The main building of the shrine at Okamoto, Japan, one of the most impressive sanctuaries in the world dedicated to the ancient craft of papermaking.

Mizuha-Nome-no-Mikoto." The moment the answer was given, the apparition disappeared and was seen no more by the simple village people. Soon after this strange occurrence the art of papermaking was established in Echizen, and the people from the surrounding countryside built, near the village of Okamoto, a beautiful Shinto shrine and dedicated it to Mizuha-Nome-no-Mikoto, the mythical founder of Echizen papermaking. The lovely old grey group of wooden, tiled-roof buildings, some half dozen in number, is set on a quiet and lonely hillside amid giant evergreen trees through which penetrate thin streaks of light casting weird patterns upon the moss-covered roofs of the inspiring shrine – one of the most impressive sanctuaries in the world dedicated to the craft of papermaking (Figure 33).

While the first paper of China was probably fabricated from disintegrated cloth, it was not long before the bark of trees and other vegetation was employed as a material for the purpose. It is recorded that the mulberry, hemp, and China grass were used as papermaking materials previous to the third century of our era. The first paper introduced into Japan from Korea (about A.D. 610) was made from mulberry (Broussonetia papyrifera) bark (Figure 34). Gampi (Wikstroemia canescens) (Figure 35), a plant of wild growth, has apparently been in use as a papermaking fibre since the ninth century. Its use was probably discovered by the Japanese. According to the Chinese scholar Su Tung-p’o, who lived from 1086 to 1101, bamboo was just beginning to be employed in China for making paper. Rice straw as a paper material dates from a later period, 1334–1521. The origin of mitsumata (Edgeworthia papyrifera) (Figure 36) as a papermaking material is uncertain, but there is a record stating that in the year 1597 a papermaking family was granted the privilege of gathering mitsumata bark in a certain locality of Japan. This plant is of the family Thymeleaeaceae and is symbolized in Chinese by the character "lucky fragrance." The genus Edgeworthia denotes "yellow lucky fragrance" (Figure 37).

The earliest specimens of Oriental papers in the Hunter Paper Museum collection date from the fifth century onward and are composed of hemp and mulberry fibres; the earliest of these papers are exceedingly well formed. Papermaking in China deteriorated from the seventh to the tenth century, when the paper became rather coarse and lumpy. The Japanese have made excellent
Fig. 37 The four most important papermaking fibres of the Orient:

Paper mulberry
(Broussonetia papyrifera, Vent.)

Bamboo
(Phyllostachys edulis, Carr.) H. de Lehaie.

Mitsumata
(Edgeworthia papyrifera, Seib. and Zucc.), (E. chrysantha, Lindl.), of the family Thymelaeaceae.

Gampi
(Wikströmia canescens, Mein.), (Passerina gampi, S. and Z.), of the same family as the mitsumata.

Fig. 38 Old manuscripts written on the soft, absorbent paper of the Orient. The Chinese, Tibetan, and Mongolian manuscripts are on paper made from the inner bark of the mulberry (Broussonetia papyrifera); the black Siamese manuscript is on paper made from the bark of the khoi (Streblus asper), stained with a pigment made from the nuts of the betel palm (Areca cathecu).

Paper from the introduction of the craft in the seventh century. Practically all of the ancient Chinese and Japanese paper was formed on the flexible type of mould upon which all papermaking is founded.

The Chinese and Japanese people had a profound reverence for paper and for the craftsman who fabricated the thin, delicate sheets. This was only natural, as the earliest paper was used chiefly for inscribing the sayings of Kung Fu-tsu (Confucius) and for other writings deeply concerned with the religious life of the East. It would be just as difficult for an Occidental to understand the traditions of the ancient Chinese and Japanese classical writings as it would to comprehend the study, thought, and practice given by them to the technique of calligraphy, and the important part that paper and all manner of writing materials played in the lives of the great Asiatic scholars.

The history of Chinese calligraphy is believed to be as ancient as the civilization of China. It is difficult, however, for the Westerner to comprehend and appreciate the mysteries and perplexities of Chinese brush writing, even though he may have a knowledge of Chinese painting. Calligraphy is one of the highest forms
THE INVENTION OF TRUE PAPER BY TS’AI LUN

of Chinese art, and every painting is accompanied by beautifully executed characters. To the Chinese scholar his calligraphy — and in turn his paper, ink, ink-stone, and brushes — are his very life. Unless an Occidental connoisseur has been reared in the artistic traditions of China it is difficult for him to grasp the aesthetic significance of Chinese writing and to visualize the time and thought given to the perfection of brush strokes with carbon ink upon thin absorbent paper (Figure 88).

From China paper found its way into central Asia and Persia by a route well known to the caravans which sought to open a road connecting the Pacific with the Mediterranean. This road was later mapped by Marco Polo in the thirteenth century, following the Gobi Desert, the Desert of Takla Makan, and the Tarim Valley, and finally arriving at Samarkand. Chinese paper made from bark and the fibres of rags and hemp may possibly have been imported and sold in Samarkand, but it is thought that paper was not actually made in Samarkand until after A.D. 751, the year a battle was fought by the Chinese in Turkestan on the banks of the Tharaz River. It is recorded that among the Chinese prisoners taken in this conflict there were a number of skilled papermakers, and their captors set these craftsmen to work fabricating paper. Up to this time the art of making paper had been a closely guarded secret in the country of its inception. The manufacture of paper was favoured in Samarkand by the abundant crops of flax and hemp, as well as by the numerous irrigation canals, as plenty of pure water was then, as now, a necessary requisite for paper production.

From Samarkand the craft of making paper spread to Baghdad and Damascus and finally into Egypt and Morocco. It required almost five hundred years to find its way into Europe from Samarkand, as there was little communication between the East and the West. It is not known whether the craft was first introduced into Spain or Italy, each country having its own claimants. In any event, the first papermaking in Europe was accomplished in the twelfth or thirteenth century, or over a thousand years after its inception in China. The early paper of Europe was regarded with disfavour, as not only was it higher in price and more fragile than parchment, which had been used for bookmaking, but it was distrusted on account of its introduction by Jews and Arabs. A fanaticism drove the Christian world to condemn, and even destroy, everything that suggested the Moslem civilization, although the European scribes have doubt knew that the newly introduced substance, paper, would eventually take the place of their cherished parchment.

Since papermaking in China, as well as in Europe, was an established art long before the advent of printing, it is only natural that paper vitally influenced the craft of printing. The nature of the paper dictated the methods employed in printing. In both the Orient and the Occident much of the first paper had been made especially for calligraphy, the inception of the art of writing having preceded the invention of papermaking and the later invention of printing by many hundreds of years. The first block printing of the Orient and the earliest impressions made from movable types in Europe were imprinted upon sheets of paper that had been made primarily for the purpose of writing. Chinese and Japanese paper has always been thin, soft, pliable, and absorbent, owing to the Asiatic vegetable fibres and their preparation as well as to the process of forming the sheets of paper upon flexible moulds made of bamboo. This paper lent itself readily to the steady, firm strokes of the brush used in the drawing of Chinese and Japanese characters. This particular style of calligraphy required an absorbent paper, and on account of the thin, transparent quality of the sheets, only one side of the paper was written upon. When the Empress Shôtoku of Japan had her million printed charms executed, A.D. 770, and when the Diamond Sutra was printed in China by Wang Chich, A.D. 868, only paper that had primarily been made for writing was available and therefore the method of printing was adapted to the paper at hand — not the paper to the printing. The printing was naturally influenced, for with the soft, pliable paper it was possible to make an impression from a wood-block in the simplest and easiest manner. The process consisted in spreading the incised surface of the block with pigment, placing a sheet of paper upon the inked relief, and rubbing the upper side of the paper with a fibre or cloth ball by hand until a definite impression was made. (For a description of ink-making see page

* See Chapter iii.
75: note.) Following the practice of all Chinese and Japanese calligraphy, only one side of the sheet was used, and to this day in all Chinese wood-block book-printing, only one side of the paper is employed.

In the same way the first book-printers of Europe had to make their work conform to paper that had been made primarily for writing. When Johann Gutenberg established his printing office in Mainz, there were no European-made papers suited to the simplicity of the Chinese and Japanese methods of making an ink impression from wood-blocks. The paper of Europe was made from macerated linen and cotton cloth, each sheet being dipped in a solution of gelatine rendered from the hoofs, hides, and horns of animals. The linen and cotton rags and the animal glue formed a hard, opaque, and impervious surface well adapted to the European mode of writing with a quill pen, but entirely unsuited for printing in the non-laborious and unpretentious manner long before adopted by the Chinese and Japanese. There is no record that Gutenberg had paper made specially for his purpose, and as it was no doubt his desire to keep the newly invented process of typography and printing to himself, it is not likely that he would have exposed his secrets by venturing to the paper mills and demanding paper that would precisely suit his own special printing requirements. Therefore, in Europe, as in the Orient, paper that had been made primarily for writing was employed for the first book-printing. In China and Japan the thin, soft mulberry-bark paper was suited to the most simple and direct manner of reproduction from wood-blocks, while with the hard rag paper of Europe a method of printing that would give a much stronger impression had to be devised. It was this unyielding linen and cotton paper, made impervious to fluid writing ink by the application of animal gelatine, that made necessary the invention of the printing press.

Paper that had been fabricated purposely for writing not only determined the sizes or dimensions of the books printed by Gutenberg and the volumes that were to follow, but highly influenced the method of making an ink impression from type to paper. Unlike the thin, transparent papers of the Orient, only one side of which could be used for writing or printing, the paper of Europe, thick and opaque, lent itself readily to writing or printing on both sides of the sheets. The construction and form of Oriental and
Empress Shōtoku and Her Million
Printed Prayers

THE FIRST TEXT PRINTING UPON PAPER TO BE EXECUTED IN THE WORLD

As outlined in the foregoing chapter, papermaking was introduced into Japan about A.D. 610. At this time Japan was experiencing a more complete cultural change than at any previous period. Japan was entirely under the influence of China, the most intellectual and most highly developed country in the entire world. Numerous Buddhist missionaries found their way from China to Japan, and in turn Japanese students in pursuit of education visited China, returning to their native land after years of study, inspired by the culture and refinement of the Celestial Empire. The returning Japanese students introduced Chinese customs and manners into their own country and it was acknowledged throughout Japan that the arts, crafts, literature, and religion of China should be admired and adopted by Japan as highly desirable. The Japanese were most eager to emulate every superior Chinese custom and there was universal approval when the government officials selected a Chinese scholar to direct the lately founded university in Nara, the new capital of Japan; the Japanese wished to pattern their place of government as closely as possible after the Chinese capital in Sian Fu, the old seat of the Tang Dynasty.

In 716 a promising young Japanese, Kibi-no-mabi, much under the spell of the elegant Chinese customs introduced into Japan by Chinese travellers and returning Japanese students, set out from his native land with a sincere desire and ambition for a long course of study in cultured China. After almost twenty years of tutoring under scholarly Chinese professors he returned to Japan, one of the most learned men of his country. Kibi-no-mabi was welcomed home with loud acclaim and within a short time he was requested to enter the service of the Nara government. In this capacity he had the opportunity of introducing to a greater degree than ever before the customs and manners of the superior Chinese. It is recorded, but often disputed, that this eminent Chinese-trained Japanese scholar was the inventor of the katakana, a Japanese form of writing derived from the ancient Chinese characters, but using only a section or portion of each character in the composition of the numerous symbols. The importance and influence of Kibi-no-mabi does not rest upon the cultural refinements he introduced from China, nor upon the possibility of the calligraphic invention, but upon the fact that he eventually became the tutor of the Empress Shōtoku, under whose guidance and sponsorship the first block printing upon paper was accomplished.

In China and in Japan printing from wood-blocks was preceded by the use of seals. In modern times such seals are cut in metal, wood, jade, ivory, stone, and water-buffalo horn. The employment of incised seals in making impressions with pigment upon paper was, to a degree, a form of printing. Also, there are examples of stamped, or printed, cloth and leather preserved in Japanese temples, dating from the first half of the eighth century. True block printing on paper of a definite nature, however, had its origin some time between A.D. 767 and 770.

Nara was the capital of Japan from A.D. 710 to 784, and during this period the seat of government was decided under Buddhist influence. It was while under the leadership of the Empress Shōtoku, who reigned with but few interruptions from 749 until 769, that the control of the Nara government by the Buddhist

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* The Chinese characters in their entirety were the first symbols employed by the Japanese in writing their native tongue. The first effort to replace these characters gave rise to the kana, a contraction of kana-nda, signifying borrowed names. The katakana, or side letters, are the oldest and most simple form of Japanese writing. According to J. C. Hepburn (Chinese Written Language; Tokyō, 1888), the system was invented by Kibi Daishi, who died A.D. 778.

† A.D. 749, accession of Empress Kōken on the abdication of Shōun; A.D. 758, accession of Empress Junmin on the abdication of Kōken; A.D. 765, deposition and murder of Junmin by Empress Kōken, who resumed the throne as Empress Shōtoku.

‡ "From the early period of Nara (A.D. 708-907) there was a method of printing various patterns on cloth, known as suri-goromo." Hōsha yoroku, by Yōshirō Wada (6 volumes; Tokyō, 1918).
priests reached its height. In 735 an epidemic of smallpox visited Japan, and with this dreadful catastrophe in mind the Empress Shōtoku attached a hundred and sixteen special priests to her court for the express purpose of driving out the demons of disease and evil spirits thought to have been the cause of the epidemic. It might have been to either this smallpox scourge or a desire to make penance for the loss of life that occurred in the suppression of the rebellion of 764 * that the world owes the invention of text printing upon sheets of paper. The Empress sanctioned the printing of a million paper prayers, each prayer, or dhārāni, enshrined in its own individual three-storey wooden pagoda (hyaku-man tō).† About the year 770, after working for six years on the project, the printing of the prayers and the turning and fashioning of the wooden pagodas was finally completed. This event, important alike to the Orient and the Occident, is documented by early Japanese manuscripts; its authenticity is clearly set forth as a definite accomplishment in early Japanese history. The momentous event is described in the histories of the Imperial family of Japan and in many local records of the temples where the printed dhārāni and their pagoda receptacles were originally deposited at the command of the Empress. The official history, the Shoku Nihongi,‡ gives this account of the printed prayers, under

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* The revolt of Eni Oshikatsu, in the 5th year of Tempei-Hoji. See Ko kuwatsu-chi ban no ken-kyū, by K. Kawase (2 volumes).

† The wooden pagodas in which the rolled paper dhārāni are housed and protected were made on a lathe, the wood surface originally covered with a white pigment, which has disintegrated through the centuries. The pagodas measure about eight inches in height and approximately four inches in diameter at the base. The top section, which is removable, allowing access to the small round scroll chamber, is termed in Japanese kurin, meaning “nine-rimmed wheel.” These nine-rimmed spires, or stoppers, are made of the wood of the katsura (Cerisifolium japonicum), a Japanese tree that reaches a height of ninety feet; the bases of the pagodas are turned from the hinoki (Chamaecyparis obtusa), a cypress tree that grows in Japan to about one hundred and twenty feet in height. The wooden pagodas are more common than the rolled printed papers, as numerous pagodas have been found empty, the papers having been removed or lost centuries ago. In rare instances colour has been applied to the outside surface of the pagodas, and several of the wooden receptacles have been discovered with signatures and dates on the under sides of the bases.

‡ Shoku Nihongi, compiled by Suge-no, Mami-chi, is a record of events in Japanese history for the years 704 to 791. The compilation was in charge of the compiler in the year 780. He died in 813, aged about seventy years. The description of the Empress Shōtoku printing will be found in Book XXX.

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FIG. 39 A wooden pagoda used as a receptacle for one of Empress Shōtoku’s printed charms, the world’s first printing upon paper.
Kompon (or Nemoto), Jishin (or Jishin'in), Sōrin, and Rokudo (Figure 40). When this work was completed, the pagodas were distributed among various temples. One hundred and fifty-seven men, from officials to menials, who had participated in the work, were granted titles, each according to his station. The following account has been taken from an old temple record: "In the year 767 there were built two small halls for pagodas on the east and west sides of the temple...a million pagodas were made which were equally divided among ten temples. In each pagoda was preserved a charm (dhārani) in block print."

These two contemporary manuscripts give authentic accounts of the printed prayers; also, what is more convincing, a number of these pagodas are preserved in the temples of Japan. A dozen or more genuine paper dhārani and their pagodas have been taken from the Japanese temples and are now in Occidental museums. In the manuscript records describing this printing accomplishment the number of printed prayers was stated to be "a million," but this great number should perhaps not be taken too literally.

The four dhārani (Rokudo) literally means "six times," or the six cardinal virtues, or the passing to Nirvana; namely, charity, morality, patience, energy, contemplation, and wisdom. It was probably a wrong translation of the Rokudo that confused Dr. Carter into believing that there were six dhārani actually there were but four.

The four dhārani used by Empress Shōtoku were taken from the sūtra: Vimala sūdha prabhāsa mahābhārani (Japanese: Mu-ku Chō-ku 5 dai dhārani kyō). The dhārani are Sanskrit forms of prayer translated in Chinese characters. It is most difficult to restore the original Sanskrit, except that of the dhārani in the sūtra whose original texts have been preserved. This scripture is said to be a story of a Brahman, Gobinsoncheta, who appealed to Buddha for help when he was told by a prophet, Zenō-shi, that he had only seven more days to live.

100,000 printed papers and their pagodas were said to have been allotted to each of the ten temples.

The ten Buddhist temples were: Taian-ji, Genkō-ji, Kōfuku-ji, Yakushiji, Todai-ji, Saichō-ji, Hōryū-ji (in Yamato Province), Shitenno-ji (in Settsu Province), Sōfuku-ji (in Omi Province), and Kokubun-ji. Nine of these temples (ji) were burnt and no printed papers or pagodas confined in them remain; only examples in Hōryū-ji, near Nara, have been preserved.

In 1908 Mr. S. Taia, a Japanese antiquarian, reported that only 43,390 pagodas had survived in Hōryū-ji and only 500 of these were in perfect condition. In the catalogue of national treasures (Tokken kokuku mokuroku), edited by Katsumi Kuroita, and published in Tokio in 1908, there were listed as under state protection, as of January 1908: 103 wooden pagodas and the following printed dhārani: 27 Nemoto (or Kompon), 39 Jishin, 25 Sōrin, and 7 Rokudo. The Rokudo is more rare than the other three.

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* Thomas Francis Carter in his *The Invention of Printing in China* (New York, 1925) states (page 36): "there were six different charms." This is a mistake; Dr. Carter, usually so accurate, was confused in this instance. The
No doubt there was a desire to convey to the populace the impression that a vast number of the prayers had been made and the expression may have been used in a purely symbolic sense.

The making of the paper and the printing of these prayers was probably the first instance of mass production; certainly the project involved more extensive manufacture of paper for one specific purpose than had previously been attempted. While even today the separate printing of a million strips of paper would be a considerable undertaking, the actual making of the paper for these dhāranī did not represent such a tremendous task as might be imagined. In the Orient in the eighth century a papermaking mould capable of forming paper that measured 20 by 22 inches would not have been unusually large, and upon such a mould one worker could have easily formed 500 sheets a day. From each sheet of paper of these dimensions eight strips of paper the size of the individual prayers could have been cut. This would make possible every day the manufacture of sufficient paper for the printing of 4,000 prayers, one person working at the vat. To have formed the quantity of paper required for the million prayers only about 250 working days, or about forty weeks' time would have been needed. For the cultivation and gathering of the material, beating, drying, finishing, and cutting the paper additional craftsmen would have been necessary, but the whole undertaking, voluminous as it appears, would have required the labour of only eight or ten artisans working less than a year. The printing of the prayers and the turning of the wooden pagodas would have necessitated much more time and labour than the production of the paper.

More often than not the paper upon which the dhāranī are printed is found in a deplorable condition, having suffered through the ravages of the destructive “silver fish,” so prevalent in the Far East. The paper that I have examined is composed one hundred per cent of hemp (Cannabis sativa), and is of the “laid” type,† having a decided Korean quality testifying that papermak-

* A fish moth, insect of the genus Lepisma.
† In the specimens I have examined there are about 18 “laid” lines to the inch and the “chain” lines are unevenly spaced, running from ⅜ of an inch to 1⅛ inches apart. The paper averages .0005 in thickness, bulking about 2½ inches to the ream of 500 sheets. The paper is of a light tan colour, as would naturally be the case with unbleached hemp as the material. There is no sizing or loading of any kind and apparently the paper had no special finishing other than the ordinary pressing.
same opinion as Fujiwara Teikan in the theory that copperplates were the medium used are: Noritane Ninagawa,² (1835–82), Tokujō Ōya,³ Osamu Ryō,⁴ Minamoto Kiyomichi,⁵ Takurei Hiraï,⁶ Yasuhiko Kimiya,⁷ Yano Michiya, and Tsuji Zennosuke.⁸ That wood-blocks were used in the production of this early printing is the belief of such well-known Japanese historians as Moroshige Kondo ⁹ (1757–1815), Yoshino Sakakibara ¹⁰ (1832–81), Yorisuke Numata,¹¹ Sho Nakayama,¹² Kamezo Asakura,¹³ Mayoi Kurokawa,¹⁴ and Noritake Tsuda.¹⁵ Only two noted Japanese antiquarians advance the theory that movable types were used: Kariya Ekisai ¹⁶ and Masazumi Eto.¹⁷

The attention given by Occidental writers to this earliest of all text printing has not been at all commensurate with the importance of the accomplishment in graphic-arts history. Very little has been written in French or German on this subject and in English the bibliography would be limited to several short articles ¹⁸ and to the six-page chapter in Dr. Carter’s excellent treatise on printing in China.¹⁹ Dr. Carter states: “... Whether the blocks used were of wood or metal is still uncertain, but they were probably of wood. ... Slight variations among the impressions of the same charm (dhārani) have led some to question the fact that the charms were actually printed from blocks at all. In answer to this, it has been correctly pointed out that such a large number of impressions would have required several blocks for each charm, as only about 10,000 impressions can be taken from a wooden block before it is worn down. ... The spreading of the ink in some of the impressions has been thought by some to indicate that the plates were of metal. On the other hand the variation between impressions of the same charm would indicate wood. The latter would be more in keeping with the general history of block printing, as far as is known.”

Dr. Carter states that only 10,000 impressions could be had from a single wood-block. In this case 100 separate blocks would have been required; the estimate given by Dr. Carter is much too low and is without foundation. It is to be assumed that if wood was employed in printing the million prayers it was side-grain as is customary in the Orient, and not end-grain as used in the Western world.

From the short article ²⁰ by Dr. Cyrus H. Peake, director of the Chinese department, Columbia University, regarding the printing of the dhārani of A.D. 770, the following may be quoted: “... The desire to print was to be found not only among the literati and officials of China, but also among the Buddhist priests. They desired to print in large quantity for sale and distribution among the devoted, paper prayer charms and pictures of the Buddha. It is not surprising, therefore, that the oldest extant examples of printing characters upon paper by means of wood-blocks were for religious reasons. These were Buddhist prayer charms and were printed in Japan by order of the Empress Shōtoku in A.D. 770.”

Dr. Shio Sakashishi, formerly of the division of Orientalia, Library of Congress, has given considerable study to the method used in printing the “million paper charms” and she has made numerous experiments in an endeavour to clarify the procedure employed. Dr. Sakashishi, under date of April 24, 1941, writes: “... we started experiments with soft clay and wrote characters on it with a blunt stylus and dried the clay in the sun. After about ten trials we made some successful ones. ... The use of wood-blocks and movable types is discarded. It is suggested that characters were written with a stylus on some medium, probably clay, which was baked, and the plate made by pouring metal over the block.”

Dr. Carter a block would be worn out after being used but three or four days! For lack of Oriental data concerning the number of impressions possible from a single block, we turn to the Occidental work on wood-engraving by Jean Baptiste Michel Papillon: Traité historique et pratique de la gravure en bois (Paris, 1786). In this book (page 433) the author tells of his grandfather, Jean Papillon, using nothing but the wood of the pear tree for his wood-engraving. He describes a large block representing the Holy Virgin from which each year 5,000 to 6,000 impressions were taken over a period of ninety years, making about 500,000 impressions from a single block. Papillon mentions another wood-block having been used for about 1,000 impressions a year, with the total of 60,000 to 80,000 printings from the one block.

* Dr. Peake has evidently forsaken his idea of wood-blocks, for in a letter to me dated December 23, 1940 he makes the following comment: “Concerning the material from which the dhārani were printed Dr. Tsumoda of our department tells me that Japanese scholars tend to favour the belief now that they were printed from porcelain blocks ... a few scholars believe iron was used, but they are now in the minority. Apparently very few, if any, now believe they were printed from wood-blocks.”

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* In the report of the United States National Museum for 1892 (pages 215–18), T. Tokuno writes regarding the number of impressions that could be made per day from a wood-block: “The printer of Yinaka genti, Tsurusaburo, printed 9,000 sheets per day from the block block. ...” According to
over it.” It would be entirely feasible to produce an evenly faced casting, or stereotype, from a clay base. For this purpose it would be necessary to spread the clay thinly (the actual depth of the characters) over a smooth metal plate and then incise the characters through the clay to the plate. With this method the characters would be drawn in the ordinary manner, as the casting would reverse the letters for proper printing. This system would be much the same as the old “chalk-plate” process in use in America many years ago for producing crude illustrations for newspapers.

From the foregoing controversial opinions it will be seen that the historians and bibliographers, as well as those versed in the mechanics of the graphic arts, have not been able to determine definitely the precise method employed in the eighth century in producing the text printing of the Empress Shōtoku dhārāni.

It has been my privilege to devote considerable research in an investigation regarding the paper upon which the dhārāni were printed; also it has been my good fortune to be able to study the method employed in printing the prayers and in Japan, Europe, and America I have examined numerous specimens. I have my own theory relative to the method used in printing the dhārāni and I hope that it will not be considered presumptuous to advance this opinion, although my ideas differ from those set down by the Japanese scholars.

About fifteen years ago while travelling in northern Korea I discovered among a great store of old wood-blocks a single printing block of stone. This block, now in the Paper Museum, is incised in relief with a human figure and eleven Chinese characters, suited for printing in the ordinary Oriental manner. The size of this stone block is six by nine inches, one half inch in thickness. While the block is undated, I suggest that it was cut as early as the fifteenth, perhaps the fourteenth, century. This printing block is of steatite (magnesium hydrous orthosilicate), also known as pagodite or agalmatolite. This type of stone is not native to Japan or to Korea, but it is common in southern China. Even as early as the eighth century there was extensive commerce among the countries of Asia and it would not have been unusual for quantities of this stone to reach Korea or Japan. Any materials used by craftsmen were readily conveyed from one Oriental country to another and they were always procurable no matter what the distance or the hardship of transport. For example, we always think of China as the home of jade, but in reality there has never been a pound of jade unearthed in China. It is only through the beautiful carvings that China for centuries has been known as the country of jade—not through the actual production of the stone.

In my numerous experiments in an endeavour to determine the method used in printing the million paper dhārāni I have made impressions from old Chinese wood-blocks, from metal plates, and from the steatite block found in Korea. It is my conclusion that the impressions from the stone block more closely resemble the elusive characteristics of the original eighth-century printing than the impressions made from any other material. The similarity is not easily defined, but the nature of the impressions upon hemp paper from the stone, with their lightly inked * and non-absorbent

* The ink used in printing the dhārāni has offered no particular enigma, as it appears obvious that the impressions were made through use of some sort of black pigment mixed with a liquid readily soluble in water. According to Liu Yu of the Yuan or Mongol Dynasty (A.D. 1280–1368), writing in the Ts’u-pien encyclopedia, the inventor of ink suitable for both writing and printing was an ingenious Chinese by the name of Wei Tang who lived during the fourth or fifth century after Christ. The ink was made by placing several twisted cotton or hemp wicks in a bowl of oil that had been pressed from fir wood. Over the burning wicks was suspended a cone of metal, the interior of which was soon coated with lamp-black. The black powder was scraped from the cone and when mixed with liquid was ready for printing. For making impressions from blocks of wood, stone, or metal the ink was applied to the raised characters by means of a round brush fashioned of coir fibre (Cocos nucifera). After the ink had been spread fairly evenly, a sheet of soft, unsize paper was laid upon the inkoed surface of the block, and the uppermost side of the paper was then rubbed with a pliable flat tool also composed of coir fibre. This was the simplest and most direct manner of making an impression from a raised surface upon paper; no press whatever was required. In an examination of the text printing of the dhārāni of A.D. 770 it will be seen that the ink is readily soluble in water, as it is possible to brush clear water upon a single printed character, cover the wet character with a piece of absorbent paper and make a transfer of the character, in reverse, by slightly rubbing the paper. This could not be done had the black pigment been mixed with oil or lacquer. In making experimental impressions from the steatite block with lamp-black mixed with water upon paper made of hemp, the same general characteristics of the ancient Empress Shōtoku printing were the result. In an endeavour to discover the exact method used in the first printing the use of stone blocks should not be entirely overlooked.
quality, gives every indication that stone may have been employed in producing the world’s earliest text printing upon paper.

Unless an original block actually used in the dhārāni printing — be it stone, wood, metal, or porcelain — is discovered in some hidden corner of Japan, China, or Korea, the production of the parent of all text printing must remain a mystery. Though this original printing is thought to have been executed in Japan, the whole masterful undertaking was made possible through the knowledge and skill of the Chinese, to whom the Japanese will always remain in debt.

IV

The Hand-Mould

THE PAPERMAKERS’ MOST ESSENTIAL TOOL, UPON WHICH REST THE TWO THOUSAND YEARS OF PAPERMAKING HISTORY

It is interesting to formulate an imaginary picture of those first eventful days of papermaking carried on in the old walled city of Lei-yang, Hunan Province, at the beginning of the second century after Christ and to speculate as to the procedure followed by those ancient Chinese artisans.

As has been explained, the calligraphy of the archaic Chinese was written upon woven cloth, and as the roll or scroll manuscripts were trimmed to assure uniformity and neatness, small clippings of the cloth fell to the floor as waste. These discarded cloth fragments probably suggested the possibility of remaking the material into a substance that would also serve for writing. In experimenting with the waste cloth it was natural that the Chinese conceived the idea of first wetting and then beating the material until it was reduced to a fibre. This was accomplished by hand with mortar and pestle, the most elementary form of maceration. The tangled and matted appearance of the beaten cloth fibres at once suggested the possibility of forming the myriad filaments into thin layers or sheets. The fibres were hastily thrown into a tub or vat filled with clear water, and when the eunuch Ts'ai Lun, a member of the Imperial Guard, the genius credited with the invention of paper, saw the minute fibres floating on the crest of the water, as windblown seeds from the milkweed and dandelion float upon the surface of a pond or stream, they no doubt suggested the feasibility of lifting up the matted and tangled film from the water’s surface and transferring the leaf or sheet intact so that it might dry in the sun. The difficult task was to devise an implement capable
of picking up the matted fibres from the surface of the water and at the same time suffer the water to escape, leaving the interwoven stratum of fibres in an even, homogeneous sheet of paper. This need brought forth the invention of the papermaking mould, the implement that has remained throughout the centuries the most essential tool in forming paper by hand, and upon the principle of which the modern paper-machine is founded. To the papermaker the mould is as important as the loom is to the weaver.

THE “WOVE” MOULD

Inasmuch as no paper is in existence from the first forty-five or fifty years after its invention, it is only possible to surmise the construction of the original moulds. It is likely that the first mould, as conceived and used by Ts'ai Lun and his helpers, was nothing more than a square of coarsely woven cloth held within a foursided bamboo frame. This type of mould could have been successfully used in making paper by two distinct methods: In the first method the mould could have been dipped perpendicularly into the water upon which the macerated fibres floated and brought up horizontally under them, lifting the matted fibres as in a sieve, allowing the water to drain through the meshes of the cloth. In the second method the mould could have been held flat and the fibres poured upon the woven material, the cloth, or in some instances rattan, retaining the fibres in a moist sheet and at the same time allowing the water to drain through the interstices of the woven material (Figure 41). In either case the mould with the thin deposit of matted and felted fibres adhering to its surface was placed in the sun for drying (Figure 42). After the moisture from the sheet had evaporated, the paper was easily stripped from the mould (Figure 43). The warp and woof of the mould left impressions in the paper, in the same way as watermarks are formed in handmade paper today.

With an implement of this type it was necessary to allow the moist sheet of paper to dry upon the mould’s surface, and if much paper was to be made, many moulds would have been needed, as the drying of each individual sheet would have required about a half hour in the sun.

The entire development of papermaking is so closely connected with mould construction that it is only through a study of moulds that the long history of paper is revealed. Without a knowledge of mould-making throughout the centuries it would not be possible to arrive at definite conclusions regarding the formation of the ancient Oriental papers that have been discovered by archaeological
Fig. 44 Two fragments of paper of the Eastern Han period (A.D. 25–220), the most ancient paper known to exist in the world. British Museum.

Fig. 45 Manuscript on paper (24 by 41 cm.) found in 1907 by Sir Aurel Stein in the ruins of the Great Chinese Wall. Date about A.D. 150. British Museum.
expeditions in the Far East. While it has not been my privilege to examine all of the papers unearthed by Sir Aurel Stein and Dr. Sven Hedin, I believe that these examples of early paper show distinctly the impressions of only bamboo moulds of the "laid" type (Figures 44, 45). While I am inclined to surmise that the original paper of China was formed on a fabric mould of the "wove" style, the discoveries of old Chinese papers do not bear out this supposition. There are no specimens of paper, however, from the earliest years of the craft which might prove this assumption. To my knowledge, no second-century paper of the "wove" type, showing the impressions of the woven fabric upon which it was formed, has ever been discovered in Asia. In my own numer-

* Sir Aurel Stein, an eminent authority on Asia, on one of his journeys through Chinese Turkestan discovered several parcels of folded paper which, upon ultimate examination under the microscope, proved to be formed partly of rag fibres. Authorities place the date of these sheets at about A.D. 150. Paper dating from A.D. 250–300 was also found by Dr. Stein in Niya in Turkestan. The earliest paper that is clearly dated was found by Dr. Sven Hedin at Loulan, the date being A.D. 264.

ous experiments in an endeavour to arrive at the methods employed by the actual inventor of paper, I have come to the conclusion that the "wove" mould must have been the earliest form used, and that the beaten fibres were poured upon the mould and the moist sheet left to dry upon it. This style of mould may have been used only a short time, but sufficiently long to convince the inventor that he had conceived a method of forming a highly useful material entirely suited for calligraphy—not only had a substance at last been developed that would eventually become a substitute for the various materials that had previously been used for writing, but a surface that was far better suited to the purpose than had ever been known.

In Kwangtung Province, China, at the present time, the "wove" style of mould, upon which the fibre is poured and allowed to dry, is in use (Figure 46). There is no record as to the number of years this type of mould, or the method employed, has been used, but it is interesting to note that the locality where these "wove" moulds are found is not more than two hundred miles from Lei-yang, near Henchow, Hunan Province, the seat of the invention of papermaking by Ts'ai Lun about A.D. 105.

The photograph of the present-day Kwangtung "wove" mould gives a clear conception of its construction. The mould pictured (Figure 47) is capable of forming sheets of paper measuring 14 by 18 inches. The two lateral bars of bamboo are 27 inches in length and about one inch in diameter, the "legs" protruding about three and a half inches beyond the point where the two cross-bars, also of bamboo, are placed. The two lateral bamboo strips are made of ch'a kan chu (Arundinaria sp.). The cross-bars, which are equal in length, plus the diameters of the two lateral bars into which they are mortised, are about three fourths of an inch in diameter and are made from split mou chu (Phyllostachys pubescens [Carr.] de Lehaie). The woven screen, upon which the fibrous pulp is poured to form a sheet of paper, is composed of ch'u ma (Boehmeria nivea, Gaud.) (ramie, rhea, or, China grass), and is made to fit precisely the opening in the bamboo framework. The warp and woof strands of this material are about the thickness of common cotton string and are twisted to give strength. The woven ramie screen is fastened to the four bamboo bars by strips of slender bamboo run at intervals through the cloth and
around the bamboo bars. There are no supports, or ribs, under the woven ramie material.

THE "LAID" MOULDS OF CHINA

I will not venture a surmise as to when the "laid" type of mould was first used; the earliest paper discovered by Sir Aurel Stein and Dr. Sven Hedin shows clearly the impressions of moulds of this construction, but this paper does not date from the first half century of the craft. My contention that the "wove" mould was probably the first form used has no other foundation than that the conception of this type of mould, so simple to make and to use, would naturally have been the first to enter the mind of the originator of paper. It is my belief that the "laid" type of mould dipped into the vat of suspended fibres (Figures 48, 49, 50) was an after invention—perhaps following the "wove" mould by only a short time, but by a sufficient period to give the "wove" mould first place in the chronological development of this implement.
Fig. 51  The original type of Chinese “laid” transfer mould. The invention of this type of mould was one of the great advancements in papermaking as from it the sheets could be removed immediately after forming.

An ancient artisan of genius conceived the idea of a mould from which the wet sheet of paper could be removed while still moist (Figure 51). This constituted the first real advance in papermaking; as it enabled the artisan to form sheets continually upon the same mould. For this purpose the mould-covering (Figure 52) had to be constructed of a smooth and firm material from which the moist sheet would readily free itself. Such a mould-covering was made by placing thin strips of rounded bamboo side by side and stitching or lacing them together at regular intervals with silk, flax, camel-, yak-, or horse-hair. The bamboo strips, as well as the stitches, left impressions in every sheet of paper made upon the mould. The marks or indentations made by the pieces of bamboo are now known as “laid-lines,” while the less noticeable impressions of the stitches are termed “chain-lines,” as the hair lacing consisted of chain stitching over and under the strips of bamboo. In the paper of a Chinese block print attributed to the tenth century (T'ang Dynasty, A.D. 618-907), now before me, I find by holding the paper to the light that there were in the original mould twenty-three bamboo strips to every inch, as there are impressions of twenty-three “laid-lines” to every inch in the paper. The hair stitchings, or “chain-lines,” of the mould that was used in forming the paper upon which this text was printed were spaced at intervals of approximately one and one-sixteenth inches.

Fig. 52  A Chinese worker holding a “laid” transfer type of paper-making mould, made of bamboo splints laced with horsehair. This mould would be capable of forming four sheets of paper at one dipping, each sheet measuring about 10 by 10 inches. The worker is holding the two deckle sticks in his left hand.
The laced bamboo mould-cover resembled a piece of matting. When a sheet of paper was to be made, the covering was placed loosely on the shallow wooden framework (Figure 53), which supported it firmly; the entire mould, both frame and cover, was then dipped into the vat of macerated pulp and brought to the surface loaded with the wet, fibrous material. The thin paper stock was prevented from flowing beyond the top and bottom edges of the matting by bamboo rods laced to the mat at its extremities, parallel with the "laid" bamboo strips. The flow of pulp on the right and left sides was kept within boundaries by the workman, who dipped the mould, holding two wooden sticks, one in each hand, along the outer edges of the matting, parallel to the "chain" stitches (Figure 55). Thus the four outside edges were fenced in such a manner that the wet paper stock or pulp was kept within bounds, forming a sheet of paper almost the size of the mould-covering (Figure 54). In couching, or laying down, a sheet of paper, the matting was lifted free from the framework and the wet layer of paper deposited flat, one sheet upon another, the undermost sheet upon a board, the workman rolling up the matting, from the top edge to the bottom, leaving the moist, tender sheet firm and unwrinkled (Figures 56, 57, 58, 59).

While this type of mould construction seems complicated, it was the simplest and best method that could have been devised, and upon this early Oriental form of mould the manner of making paper in all ages has rested; even the most modern paper-machine employs precisely the same principles.

While these moulds may differ in the construction of the frame-
work and the manner of keeping the wet paper stock within bounds, the top covering, or matting, is usually of the same form of fabrication, and the principle of the whole operation of paper-making is almost identical.

These bamboo moulds of the “laid” pattern were used by the Chinese many centuries before the introduction of paper-making into Europe. To my knowledge, no watermark in the form of an object or design has ever been found in paper from the period of the first vegetable-filament moulds. Perhaps the ancients did not think of this means of marking their paper; or perhaps it may have occurred to them, and, finding the bamboo strips so inflexible, the idea was not carried out. The “laid-” and “chain-lines” of the moulds caused indentations in the paper unintentionally, but the use of insignia or devices was not practised by the early Oriental workers in paper.

It is not possible to determine the date of the introduction of bamboo moulds, nor can it be stated at what time metal wire succeeded vegetable filaments as a material for mould-covering. The
of paper. This technical fault was probably a misconception of the artist, as the delineation of the vatman in a companion print (Figure 61) shows quite clearly that the framework is supporting the "laid" bamboo mould-cover and it would be from the flexible bamboo screen only that the paper would naturally be couched. One of the earliest Chinese "laid" moulds in the Paper Museum collection dates from about the year 1830, but from an examination of ancient Chinese paper it would be determined that practically the same type of mould was used as far back as the third century of our era. This particular Chinese mould from more than a hundred years ago is capable of making paper measuring about 23 by 35 inches, but of course the same style of "laid" mould was capable of forming sheets of paper much larger than these dimensions. The mould in question has a soft-wood frame with twenty square supporting ribs; the mould-cover of finely cut bamboo has twenty-one "laid-lines" to the inch, the "chain-lines" of horsehair being one and three-quarters inches apart. In all of the paper-making districts of China "laid" moulds of this style are in use. Some of these moulds are made with frames and supporting ribs cut from China fir (Cunninghamia lanceolata, Hook. f.), while other moulds have delicate ribs fashioned from arrow bamboo (Arundinaria or Sasa sp.). The "laid" bamboo mould-covers are usually laced with horsehair or ramie, but twisted cotton is not unknown as a material used in lacing the "chain-lines."

In the Paper Museum collection of Chinese "laid" moulds dating from the nineteenth century to the present day, there is such a variation of spacing in the bamboo "laid-lines" and in the widths between the rows of "chain" stitches that a classification would be a difficult undertaking. It can be said, however, that the original type of "laid" mould from the earliest years of Chinese paper-making served as a model for all the moulds that followed, and throughout the world there has been but slight change in their
pattern. The principle of the invention remains practically unaltered.

THE MOULDS OF KOREA

The craft of papermaking was introduced into Korea from China, and while the exact time is unknown the inception dates from a very early period. Unfortunately I do not have any ancient Korean moulds, but in my assemblage of papermaking equipment from the Orient there are Korean moulds dating from the past fifty or sixty years. In visiting the small handmade-paper hamlets in Korea (Figure 62) I did not find a counterpart of the "wove" type of mould such as is used in Kwangtung Province, south China, nor do I believe that the "wove" mould ever played a prominent part in Korean papermaking. Korean papers have always had their own special characteristics, largely due to the moulds on which they were formed. Like the common "laid" mould of China, the Korean mould (Figure 63) consists of four

Fig. 63 A Korean papermaking mould from the paper-village of Ompe, central Korea. This mould is capable of forming paper measuring about 28 by 46 inches.

Fig. 64 A section of a mould-cover in exact size. This cover is composed of grass (Andropogon microanthus) laced at intervals with horse-hair. From the papermaking village near Srinagar, Kashmir, north India.