, an adhesive solution and certain insoluble materials were usually added to the pulp, in order to improve the physical and chemical qualities of the finished product. After the paper was manufactured, it was sometimes treated with special ingredients to protect it against injury from insects or for artistic purposes. The processes included sizing, loading, dyeing, colouring, and coating. Different kinds of vegetable, animal, and mineral substances were used as ingredients for such treatment and sometimes prepared and applied by elaborate procedures. All these were essential steps in the technical and artistic advancement in papermaking.

(1) Sizing and loading

Sizing is essential to make the paper suitable for writing with ink, to prevent undue absorption and running of the ink. It is necessary not only for artistic purposes in painting or calligraphy, but also for technical reasons. It helps to keep the fibres floating in the tank, thus making the sheet even and uniform, and also adds to the bonding strength of the fibres. Especially important, when the sheets are transferred from the screen to the board to be pressed and dried, is the fact that the sizing prevents the sheets from sticking together. Loading with certain finely powdered materials improves the opacity, texture, and weight of the finished paper.

The earliest papers were sheets of fibres without sizing or loading, but these additions are believed to have been introduced as early, probably, as before the 4th century B.C. The specimens of the Ch'in dynasty (+255-240) found in Sinkiang are well sized and loaded. These papers were first coated with gyppsum and later sized with gum or glue made of lichen. Subsequently starch flour was used to make paper much stronger and harder. Recent studies of ancient papers by Chinese scientists have found that specimens of the late 6th and early 5th centuries are coated with starch on the front side and smoothed with a stone. Those of early 5th century from Tunhuang and Sinkiang are sized with starch in the pulp. Paper sizing in modern Kuangtung is made by boiling the leaves and twigs of an evergreen shrub called *li koh tung chih ping* (*Arala pseudos*), or from shavings of the
toxic effect in keeping insects away. It was prepared by soaking its inner bark, which is yellow and bitter, to produce a liquid used for dyeing.

The methods of preparation and application of this liquid are described by Chia Su-Hsiêh (3rd century):

The paper to be treated should be unlined, for it is tough and thick, and especially suitable for dyeing. When the whiteness is diminished through the treatment, it should not be dyed too deeply, or its colour will turn dark in the course of time.

When the paper is thoroughly soaked, if one throws away the dregs and uses the pure liquid only, it is wasteful. After soaking the paper, the dregs should be pounded and boiled, pressed in a cloth sack, and again pounded and boiled, three times. The liquid is then added to and mixed with the pure juice. Thus four times as much liquid is saved, and the paper so dyed will be bright and clear.

Writing on a book should be treated after the lapse of one summer, then the seams will not be loosened. Those newly written should have the seams pressed with a flat iron; only thereafter may they be dyed. Otherwise, the seams will become loose.

Many papers dyed with this liquid are found among the manuscripts from Tun-huang surviving today. The earliest example of known date is a note written in +500, which is about twenty-six feet long and dyed yellow, except at the very end, where the original whiteness colour remains. Other examples of such dyed paper are found among the manuscripts especially of the +7th and 8th centuries some of which, treated by this process, are said to have been preserved in better condition than others which were not. In some cases, the name of the dyer is given in the colophon, indicating the importance of such artisans in producing books.

Some twenty sutras written in +671–7 name the dyers as Haich Shang-Chiêh, Wang Kung¹, Hui Chih⁴, and Fu Wen-Kai². A few mention the dyer, but omit his name. The dyers, known as chuang huang chung⁵, also served in various departments of the court, along with such other artisans as scribes, makers of inked rubbings, and brush-makers. The Tang administrative codes of +723 –30 and the History of the Tang Dynasty both record that official positions for paper mounter-dyer and paper-sizer existed in various academic agencies, including nine in the Chancellery (Men Hsia Sheng⁶), six in the Palace of Assembled Worthies (Chi Hsien Tiên⁷), three in the Academy of Respecting Literature (Chih Huang Wen Yu'an⁸) and ten in the Imperial Library (Pi Shu Sheng⁹), for duties connected with the treatment of paper for documents. A decree of +675 says: "Since the issuing of decrees and orders is a permanent institution and since white paper has generally been darned

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¹ See chemical formula in Pian Chi-Hsiung (14), p. 46.
³ Giles (17), p. 47 (no. 8, 4150).
⁴ See the list of colophons in Giles (17), p. 66; also discussion in Pian Chi-Hsiung (14), p. 46.
⁵ Chang Lou Tien, ch. 1, p. 236–9, ch. 9, 34, ch. 10, 21, ch. 11, p. 249; Hsi Liao Tien, ch. 43, p. 426; Hsiang Shou, ch. 47, pp. 59-60.
⁷ See the list of colophons in Giles (17), p. 66; also discussion in Pian Chi-Hsiung (14), p. 46.
aged by insects, hereafter let the Grand Secretariat be instructed to order that yellow paper be used by the various government offices and all the districts and prefectures.\(^7\) This practice of dyeing paper was continued until some time in the Sung dynasty, when book format was changed.

Another method of treating the paper with insecticide was the use of litharge or red lead (tung tan\(^6\) or shih tan\(^7\)), which is a mixture of lead, sulphur, and saltpetre. Paper treated with a solution of these chemicals turns a bright orange colour called wun nun han\(^6\) (ten-thousand-years red) and is toxic to bookworms.\(^6\) Many books printed in the Kuangtung area in the Ming and Ching period and bound with such papers have been preserved in perfect condition without being damaged by insects. The manufacture of the red lead is described by Sung Ying-Huang of the 17th century, as follows:

The ingredients for making lead litharge are: ten ounces of native sulphur, one ounce of nitre and a cake of lead. Melt the lead first. While it is in the molten state, add some drops of vinegar, then add a piece of sulphur while the molten mass is steaming. Shortly afterward, a small bit of nitre is added. When the steaming subsides, more vinegar is added and the process is repeated with the nitre and sulphur being added little by little. Litharge is obtained when the mass turns into powder.\(^7\)

This powder was mixed with water and vegetable glue and heated into a solution, which was then applied over the white paper. After drying, the treated sheets were used as endpapers inside the covers for the protection of the untreated paper from damage by bookworms.\(^7\) After the book was changed from the roll to the flat format, it was impossible to dye the entire book in the former way. The use of paper treated with red lead solved this problem and proved to be much simpler, easier, and more effective than the old method.

(ii) Colouring

While dyeing of paper was primarily for incunabular reasons and permanency, colour was also added for artistic purposes. The earliest known coloured paper was probably the ho-foh of the Han dynasty, which was described by Meng Kiang of the +3rd century as a kind of "ink-paper dyed red for writing, as it is dyed yellow today."\(^7\) If this is correct, red paper must already have been used as early as the

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* Wen Fang Shu Fa (TSNCC), p. 54.
* For a study of the litharge-treated paper, its chemical analysis, and bookworms, see a report by Chou Pao-Chung and others (1), pp. 194–200.
* Other Hsien Shu, ch. 67, p. 194.
* 赤丹 * 赤丹 * 赤丹红

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* Why Fang Shu Fa (THSC), p. 49.
* Chien Oih Fu (THSC), p. 4.
* See discussion of ornamental stationery on pp. 91 ff. below.
* Why Fang Shu Fa (THSC), p. 53.
(iv) Coating

To make the paper glossy, stiff, and translucent, a kind of yellow wax was applied to its surface. The wax was called ying huang④ (stiff yellow), or by some scholars huang ying.⑤ After the application of the wax to the surface with a hot iron, the paper became smooth, stiff, and translucent, and could be used for tracing paintings or calligraphy. The process was also used to brighten paper material if darkened by age. It was commonly used from the Tang through several dynasties for these purposes; thus Chang Yen-Yüan⑥ (c. 860) mentioned that 'art lovers should keep a hundred sheets of Hsian paper to be prepared and coated with wax for making traced copies.' Later, Chang Shih-Nan⑦ (+ 13th century) said that paper could be evenly coated with beeswax by means of a hot iron. Although the paper became somewhat stiff, it was glossy, smooth, and translucent like ming-chihli⑧ (translucent horn) so that the slightest particles could be seen through it. A Ming scholar, Li Jih-Hua⑨ (+ 1655 to 1685) wrote:

Ying huang paper is made because people dislike the opacity and rough surface of ordinary paper. Therefore they heat paper over a hot flat iron, and then wax it evenly with yellow wax. Although the paper then becomes slightly stiff, it is glossy and translucent, resembling flakes of fish bone or sheets of transparent horn. If one lays a sheet of this paper over something, even the smallest details of such an object will be perfectly discernible. Generally antique autographs from the Wei and Chin periods, left by calligraphers like Chung Yu⑩ (+ 191–379), So Chihing⑪ (+ 259–303), or Wang Hsi-Chih⑫ (+ 321–379), are treated in this way, because in the course of the centuries they have grown dark.⑬

Apparently there were two kinds of stiff yellow paper. One was dyed with a yellowish insecticidal substance and used for writing, the other was coated with yellow wax and it was this that was used for tracing painting or calligraphy. Tung Yu[11] (+ 1127) wrote: ‘Ying huang was used by the Tang people for tracing writing. There was another kind of paper for copying sutra. These two kinds of paper were similar, but different in quality; the stiff and heavy kind was not suitable for sutra paper.’ ⑭ The paper called ying huang is generally characterised as thick, stiff, glossy or translucent and heavy; it was to be found in smaller sheets. A Ching scholar said that the ying huang paper of the Tang dynasty was two feet and 1.7 inches long and 7.6 inches wide, weighing 6.5 ounces.⑮

Besides ying huang, the term tza huang⑯ should be mentioned. As used in early writings it meant a mineral (As2S3), similar to hoang huang⑰ or orpinment (As2S5).

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⑤ See Li Ta, Ming Hua Chi (TSHC), pp. 55-6; also Wen Shih Shu Po (TSHC), p. 98.
⑥ Ye Huan Chi Wu (TSHC), ch. 3, p. 48.
⑧ Chuang Hsiang Shu (TSHC), p. 226.
⑨ Yi Huang⑧ ⑩ Yi Huang⑧ ⑪ Yi Huang⑧ ⑫ Yi Huang⑧ ⑬ Yi Huang⑧ ⑭ Cf. van Gulik (9), p. 127, n. 2.
⑮ Ming Ool Pi Yau (TSHC), ch. 1, p. 4.
⑯ Quoted in Fu Hua T’ou Lu (TSHC), p. 63; see also van Gulik (9), pp. 139-40.
⑰ Yi Huang⑧
technique was improved, and mounting became one of the most important processes in the decorating and preservation of works of art on paper. In the process to a work on mounting, the Ming scholar Chang Chhao4 says: 'Mounting is to a scroll what make-up is to a woman.' Without it, 'although this will not detract from her charm, yet it will make her insignificant.'

Mounting is a very specialised technique that requires skill and a knowledge of art to handle different varieties of material—mounting of new paper stock, remounting of old works on paper, or restoring an antique work of art. In any case, it involves many steps of careful study of the work and days or weeks of working time to complete a piece of mounting. It is generally agreed that the quality of workmanship determines the length of life of a picture on paper, and the mounter is said to be 'the arbiter of the destiny of scrolls.'

For mounting, a new piece of paper is usually treated with a thin alun solution first, to prevent the ink or pigments from running. The crystals of alun are first dissolved in cold water, then the solution is brushed over the coloured portion of the paper, on the right side. When this is thoroughly dried, the treatment is repeated on the reverse. Next, a thin but tough piece of backing paper is spread out and moistened with a large, soft-haired brush dipped in clean water, and placed over the original paper. A very thin layer of paste is applied with a broad pasting brush to attach the two sheets of paper, and they are made to adhere by softly tapping with a still-haired brush [Fig. 1072]. If one sheet of backing is insufficient, a second or more may be added in the same way. When the paste has had time to penetrate well into the paper but has not yet dried thoroughly, the scroll must be taken from the table, transferred to the boards on the wall, and left to dry for a week or longer. When this is done, a last sheet of backing may be added before the stave, roller, and suspension loop are attached to complete the scroll.

When an antique piece of art on paper is remounted, the scroll is spread face down on the table and thoroughly soaked by going over it repeatedly with a large, soft-haired brush dipped in clear water. After a while, the old backings are peeled off one by one with a bamboo spatula and tweezers while the scroll is still moist. Holes and tears in the paper are patched by pasting thin strips of paper of matching colour on the reverse. If the surface of the paper has accumulated dust in the course of years, this is washed off with a pure extract of acacia pods or of loquat seeds (Gleditschia sinensis), both of which contain detergent. When the dust is thus removed, a fresh and bright surface will be obtained without fading of its colours. After the paper has dried thoroughly, new backing is added as is done with new paper, and additional work such as re-touching is done.

For mounting sheets of inked squerres, there are different methods depending on whether the original is cut or uncut, and is to be rolled in a sheat or album, or folded. Mounting of an uncut piece is primarily to strengthen the sheet by backing with a thin layer of bark paper. A large sheet can be folded to be kept in a box, or made into a scroll with rollers, like a painting for hanging. Mounting of a cut piece requires a special technique. A sheet of inked squerres from a large tablet may be cut into long vertical strips like the columns of a traditional book and then mounted in book form as an album. The technique depends on the skill with which the strips are cut. Vertical cutting should be done in such a way that all pages nearly fit to each other in an unbroken row, while the horizontal cutting should result in a perfectly straight top and bottom; if this is expertly done, the work is as good as finished.

(ii) Preparation of the paste

The success of mounting depends largely upon the proper preparation of paste, especially its viscosity and its adhesive effect. The basic ingredient is flour or rice

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5 C.f. van Gulik [9], p. 6.
6 Washing with acacia pods is as early as the Thang dynasty; when Chang Yun-Yuan mentioned it in his L.Tai Ming Hsueh Oki (TSKCC), ch. 3, p. 197. The use of the loquat seeds is mentioned in the Chang Hsuan Oki (TSKCC), pp. 8 - 9: C.f. van Gulik [9], pp. 114, 187 - 4.
7 张燕
8 For mounting of inked squerres, see Chang Hsuan Oki (TSKCC), p. 7; C.f. van Gulik [9], p. 325.
starch, but the addition of a plant root called po-chi (Blätilla striata) is said to be best for increasing viscosity. Thao Trung-Fu (+ 1390–99) cites in his Cho Keng Lu a conversation between a scholar, Wang Ku-Hsin, and an 83-year-old monk, Yang-Kuang, the custodian of old sutras in a Buddhist temple. When he visited Wang’s studio, the monk was asked: “How is it possible that the sutra rolls of former dynasties, although their seams are as narrow as a thread, have after so many years not become loose?” He answered: “The old method was to use sap of paper mulberry, fine flour, and a powder of po-chi. When the three are mixed into a paste and used to fasten the sheets of paper together, they will never become loose, for this paste is as sticky as glue or varnish.”

The po-chi is an orchidaceous plant, which tastes bitter and contains a large proportion of mucilaginous substance. The sap of its root has been used in pharmacy as well as in preparing paste, as is mentioned in the Po-Pu Thao by Ko Hung (+ 4th century), who said in a chapter on medicine for immortality that “the po-chi is for making paste.” Sometimes other ingredients such as pepper, incense, and alum were added for fragrance, preservation, and an insecticidal effect. The recipe by Chou Chia-Chou says that the paste is made of po-chi and white alum, to which is added a little frankincense, yellow wax, and also hou-chiao (Xanthoxylum piperitum) and po-pu (Stemonita tuberosa), which were put into boiled water. Both hou-chiao and po-pu have the effect of keeping insects away, because the paste is never eaten by insects, while the paste itself will never allow the sheets to become loose or be subject to other deficiencies.

(iii) Restoration

The methods of repairing and restoring the torn pieces of paper of a traditional book are similar in part to those for remounting antique art pieces. The paper of Chinese traditional books has usually been damaged by insects attracted by the rice starch paste, by fungi caused by heat and moisture, and other hazards such as water, dust, and smoke. Insects perforate the paper, while fungi leave discoloured spots, and also weaken the paper. To repair insect perforations or tears and other worn places, a piece of thin but strong last paper may be pasted on the reverse. If the paper to be restored is yellowed, the discoloured patches may be dyed with an infusion of tea to which a disinfectant is added, while if the perforations are minor, they may be repaired individually. The page is placed face down on a waxed board and paste is applied to the edges of the perforation, and the patch is applied. After drying, the page is carefully peeled off the board. If the perforations are complicated, the patch may be placed on the board and the damaged page placed over it, face up. Then the edges of the perforations are placed in their correct positions on the pasted patch with a pair of tweezers. The page is worked into perfect contact with the patch, and is left to dry on the board (Fig. 1073), from which it is carefully peeled away when completely dry.

If the paper is weak and brittle, or extensively damaged, it is necessary to mount the pages on sheets of thin, strong last paper, as described earlier for mounting pieces of artwork. An extra, usually longer, sheet of paper is inserted inside the fold of the double leaf. If a white paper is inserted into a yellow one, it is known as chia-kung yii, “gold inlaid with jade.”

Apparently restoration of paper was practised very soon after paper became used extensively for writing. Chia Su-Hsieh (+ 5th century) said that when book rolls were damaged, if thick paper were used to patch them, these patches would become hard like a scab or scar, which would in turn damage the book itself, but if a

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* The description here is taken primarily from Nordström (1), pp. 274–88, on the restoration and conservation of Chinese double-layered books. The account is generally based on traditional techniques practised by Chinese artisans for centuries.
piece of paper as thin as a scallion leaf were used, the patch could hardly be seen unless it were looked at against the light. If the damaged spot was curved, the patch should be cut to fit, but if too large a piece were used, and not cut to the shape of the damaged area, the torn parts of the paper would twist and shrink.4

(iv) Conservation

For preservation of the paper, Chia suggested that musk and quince (Cydonia oblonga) be placed in bookcases to prevent insects from breeding there. During the humid and hot season of the fifth month, bookworms are hatched. If the books are not unrolled during summer, there are sure to be insects in them. Between the fifteenth of the fifth month and the twentieth of the seventh month, book rolls must be unrolled and rolled three times. This should be done on a clear day in a spacious house which is aired and cool, and books should not be exposed directly to the sun, for it will turn the paper brownish. Rolls heated by the sun quickly attract insects, and rainy and humid days should especially be avoided. If books were cared for in this way, they would last for several hundred years.5

Chia also warned readers against carelessness in handling paper rolls. He suggested opening and closing the books slowly and protecting the roll with extra wrappings. He said:

When a book is unrolled for reading, the extending paper at the beginning of the roll should not be opened in haste; if it is it will be creased, which in turn will cause tears. If a ribbon is wrapped around the extending paper of the roll, it is certain to become damaged. If a few sheets of paper are added before the ribbon is wrapped around the upper and lower parts of the roll, the roll will be kept tight and will suffer no damage.6

These are some of the external factors which influenced the permanence of paper. While the best fibres were used to ensure its durability, all the physical, biological, and atmospheric factors to enhance the longevity of paper were taken into consideration rather early in China, especially for artistic work and for graphic records.7

(4) USES OF PAPER AND PAPER PRODUCTS

Paper has always been a cheap and convenient substitute for more expensive materials or more clumsy objects which have other uses, and it is sometimes suitable for uses in which other materials will not serve. Paper was apparently not invented for writing, but as time went on writing on paper developed into a special branch of art, and for both calligraphy and painting, paper turned out to be the best medium for artistic expression. The use of paper made further progress where

it became available in fancy colours and delicate designs as stationery and for decorative purposes. Being cheap and light, it has been used as a medium of exchange in place of heavy valuable metals, or as a substitute material for personal furnishings, household articles, and recreational objects. Paper has also been chosen for the craft of making replicas or models of treasured objects for ceremonial and festive occasions. Today, paper and paper products have hundreds of uses in communication, business, industry, and household operations; they are found everywhere in daily life. Yet many of these uses can be traced back to centuries ago when paper was used as extensively and variously in China as it is elsewhere to the world today.

Generally speaking, paper was probably used for wrapping from the moment of its invention in the Western Han; for writing from the Later Han; for cutting into designs, making stationery, fans, and umbrellas from the third or fourth century onwards; for clothing, furnishings, visiting-cards, kites, lanterns, napkins, and toilet purposes no later than the fifth or sixth century; for family ceremonies in the seventh; for state sacrifices and making replicas of real objects from the eighth; and for playing cards and in lieu of metal as a medium of exchange from the ninth century. In other words, all these uses for the graphic and decorative arts, for commercial and ceremonial occasions, and for household and recreational purposes existed in China before paper was known to the West.

The progress of papermaking is reflected in the increasing varieties of and names for paper, which have many different origins. Some of the names denote the raw materials from which paper was made; others refer to places where it was manufactured; and still others are the names of designers or of the studies which the product has made famous. Papers are also named for methods of treatment, as sizing, coating, dyeing, or treating with spices; for their appearance or size; and for the use for which a variety is particularly made. The following pages will trace the origin and development of some special kinds of paper and paper products used for different purposes as recorded in literature or found in existing specimens or artifacts.

(1) PAPER FOR GRAPHIC ARTS AND STATIONERY

Paper was used very early as a substitute for bamboo and silk as writing material. No written characters, however, are found on the earliest paper specimens so far discovered, and no reference to the use of paper for writing was made in the Former Han period, though paper was certainly used for books and writing from the Later Han. It is recorded that paper was used together with brush and ink at the court during the reign of Ho Jazz (4-23-36),6 and that a copy of the Chian Chian Tai Chuan6 on paper was given to students who studied the classic at the Han court in

5 Chia Min Yen Hw (TSMC), p. 576.
7 See the discussion on the factors influencing the permanence of paper in Browsing (1), pp. 31-33.
8 Ho Han Shu (ESW), ch. 36, p. 33.
9 留快大傳
Some two dozen characters are found on a remnant of paper from Chü-yen dated around +110 (see Fig. 160), and samples of the late +2nd century recently discovered in Han-Than-Pho, Kansu, also have a few characters on them. Numerous paper documents discovered in Chinese Turkestani bear dates from the +3rd century onwards, while Hsin Hsu (+254–89), custodian of the imperial library of the Chin dynasty, wrote that the bamboo books discovered in the Wei tomb in +280 were copied on paper and kept in three separate collections. The increasing use of paper for books is also reflected in the records in earlier historical bibliographies. From such evidence, it may be concluded that paper was adopted for writing from the +1st century, but not extensively used for books and documents until the late +2nd or +3rd century.

The earliest extant example of a complete book on paper is probably the P'ei Yü Ch'ang [Party para sutra] written in +256 on lu ho ch'ieh [Fig. 1074], which is said to be a paper made of six different materials or in Lu-ho in northern Chiangsu. This kind of paper may have continued in use in the Sung dynasty, for the noted artist Mi Fu (+1051–1107) remarked that the lu ho paper had been used since the Chin dynasty. Other early book rolls extant today are generally written on papers of hemp, paper mulberry, or a mixture of these materials. Some of them survive in excellent condition (Fig. 1076).

The most common papers used in the Thang dynasty were made of hemp, paper mulberry, and raffia, as is testified by both analytical studies of the paper specimens and literary records. Some sixty pieces of paper from T'ung-huang and made between the +5th and the +10th century, were photometrically examined by Clapperton, who says that the earliest papers are all thin, transparent, and almost without exception made from carefully prepared and well-beaten materials, while the sheets themselves are even and free from "pinholes" or thick or thin patches. They generally exhibit a high degree of skill on the part of the vannan or papermaker. In addition, most are well sized and can be written on with ease with modern ink and a steel pen. But after the middle of the +8th century the quality of the paper rapidly deteriorated, becoming thick, flabby, uneven in texture, with poor resistance to ink. This change is generally attributed to the political and economic chaos during the later period of the Thang dynasty.

The papers used during the Thang for copying sutras and other books were of two kinds, both made chiefly from hemp. The white kind, called pai ch'ing chao [white sleeve paper], is in small sheets but made heavy by loading or coating. The yellow,
contains an insecticidal substance with a spicy flavour. This paper is strong, with a
scent which is said to last for several hundred years, and books printed on it survive
today. Other papers popular for book printing in the Sung dynasty included pei
chiao chih, a lustrous white kind made probably from the creeping plant pei kish
(Dioscorea quinqueloba) in Fu-chou, Chiangsi; Phu-chiao chih, a medium heavy paper
made in Phu-chhi, Hupeh; Kuang-tu chih, a product of the paper mulberry from
Kuang-tu, Szzechuan; Fu chiao chou chih, a rattan paper made at Yu-chiaochou village
of Hangchou, Chekiang; and Chi-tsu chih, a very smooth and heavy paper made in
Korea.

From the Sung dynasty on, printing became popular and papermaking made
further progress. Publications by the National Academy and various local government
agencies, monasteries, private families, and trade publishers greatly in-
creased in such places as Kuaifeng, Chihheng, Hsia-an-chheng, Hangchow, and
Chien-yang, which were also known as centres for papermaking. A close exami-
nation of the extant Sung, Yuan, Ming, and Ching editions printed on various
kinds of paper shows the high quality of the paper used for printing, which was,
generally speaking, thin, soft, light, and fine. The raw materials were mostly
bamboo and paper mulberry, with sometimes a mixture of rice stalks and other
substances. In the Yuan and Ming dynasties, a kind of extra wide paper was made
of bamboo for writing, and was known as ta tsu lien (large fourfold), whilst in some
districts, fine bamboo was made into an especially heavy and sturdy paper called
tung tsu chih (official document paper); it was kept primarily for official documents.

The paper used for books during the Ming, the best is said to have been the white,
sturdy man chih (cotton paper), which was actually made of bamboo from Yung-
feng, Chiangsi; next was the soft, heavy chun chih (stationery paper) from Chih-
shang, Chekiang; then came the less expensive chu chih (book paper) from Shun-
chhung, Fukien, and last was the chu chih (bamboo paper) from Fukien, which was
short, narrow, dark, and brittle, and lowest in quality and price. The Khi-a-hua
chih, a paper of extraordinary quality made in Khi-a-hua, Chekiang, was especially
selected by the Ching court for the printing at the Wu Ying Tien of the tsu pen, the
Palace editions.

Most popular among the many kinds of paper for artistic uses, especially
calligraphy, has been and still is the Hsi-an chih, a fine, white soft paper made in Hsi-an-chou (modern Hsia-an-chheng, Anhui). This paper was first
mentioned in the Thang documents as an article of tribute from Hsi-an-chou; since
then it has been continuously used and praised by artists. Not all papers made in
the Hsi-an-chou area, however, were of high grade and suitable for artistic use.

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2 The Chih-yu paper is said to have been made of silk fibre, but a recent analysis indicates that it contains mulberry and hemp but no silk; see Phan Chi-Hien (6), p. 97.
3 See Chiao Chao Shih by Chang Yen Chiang (1727-1814), a native of nearby Hsiao-yen, who was among many collectors of this paper. The back of the document is marked with the seals impressed on the front and back of the paper.
4 A sample of a modern imitation is given in van Gulik (2), Appendix V, no. 19.

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Many other kinds were made of bamboo or straw, and used for wrapping, burning, or such handicrafts as making umbrellas; only those of pure bark or bark and straw are suitable for calligraphy and painting. These high-grade papers include 78 pén1 (jade tablet), a very large sheet of white, heavy paper; bún hàn2 (picture heart), one of the artists’ treasures; and 70 cát3 (silk strips) which apparently was made with textile patterns. Unlike writing or printing, works of art sometimes require very large sheets of paper, and the Hán cát3 is especially noted for its extraordinary size, normally twelve by eight feet, with one to three layers in one sheet. Some of the sheets, known as phi chích,4 were as long as fifty feet. A sheet of one layer is made by lifting the screen once from the vat of pulp, of two layers by lifting twice, and of three layers by lifting three times, by two or more vatmen operating the large screen. These sheets are soft, absorbent, smooth, strong, and elastic, suitable for books, documents, stationery, rubbings, and especially for calligraphy and painting.

Another time-honoured paper for artists is the Chinh-Hoang-Thang chích5 (paper from the Pure Heart Hall), especially made in Nanking for the royal poet Li Yu6 (+957–178), the last ruler of the Southern Thang dynasty. The name of this paper is apparently derived from that of his royal palace. Its raw material was paper mulberry, but its fibres were made extremely pure and fine through additional processing. Its surface was polished and waxed after manufacture to increase its quality and beauty, and was described as fine, thin, glossy, smooth, and absorbent; it was considered the best kind of paper at that time. The Ming connoisseur Chang Ying-Wen7 (16th century) said that ‘the paper is thin like the membrane of an egg, tough and clean as jade, and covered with a fine and brilliant coat’.8 Another Ming collector, Thu Lũng8 (+1542–1605), claimed that the paper was so extremely good that many famous calligraphers and painters of the Sung dynasty used it.9 Ouyang Hsin9 (+1007–77) is supposed to have used it for his draft of the History of the Five Dynasties. Apparently the formula for making this paper was still used in the Sung and later times, even though the royal studio was no longer extant by then.

Paper was certainly the most popular medium for artistic use by the Chinese as well as peoples in other nations in East Asia from very early times. They adopted it not only for painting and calligraphy,10 but also for making rubbings from inscriptions and engraved designs and for many different kinds of decorative arts. One example was its use for reproduction of painting and calligraphy by weaving very fine paper strips in colour or in black and white into a sheet as if it were made in fabric with other fibres. A set of forty-six pictures of the Kinh Chích Thù11 showing the processes of tilling and weaving, accompanied by handwritten poems of the

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1 The making of the extra-large paper sheets is described in Hsin-an Hán Chích (1887 ed.), ch. 10, pp. 138. Hán chích is produced in many other places today.
2 Chinese Pt Zhang (MSTF), p. 216.
3 See discussion on pp. 236 ff. below.
4 Chiên Tăng (MSTF), p. 152.
5 Kinh Me Pt Yen Chia (MSTF), p. 216.
6 Kinh Me Pt Yen Chia (MSTF), p. 152.
7 Chinese Pt Zhang (MSTF), p. 216.
8 Chinese Pt Zhang (MSTF), p. 216.
9 Chinese Pt Zhang (MSTF), p. 216.
10 Chinese Pt Zhang (MSTF), p. 216.
11 Chinese Pt Zhang (MSTF), p. 216.
12 Chinese Pt Zhang (MSTF), p. 216.
14 Chinese Pt Zhang (MSTF), p. 216.
15 Chinese Pt Zhang (MSTF), p. 216.
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20 Chinese Pt Zhang (MSTF), p. 216.
21 Chinese Pt Zhang (MSTF), p. 216.
22 Chinese Pt Zhang (MSTF), p. 216.
23 Chinese Pt Zhang (MSTF), p. 216.
24 Chinese Pt Zhang (MSTF), p. 216.
26 Chinese Pt Zhang (MSTF), p. 216.
27 Chinese Pt Zhang (MSTF), p. 216.
28 Chinese Pt Zhang (MSTF), p. 216.
29 Chinese Pt Zhang (MSTF), p. 216.
31 Chinese Pt Zhang (MSTF), p. 216.
32 Chinese Pt Zhang (MSTF), p. 216.
ments. These papers were dyed a single colour, printed with multicoloured paintings (Fig. 1077), embossed in patterns, or sprinkled with gold or silver dust, in order to make them as elegant and pleasing as possible. The making of such papers was an art in itself, and many artists and poets contributed to the advancement of techniques for such ornamentation. For example, violet notepaper was used by the famous calligrapher Wang Hsi-Chih¹ (+371–379), and notepapers decorated with a peach blossom pattern in bright green, blue, and red were designed by Hwan Hsian² (d. +404) in Szechuan,³ a centre especially distinguished over many centuries for its decorative notepapers.

According to early records, stationery papers in ten different colours were made by a Thang official, Hsieh Shih-Hou⁴ of Szechuan.⁵ There were also fancy varieties of paper called by such names as pine flower, golden sand, bright sand, rose cloud, golden powder, dragon and phoenix (red with gold), peach-pink with golden spots. However, the most famous notepaper throughout the centuries was probably the small reddish note sheets designed by Hsieh Thao⁶ (+768–831), a courtesan well versed in poetry who exchanged poems on notepaper of her own design (Fig. 1078) with such well-known poets as Yuan Chen⁷ (+779–813) and Po Chü-i⁸

¹ Wén Fang Shu Pin (SHMF), ch. 4, p. 49.
² Chao Chih Pin (SHMF), p. 2.
³ 王義之
⁴ 蜣玄
⁵ 鴻倩
⁶ 魏伯元
⁷ 斯緹
⁸ 天倫

¹ Wu Yu-Jhiu in Pai Mei Hua Pin, printed in lithography in Shanghai, 1928.
² Hsieh Thao, a Thang courtesan, designed her own note paper for writing poetry. Drawing by Wu Yu-Jhiu in Pai Mei Hua Pin, printed in lithography in Shanghai, 1928.
³ (+779–813). This paper was made of hibiscus skin mixed with powdered hibiscus flower petals to increase its lustra.⁴ It continued to be made, bearing the famous name “Hsieh Thao notepaper,” for many centuries, not only in Szechuan but all over the country.
The earliest note-paper with multi-coloured pictures was probably developed before the Sung dynasty. The family of Yao Chih¹ (fl. +940) made luminous letter papers in beautiful coloured designs of mountains, rivers, forests, trees, flowers, fruits, lions, phoenixes, insects, fishes, 'old father', 'the Eight Immortals', and ancient seal characters.² A poem written about this time describes the designs of a landscape painting of wild geese, reeds, and a setting sun on letter paper.³ Apparently, paper with embossed designs, with watermarks, and even a marbled paper were also developed at this time or earlier. Su I-Chien (†957–959) said that the people of Szechuan made stationery papers with decorations by pressing them on wooden blocks to make such designs as flowers, trees, unicorns, and phoenixes in numerous styles. He also described a 'fish-eggs note-paper' (chieh-te chien¹⁰⁴), made with starch on a piece of closely-woven cloth from which a hidden design like fish eggs resulted,⁴ and in fact many specimens of paper with hidden or translucent designs survive from the +10th century, including one example used by the noted calligrapher Li Chien-Chung⁵ (+945–1108). These translucent designs are considered forerunners of the watermark.⁶ Another kind was 'drifting sand note-paper (lin sa chien¹⁰⁴), the design of which was printed from a flour paste sprinkled with various colours, over which the paper was placed to become stained; thus the design was free and irregular. Sometimes, paste was prepared from honey locust pods (Gleditschia triacanthos) mixed with croton oil and water, with black and coloured inks on its surface. Colours were scattered when ginger was added and gathered if sandblasted was applied with a hairbrush. The various designs which looked like human figures, clouds, or flying birds were transferred from the surface of the liquid to the paper, and in this way a marbled paper was made.⁷ Western authorities have set the origin of watermarks in +1282 in Europe, and of marbled paper in +1550 as a 'Persian invention', but the literary record as well as existing specimens show that the Chinese made such papers at least three to five hundred years earlier.

A close relationship between the manufacture of writing paper and the art of colour prints developed in the late Ming dynasty. The most famous examples are the manual of ornamental letter papers designed at the Ten Bamboo Studio, known as the Shih-Chu-Chao Chien Pha, published by Hu Ching-Yen⁸ about +1643.⁹ The manual included various designs printed in multicolour or by embossing without colour from wood blocks. The earliest extant designs can be seen in the Ten Shih

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¹ Chih Li (Hsien-Tsai), ch. 2, p. 348
² Li Shao-Yen (1), pp. 115–7
³ Wun Fung Sao Pha (Tao-Ke), p. 33
⁴ See examples at the Palace Museum, Peking examined by Phan Chu-Hsi (2), pp. 38–52; also Shih Tung-Kung (1), pp. 3–51
⁵ Wen Fung Sao Pha, p. 53
⁷ The preface of the manual is dated +1449, but our orchid designs, in chapter 2, bears the date +1643. The work was reprinted in facsimile by the Peking Society of Woodcut in +1955; see also below, pp. 381 ff.

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¹ 魏　¹ 魏子娥 ² 季建中 ³ 沈沙梅 ⁴ 十竹僧删

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⁸ See Shen Chih-Yu (1), pp. 7–10; the second volume of this manual was reproduced in facsimile in Tokio in +1933. This art of making ornamental stationery has been handed down to the present day; a great deal of such manuscript is still in use and several excellent manuals of this type have been printed by Jiang Po-Chi, Peking.

⁹ See Lai Shao-Chu (1), which reproduces forty colour designs of contract papers, including one written in +1640.

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¹ 惪氏漢譯 ² 蘇軾變古譯 ³ 傳帖