

## Paper made from Millet and Grass Fibre found in the Secular Documents of Pre-Tang and Tang Dynasty

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### Abstract

As is well known, an innovation of papermaking using rice straw started in early Song Dynasty. Along with bamboo fibre origin paper invented in the same period, rice straw paper had diffused into every area of peoples' life and became basic and necessary material for development of social and cultural lives during Song Dynasty and its successors for long time until the end of the 19th century. Every innovative technology has its forerunner before its accomplishment. However, who, when or how papermaking by cereal straw began is still not clear yet. In the present study, we analysed Central Asian origin documents, mainly the secular documents of Gao-chang Kingdom and Tang Dynasty of the 7th to the 8th centuries, of the Otani collection, by high-resolution digital optical microscope. Observing the morphology of paper, plant remains, sizing substance, over 50 items were found to be cereal straw paper, mainly the one made from foxtail millet (Italian millet, *Setaria italica*) straw. Besides this, it was found that foxtail millet starch was used for sizing on several documents. When considering the fact that the domestication centre of foxtail millet is the Central Asian region, it is quite understandable that application of foxtail millet for papermaking started in that region. Also the fact that the application of cereal straw for papermaking as a kind of additives was found to exist in the documents with a colophon dated the era of the 4th century. These results tell that papermaking using cereal straw really started in the Central Asian region having not enough kinds of raw material for papermaking compared to China mainland, and then gradually had been transferred to the mainland.

### Why Foxtail Millet ?

As was shown in the above observations, it was confirmed that the paper of so many Central Asian documents was made from foxtail millet straw. One may ask "Why foxtail millet?" According to [1], "foxtail millet and common millet, *Panicum miliaceum*, were first domesticated within the area ranging from Central Asia and Afghanistan to India, and from there they were dispersed both westwards to Europe and eastwards to East Asia being gradually differentiated genetically." It is thus known that Central Asia is the motherland of foxtail millet and it has been the main foodstuff of peoples of Central Asian countries for 4000 years more.

In the first systematic study by European on Chinese Botany [2], the author Bretschneider correctly mentioned as follows: "In the Northern China, where the rice is dear it (Siao-mi: *Setaria italica*) is largely cultivated and forms the principle food of the lower classes." This situation had continued for long time in China. In Reischauer's book on Japanese Buddhist priest diary [3], we can see that it was truth in Tang Dynasty.

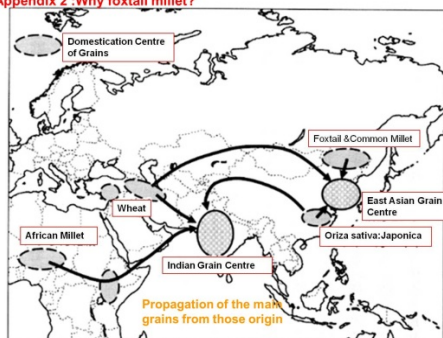
Reischauer introduced in his "Ennin's Travels in Tang China" (Ennin was a Japanese Buddhist priest who stayed and studied Buddhism in Tang from 832 A.D. to 854 A.D.) that Ennin recorded in his diary a comment on the agricultural condition in the northern China: "It is said that this prefecture growth millet\* (\* in Ennin's original text foxtail millet:粟), and rice is very expensive."

Not only the northern China but also Central Asia it was difficult to cultivate rice which is essentially tropic-semi-tropical plant and much water is required to cultivate. Thus, there was no reason to utilize rice straw for papermaking in Central Asia. In Central Asia, enough resource of paper mulberry trees both *Broussonetia papyrifera* and *Broussonetia kajanoki* were hard to obtain. It

is quite natural to imagine that papermaker in Central Asia were pushed to use foxtail millet straw instead of rare paper mulberry, or hemp and silk mulberry (*Morus alba*) both are quite important plants for textile production.

Necessity is the mother of invention: paper craftsman of Central Asia was really the great innovator in papermaking technology. Once it was innovated, it was easy to transfer new technology to China mainland where rice had been widely cultivated for more than 3000 years. Since the end of 10th A.D, via Wu-Dai period, then Song Dynasty, paper made from rice straw were penetrated into Chinese economy along with bamboo paper which was began to make in Song Dynasty. In the 18th century, Qing Dynasty, rice straw paper was used even for the Imperial Court use. Paper used for total 7249 volumes of “The Tripitaka (Complete Buddhist canon)” specially made under the order of 乾隆帝(Emperor Qian lon) in 1734-1738 was found to be rice straw paper. China had continued to be the biggest country in production of paper, owing to huge amount of rice straw paper production along with bamboo paper production until the end of the 18th century.

Appendix 2 :Why foxtail millet?



## Conclusion

1. In the Central Asian secular documents of the Otani collection, many plant remains, mainly those of foxtail millet, were found to exist on/in paper.
2. Microscopy of stalk fragments, leaves, and other plant parts showed that most of those remains are of foxtail millet which was the main foodstuff in the Central Asian region.
3. In addition to foxtail millet, other grasses, e.g. reed, were used for papermaking in Central Asian region.
4. Even in the rag paper dated 386A.D. , not less amount of grass( foxtail) remains were found to exist. This paper is the oldest example of the paper utilizing grass fibre as additives, in the present study.
5. All these observations suggest that papermaking technology using grass or cereal straw fibre began in Central Asian region, the western front of Chinese Empire, and had been diffused into China mainland. Rice straw paper seems to have its origin in those cereal straw origin paper invented in Central Asian region.

[1] Sadao SAKAMOTO: Origin of Common Millet and Foxtail Millet, J.of Tropical Agriculture Research Center, Vol.21 No2, 1987, pp.84-89]

[2] Emil Bretschneider: ON THE STUDY AND VALUE OF CHINESE BOTANICAL WORKS, WITH NOTES ON THE HISTORY OF PLANTS AND GEOGRAPHICAL BOTANY FROM CHINESE SOURCES, Elibron Classics Replica Edition.

[3] EDWIN O. REISCHUER: ENNIN’S Travels in T’ang China, The Ronald Press. Co., New York, 1955