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# A Study of Ancient Paper Fragments from an Eastern Han Dynasty Tomb in Minfeng County, Xinjiang Uygur Autonomous Region

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**I**n 1959, a joint husband-and-wife burial dating to the Eastern Han Dynasty was uncovered in the Taklamakhan Desert north of Minfeng County, Xinjiang Uygur Autonomous Region. The burial holds a rich collection of grave goods, including a yellow silk sachet containing a tinge of vermilion pigment and a small crumpled piece of paper that is mostly colored black, measuring 4.3 centimeters long and 2.9 cm wide.<sup>[1]</sup> This piece of paper is currently held in the Xinjiang Uygur Autonomous Region Museum (ID number: 59MN1:477; Artifact ID: 06966) as a Class A artifact under national protection. The tomb [from which it came] is situated at the Niya site, which has been excavated multiple times since the early twentieth century; for this reason, the piece of paper will hereafter be referred to as the “Niya paper.”

To date, paper fragments dating to the Eastern Han Dynasty have been discovered on two occasions

in the area of Xinjiang Uygur Autonomous Region. The first was when British archaeologist Sir Marc Aurel Stein unearthed from an undated context two paper fragments with writing in Lop Nur [a dried salt lake 120 miles from Urumqi City – **Trans.**]. French sinologist Édouard E. Chavannes thought these two pieces of paper – of which one is white and very thin, and the other is a scrap of writing paper with admonition texts – should be dated to the Eastern Han Dynasty [second century CE]. In the early years of the Republic of China, Luo Zhenyu researched the penmanship and stated that “based on the handwriting, the characters 永 [*yong*] and 衣 [*yi*] seem to be written in the small seal script; the characters 其 [*qi*] and 存 [*cun*] are written in the clerical script and appear crude, suggestive of late Han Dynasty production. The correspondences that constitute the book on the journey from Haitou (Lop Nur) were the most ancient of late Han



Dynasty writings.”<sup>[2]</sup> These attempts to date the Lop Nur paper based solely on its script are not sufficiently convincing. The fragments are now held in the British Museum. The second occasion was when the Niya paper was discovered in an Eastern Han Dynasty tomb. With its securely established date, this paper attests to the circulation of paper in the area of Xinjiang Uygur Autonomous Region, and provides important evidence for the study of paper and the history of the westward transmission of papermaking technology.

Among researchers who studied ancient paper in the Xinjiang area, as early as the turn of the twentieth century there were Western scholars who studied ancient paper fragments acquired by Sir Aurel Stein and noted the presence of rag paper.<sup>[3]</sup> In the 1960s, Japanese researchers conducted a microscopic analysis of ancient paper fragments from Loulan [aka Krorän or Kroraina]. In the 1970s, Jixing Pan did microscopic examination of 31 samples of ancient paper fragments from the Xinjiang area dating from the Jin Dynasty to the Tang Dynasty, and examined some of them using fiber analysis; his research represents one of the more thorough studies of paper fragments found in Xinjiang.<sup>[4]</sup> The author’s report on Uygur handmade paper in Moyu County, Xinjiang area,<sup>[5]</sup> and the thesis on ancient paper dated to the period from the Eastern Jin Dynasty to the Tang Dynasty recovered from the Qara-khoja [aka Halahezhuo] Cemetery,<sup>[6]</sup> both determine that there were two papermaking techniques in the ancient Xinjiang area: namely, the watering method and the pulping method. These two methods have existed in the Xinjiang area for over 1,500 years, but there has been no scientific analysis or study of the Niya paper fragment or any other Han Dynasty paper fragments discovered in the Xinjiang region, until now.

With support from the Xinjiang Uygur Autonomous Region Museum, this study sampled the Niya paper, examined its appearance and analyzed its fiber content.



Figure 1: The “Niya paper” (Eastern Han Dynasty)

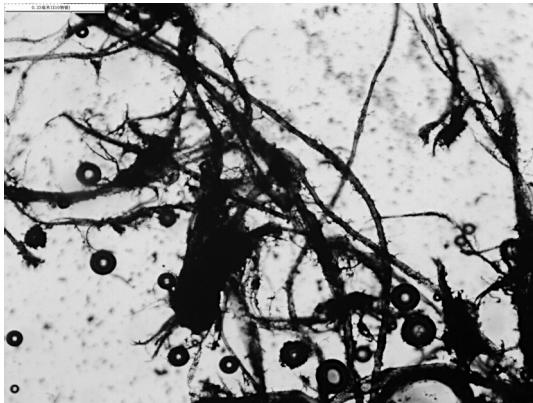


Figure 2: Analytical photographs of light transmitted through the paper and reflected by fibers

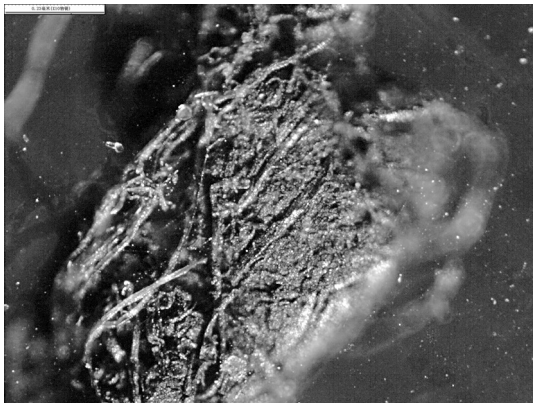


Figure 3: Analytical photographs of light reflected by paper fibers

APPEARANCE

The appearance of the Niya paper (Figure 1) is as follows: It has the shape of a right triangle, ap-

proximately 3 cm in width and height, with a slightly curved hypotenuse 4.3 cm long. The paper is quite thick; it measures roughly 0.3 millimeters (in thickness) and is estimated to weigh about 60 grams per square meter. Both the front and the back surfaces of the paper are rough, and no screen patterns are visible when the paper is held to the light. The fibers are unevenly distributed. Considering the rough texture, thickness, absence of screen pattern and uneven fiber distribution, one may conclude that this paper was produced using the watering method.

The surface is mostly black, likely due to application of ink or some other black colorant. This Niya paper fragment is the earliest dyed paper in the world uncovered to date. On the edge of the paper fragment, where it is not dyed, yellowish-white fibers can be seen.

It can be observed from this yellowish-white edge that the fibers have the texture of flax; flax-like bundles can even be seen in certain parts, which indicates that flax-like fibers were used as raw material; it still needs to be verified whether linen rag was used as the raw material. The fibers at the edge of the fragment are finer and evidently fibrillated, which means that the paper must have been beaten in the production process. The fibers of this fragment are quite tightly bound. Since the paper was once crumpled, its surface is uneven and crinkled.

## EXPERIMENTAL ANALYSIS

The Niya paper was examined using an instrument for paper fiber analysis. The surface topography

of the paper was studied using reflected light, and the fiber type and form were observed using transmitted light. The paper was photographed as these light techniques were used.

From the analytical photographs of light transmitted through the paper and reflected by the fibers (Figure 2), it can be seen that, despite the alteration of these paper fibers by ink or some other black colorant, the fibers are long, straight, and relatively uniform in diameter. They are arranged along the paper's rough surface in mostly tubular formations, with some in flat strip formations. They must be made of flax-like fibers. However, further analysis is required to determine whether the fibers are ramie or hemp. The fibers of this paper show splits, and the pulp degree of beating is about 50°SR, indicating certain pulping processes were applied at the time the paper was manufactured. Thus, the analysis of the Niya paper once again confirms it must be made of flax-like fibers (Table 1).

From the image created by reflected light (Figure 3), it can be seen that the fibers are entirely covered by ink or black colorant, suggesting that the black substance permeated when it was applied to the paper's surface after the paper was made, but it is unclear what use the paper might have had. The image created by transmitted light shows that the walls of the fibers are also blackened, but that the ink or black colorant contains many colorful, bright spots; these are not normally characteristic of ink and probably derive from the minerals it contains. This black colorant could have been natural ink or

Table 1

Analysis and Testing Results of the "Niya Paper"

Artifact number	Description of appearance	Microscope view of the paper surface	Fiber composition	Beating degree of pulp °SR	Conclusion
59MN1:477	Black color; estimated weight of paper is about 60g/m <sup>2</sup> ; no screen pattern	Surface contains ink or other black colorant, with yellowish-white fibers	Flax	50	Paper made of flax-like fibers



some kind of cosmetic dye; its chemical properties will need to be clarified through further analysis. The use of this colorant makes the Niya paper the earliest dyed paper in the world, representing a significant find in the study of the emergence of dyeing techniques.

In addition, these images show that there was originally paint on part of the paper surface, and that the fibers are slightly yellowed. This suggests that the paper went through some form of processing, which can only be clarified through further research and analysis.

## CONCLUSIONS

The examination shows that the Niya paper is made of flax-like fibers, has no screen pattern, and has a rough surface with unevenly distributed fibers. These characteristics illustrate early papermaking techniques, i.e., the emergence of the watering method; they are consistent with the techniques used in early Han Dynasty paper, such as the Xuanquan paper from Gansu Province and the Zhongyan paper from Shaanxi Province,<sup>[7]</sup> which are distinctly primitive. The Niya paper has a dyed surface, and is the earliest dyed paper discovered to date. Whether the Niya paper was produced locally in the Xinjiang

area or imported from the Central Plains cannot be determined, but it is certain that paper made with the watering method had already been introduced to the Xinjiang area by the Eastern Han Dynasty.

The earliest record documenting papermaking technology in the Xinjiang area dates to the fifth century.<sup>[8]</sup> Thereafter, the bark of white mulberry trees was consistently used as the raw material for papermaking with the watering method. This technique is still practiced in areas of Moyu County, Hotan Prefecture (southern Xinjiang Uygur Autonomous Region).<sup>[9]</sup> The appraisal of the Niya paper confirms that paper produced with the watering method had already appeared in southern Xinjiang by the Eastern Han Dynasty, and that this craft has been passed on until today, with the sole exception of a change in raw material. This makes the watering method the longest-lived as well as the most ancient papermaking technology.

Since the Niya paper is the earliest Han Dynasty paper found this far west, and since it is also the earliest paper in the Xinjiang area, as determined by scientific analysis, the results of this study are of great significance to the study of early Chinese paper and the transmission of papermaking technology to the Xinjiang area and the heartland of Central Asia.

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- [8] See [4], p. 136.
- [9] See [5] above.

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