HAND PAPERMAKING

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FRONT COVER: *Lacquered papier-mâché shaffron; a ceremonial horse's head defense, in the form of a dragon head. Japanese, nineteenth century. Papier-mâché, wood, lacquer, pigments, gold, hair, 21 x 13 inches (53.3 x 33 cm). Bequest of George C. Stone, 1935. 36.25.499. Collection The Metropolitan Museum of Art, New York. Image © The Metropolitan Museum of Art, New York.*
BACK COVER: *An eighteenth-century Dutch gilt paper that is stamped with metallic foil over a patterned paste paper. Collection of Sidney Berger. Courtesy of Sidney Berger.*

"Practically Invulnerable": Chinese Paper Armor

Peter Dekker

Two Chinese composite bow handles. Top: a high-quality Manchu bow of the early nineteenth century with ray-skin on either side of the handle, 105 cm unstrung, approximately 160 cm strung. Bottom: a mid-nineteenth-century Chinese pellet bow with paper on either side of the handle, painted and worked to mimic the more expensive ray-skin, 98 cm unstrung, approximately 115 cm strung. All artifacts collection of the author. All photos by and courtesy of the author.

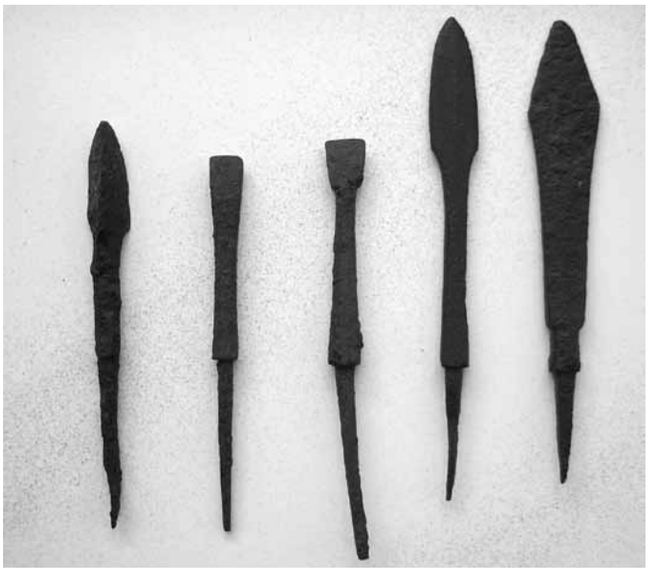
Being credited with the invention of a papermaking process as early as the second century CE, and with having even earlier references to paper-like materials, China is commonly believed to be the first nation to put paper to widespread use. Apart from the obvious use of paper for letters, books, and paintings it was also made into kites, shoe soles, blankets, fans, umbrellas, and even mattresses. The Chinese are also believed to be the inventors of wallpaper and paper money. But perhaps one of the most peculiar uses the Chinese found for paper was that of making armor for its military.

Through the ages the Chinese armies have used all kinds of materials to protect the bodies of their men. It would be well beyond the scope of this article to describe them all but allow me to begin with a short overview of some types of armor used commonly in China from the Late Bronze Age to the dawn of the twentieth century.

Among the earliest types of armor known are those dating from the Shang dynasty of the sixteenth century BCE up to 1024 BCE, which were made from pieces of turtle shell laced together. Around the time of the Han dynasty of the third millenium BCE armors consisted mostly of bronze plates or sections of cured leather that were laced together. Such leather armors endured in some remote areas in China up to as late as the twentieth century by Chinese ethnic minorities such as the Yi. Many of these armors bear a striking resemblance to their much earlier predecessors.

When steelmaking picked up during the Warring States period it eventually came to replace bronze as the main metal for armor and remained in use until as late as the nineteenth century. Like the leather armors, the steel armors often consisted of many small plates that were laced together. The shape of the plates varied from simple square or rectanglar pieces to those that were shaped like fish scales or had complex interlocking shapes such as the Ming dynasty's *shanwenjia*, or "mountain pattern armor."

By the mid-Qing dynasty firearms were so well developed that they could pierce nearly any armor. Instead of striving for maximum protection Qing soldiers preferred to remain more mobile and dressed in a multitude of layers of cloth, felt, and/or silk. Such protection can easily be underestimated, but actual testing has shown that it can be quite hard to get through many layers of cloth with sword or arrow.



Antique arrowheads that paper armors may have been up against. From left to right, measuring between 107 and 129 mm in length, and up to 20 mm wide: early Iron Age armor-piercing arrowhead of triangular cross section, two Jin dynasty Jurchen arrowheads with chisel-shaped tips, Qing dynasty Manchu standard military arrowhead, Qing dynasty Manchu military rattan-piercing arrowhead.

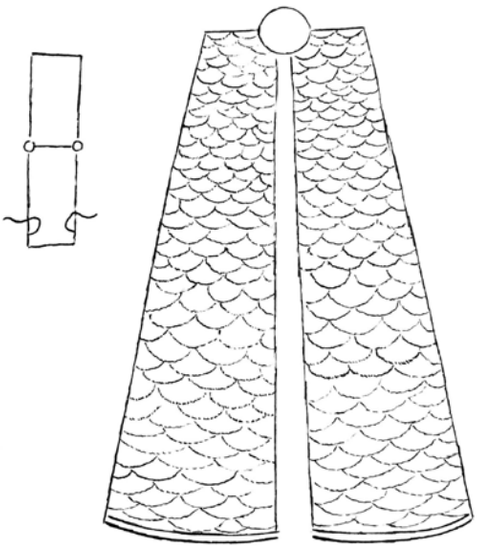
References to paper armor in Chinese history are relatively scarce but nevertheless persist over a long period of time. The earliest references to paper armor appear to date from the Tang dynasty, which lasted from 618 to 907 BCE. During the latter part of this dynasty a certain Shang Suiding is credited with the invention of paper armor that was initially only used by civilians in times of peril.[1] Later yet in the Tang we find an account on governor Xi Shang (847–94) of the city of He-Dong who kept an army of one thousand soldiers at the ready who were equipped with suits of pleated paper armor. It is of special interest that this armor was described as being able to withstand heavy arrows.[2] This city was close to Khitan territory and the heavy arrows referred to were those of Khitan mounted archers with whom the Tang was in a constant state of war.

About a century later, during the early Song dynasty (960–1279 CE) there was an attack on this very same town led by the captain of the imperial Song army Li Tao. He noted that the town's defenders were dressed in yellow paper armor, indicating that the use of paper armor endured here even after the fall of the Tang.[3] Later in the Song dynasty there is mention of the capture of 110 suits of paper armor from two surrendered coastal pirate vessels by a commissioner of military affairs Gong Hua.[4]

The use of paper armor was not restricted only to the enemies of the Song. Chen De-Xiu (1178–1235), magistrate of Chuanzhou, stated in one of his memorials to the capital that the weapons in his fort were sufficient for coastal defense except that fifty sets of paper armor were needed for his navy, for which he would exchange one half of the one hundred sets of iron armor in his possession.[5]

An account dating from 1040 describes that troops stationed in the cities of Jiangnan and Huainan in Anhui province, both noted papermaking centers, were ordered to produce as much as thirty thousand suits of paper armor for the garrisons of Shanxi province.[6] Shanxi was near the Jin empire where Jurchen attacks, again consisting of mainly mounted archers, were eminent.

Perhaps the most detailed information on paper armor that has surfaced from classical Chinese texts is the description provided in the military treatise *Wubeizhi,* or "Treatise on Military Preparedness" dating from the Ming dynasty (1368–1644). Compiled by Mao Yuanyi and finished in 1621, the treatise states in chapter 105, pages 17–18 of the original version:

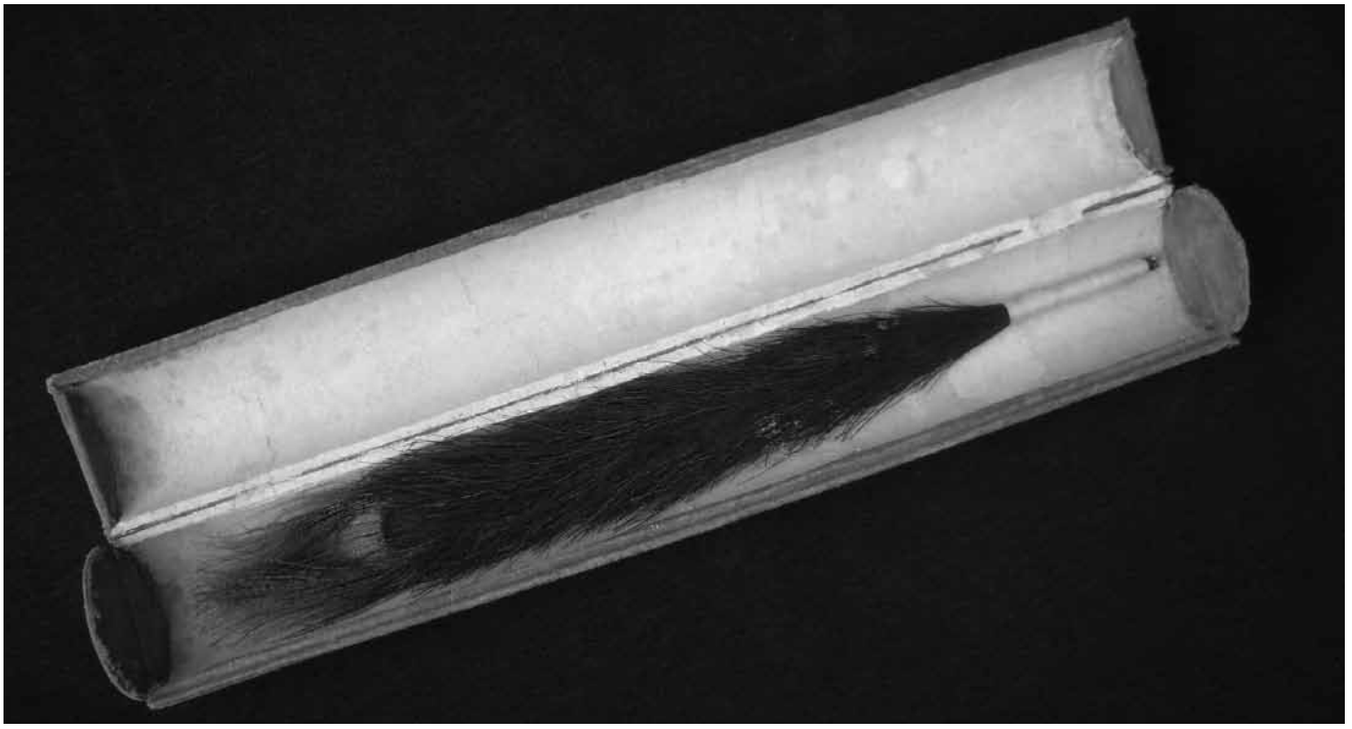


A suit of paper armor and paper arm guard as they appear in the 1621 Wubeizhi, *or "Treatise on Military Preparedness." Illustration by the author.*

Armour is the basic equipment of soldiers, with which they are able to endure without suffering defeat before sharp weapons. The terrain in the south is dangerous and low, and where foot soldiers are generally employed they cannot take heavy loads on their backs when travelling swiftly. If the ground is wet or there is rain, iron armour easily rusts and becomes useless. Japanese pirates and local bandits frequently employ guns and firearms, and even though armour made of rattan or of horn may be used, the bullets can nevertheless pierce it. Moreover, it is heavy and cannot be worn for too long. The best choice for foot soldiers is paper armour, mixed with a variety of silk and cloth. If both paper and cloth are thin, even arrows can pierce them, not to say bullets; the armour should, therefore, be lined with cotton, one inch thick, fully pleated, at knee length. It would be inconvenient to use in muddy fields if too long and cannot cover the body if too short. Heavy armour can only be used on ships, since there soldiers do not walk on muddy fields. But since the enemy can reach the object with bullets, it could not be defended without the use of heavy armour.[7]

It is interesting to note from this passage that one of the main advantages of paper armor, in the eyes of distinguished naval commander Mao Yuanyi, was that it was lighter than iron (steel) armor and did not rust. The same treatise also describes a paper arm guard that consists of layers of paper, silk, and cloth.

Little is known about the exact method of construction of these armors but we do know that by the Qing dynasty, Korean paper—recognized for its toughness and durability in both China and Japan—was preferred for making armors. Korean paper thus made up large part of the tributes from Korea to China in the Qing dynasty.[8]

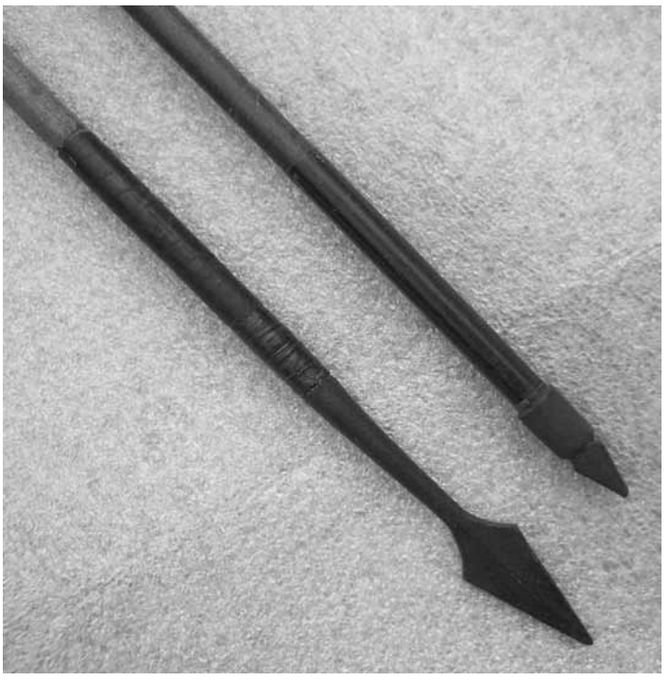


A peacock-feather hat ornament with its box, nineteenth-century; box: 40.7 cm long, 6.2 cm diameter; plume: 36.3 cm long. Such plumes were awarded by the emperor for special civil service or merit in battle. Box frame and inside lining of paper, covered with green cotton.

Consul Bedloe of the Amoy mission offers one of the most detailed descriptions of paper armor in a rare Western eyewitness account:

Parallel to this alternating of leather and wool in the north was that of paper and cotton cloth in the south of China. It seems ridiculous to call such combinations armor, and yet they make an armor superior in many instances to steel. Thirty thicknesses of alternate calico and paper will resist a pistol bullet or one from a rifle at a distance of a hundred yards. A spearman who thrusts his weapon into a man clad in this kind of garment can neither wound his enemy nor extract his weapon, and if his enemy is an archer or is armed with a long sword or javelin, he is likely to lose his life for his mischance. The suit of a famous Yiinnan bandit consisted of sixty thicknesses of cotton cloth and paper, and made him practically invulnerable. These suits are comparatively light, are very durable, and of course, extremely cheap.[9]

The above description suggests that by the nineteenth century the use of paper armor was primarily a southern custom.[10] This is probably due to the climates, with the north having a dry desert-like climate with extremely cold winters while the south enjoys subtropical weather. One can well imagine how hard it would be to have to fight in alternating layers of leather and wool in temperatures of above 100 degrees Fahrenheit. Also interesting to note is that in contrary to the Song era account where a piece of steel armor was traded for a piece of paper armor, consul Bedloe states that these paper armors were extremely cheap. Reasons for this may be numerous, from the availability of paper at the time to the sheer necessity of Chen De-Xiu to obtain these paper armors. Perhaps the most interesting part of this account however is how it describes the surprising effectiveness of paper armor, being even bulletproof from certain distances, making the wearer nearly invincible.



Two late nineteenth-century arrows. Top: a target arrow with Amur cherry-bark wrapping , 91 cm long, 9 mm thick. Bottom: a standard-issue military arrow with black-painted paper wrapping, 104.5 cm long, 9 mm thick.

One might ask, how can a relatively fragile material like paper do better than steel to defend against spears, arrows, and even bullets? The answer lies in the flexible layered construction. With an armor made of a single mass of material, say a plate of metal, the integrity of the whole plate is compromised by a single crack,

A late nineteenth-century hat box with official's winter hat; box: 18 cm high, 29.5 cm diameter; hat: 21 cm diameter.

Detail of damage on the hat box, exposing the paper construction of the walls.

whereas with a multitude of layers any damage on one layer does not affect the integrity of any of the other layers. On flexibility, the idea that the soft overcomes the hard is widely known in Chinese Daoist thought and may have well contributed to the development of soft armors from early times onward. Instead of taking all of the energy of the impact, soft materials yield and neutralize much of the impact energy before they start taking damage. In tests performed with replicas of historical armor-piercing arrowheads, a fixed steel plate was easily pierced while softer targets such as a pillow were impossible to penetrate. Although not discussed in this article, I have included illustrations of nineteenth-century Chinese weapons and related items from my collection in which handmade paper is a component of their construction.

It should hardly surprise the reader by now that the latest bulletproof body armors make use of a very similar concept. Today, paper-thin layers of synthetic materials such as Goldflex or Dyneema are employed in making body armor. Although these synthetic materials are far more advanced than paper, with high tensile strengths, resistance to abrasion, no moist absorption, and increased atomic weight, they still make use of the same principle of having many flexible layers to deal with the kinetic energy of the impact. They do so very effectively without being excessively heavy, hot, or hindering the wearer's movements, much like paper armor.

Paper armor endured in both civilian and military circles from the late Tang dynasty all the way to the late Qing dynasty, providing protection against the developments in weapons for over a thousand years. It even outlived steel armor that was made obsolete by developments in firearms at around the mid-eighteenth century, and may well have been the first type of bulletproof armor ever devised. Some sources suggest that the price was similar to steel armor, while other state it was very cheap. No doubt there were many gradations in quality and finish, which may contribute to the inconsistency of pricing in those few sources that we can reference today. Paper armor was proven to be surprisingly effective, even in the eyes of period observers such as consul Bedloe as well as seasoned imperial naval commanders such as Mao Yuanyi. The fact that modern armorers again use very similar concepts of armor construction, albeit with high-tech materials, attests for the effectiveness of multi-layered protection that handmade paper already provided for centuries.

NOTES

1. *Berthold Laufer, "Chinese Clay Figures, Part I: Prolegomena on the History of Defensive Armor,"* Field Museum of Natural History Publication 177, Anthropological Series, *vol. XIII, no. 2 (Chicago: Field Museum, 1914), 292.*
2. *Wu Zhen,* Xin Tang Shu *[New Book of the Tang], eleventh and twelfth centuries. Reprinted in* Shang wu yin shu guan, Minguo 24 *(Shanghai, 1935).*
3. Fujian Tongzhi *[General Gazetteer of Fujian], 1737 edition.*
4. Tsien Tsuen-hsuin, *"Paper and Printing," part 1 of* Chemistry and Chemical Technology, *vol. 5 of* Science and Civilisation in China *by Joseph Needham (Cambridge, England: Cambridge University Press, 1985), 114.*
5. *Ibid.*
6. *Laufer, 292.*
7. *Translation by Tsein Tsuen-hsuin, in "Paper and Printing," 115.*
8. *W. W. Rockhill,* China's Intercourse with Korea, *(London: Luzac & Co., 1905), 25.*
9. *Laufer, 293–94, note 2.*