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Among those technologies that spread from China to the West during the last four centuries, Paktong, a copper-nickel-zinc alloy invented in China probably as early as the 4th century AD, is undoubtedly the most intriguing one. The first systematic research on *paktong* is Alfred Bonnin’s treatise, *Tutenag & Paktong*, published in 1924. This work remained the only authoritative account of *paktong*’s history in Europe until recently. The publication of Volume V, Part 2 of Joseph Needham’s *Science and Civilisation in China* in 1974 provided some new understandings of *paktong*, but not a great deal. It was not until the late 1980s that detailed scientific research on the metallurgy of *paktong* was carried out in Beijing, revealing for the first time the smelting process used for *paktong* in Southwest China. At the same time, fresh insights into the history of *paktong* in Europe were also gained through the analysis of *paktong* artefacts in collections in Britain. However, the most important and comprehensive study of *paktong* undertaken in recent years is Mr. Pinn’s book.

The present volume is beautifully designed and well written, and its 190 illustrations are especially impressive. It consists of 12 chapters, the first six focusing on historical issues, the latter six on typological and chronological topics. It opens by placing *paktong* in its historical context, from the earliest European reference to the alloy in 1597 to the final success of attempts to imitate *paktong* in the third decade of the nineteenth century. The processes involved in the manufacture of *paktong* are briefly discussed in the opening chapter, and new sources of information about *paktong*, such as Matthew Boulton’s records,

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are also highlighted. In the light of information newly discovered, Chapter 2 presents a brief review of Alfred Bonnin’s book. Having acknowledged that Bonnin’s basic research was excellent, Pinn points out that there are some errors in his book, such as Bonnin’s insistence that pak tong could only be cast. He then explains some of his new understandings of the confusion between tutenag and pak tong, as well as a number of specific issues about pak tong, such as importation, costs, retail prices and advertising. Chapter 3 highlights what is known so far about pak tong in China, and also offers an interesting discussion of those pak tong pieces in Western style but of Chinese manufacture. In Pinn’s opinion, Chinese artisans did not produce large quantities of pak tong goods in Western style for export to Europe, although they were capable of reproducing them.

The most significant and welcome part of the present volume is Chapter 4, which focuses on Matthew Boulton, a businessman who was closely involved in the story of pak tong during the late eighteenth century. Pinn’s brilliant research of the Boulton & Fothergill records held at Birmingham Library has revealed a large quantity of new information, much of it very valuable and informative. As Chapter 4 shows, Boulton’s interest in pak tong led him to request that his agent in London acquire the alloy, his company becoming a major manufacturer of a variety of pak tong wares by using the raw material of white copper imported from China. This is a fundamentally new perspective in the exploration of the history of pak tong, allowing the clarification of a number of long-standing mysteries.

One of the mysteries surrounding pak tong is how it was imported into Europe. Bonnin’s search through the eighteenth-century trade files at the Public Records Office indicated that only one entry for the importation of white copper (50 kilograms) from the East Indies in 1760 was registered. This suggested to Bonnin that the majority of pak tong was not officially imported into Britain, but was brought into the country as part of "privileged trade" (a system that allowed officers of the East India Company to do their own private trade on a small scale). This was just an assumption and Bonnin did not have any evidence to substantiate it. But now, Boulton’s correspondence with his agent in London regarding negotiations for the purchase of pak tong from two East India Company captains provides clear evidence to confirm that pak tong was imported on a private trade basis rather than through official East India Company channels. This clarification is significant for the correct understanding of the social context of pak tong trade.

The activity of analyzing and imitating pak tong in Europe during the late eighteenth century is another intriguing issue on which Matthew Boulton’s archives also shed some new light. Pinn’s research suggests that Boulton had a keen interest in pak tong and was actively involved in investigating its constituents in order to reproduce it. The letter from Dr. James Keir to Boulton on March 4, 1781 shows that they once undertook joint experiments on Chinese (white) copper. Dr. Bryan Higgins is another important figure in the story of pak tong, because he received a gold medal from the Society for the
Encouragement of Arts, Manufacturers and Commerce for "white copper made with English materials in imitation of that brought from the East Indies" in 1773. His letter to Boulton on 28 February 1773 is an interesting new find, showing that he attempted to sell his "discovery" to Boulton. Also of great interest is Boulton’s letter to His Excellency Rodney Valtravers. As Pinn explains, this letter includes important information about the so-called "Gotha White Metal," which, in Pinn’s opinion, "came closer to imitating pak tong than was to be achieved in the West for another sixty years."

Matthew Boulton’s archives contain very valuable information about goods made of pak tong at the Soho factory. Pinn’s research suggests that as early as January 1769 Boulton was already considering the potential use of pak tong. A letter, dated 8 January 1771, shows pak tong candlesticks were manufactured at Soho at that time. Other letters dating from 1771 to 1773 show that a variety of pak tong goods were also produced to special orders, such as buckles, salvers, buttons, dish crosses and snuffer stands. Useful information about the variable quality of the pak tong available, public interest in pak tong and the price of pak tong articles can also be found in those archives. This fresh information is undoubtedly important in providing a fuller picture of the story of pak tong during the late eighteenth century.

Chapter 5, entitled "Paktong and German Silver," also contains significant contributions to a new understanding of pak tong. The central theme of this chapter is to explore whether it is possible to distinguish pak tong from German silver on the basis of compositional analysis. Pinn first discusses the composition of pak tong, pointing out that the majority of genuine eighteenth century pieces contain about 40-50% copper, 35-45% zinc and 5-15% nickel, plus 1 to 2% iron and traces of a few other elements, such as lead and tin. This judgement is based on the analysis results of 129 pieces in the W. A. Pinn Collection. Gilmour and Worrall (1995: 267) reached a similar conclusion in analyzing pak tong pieces in other collections in Britain, such as Liverpool Museum and The Royal Armouries, but Pinn notes that a few pak tong pieces show some unusual characteristics, giving high copper and low zinc readings. He suggests that this may have resulted from the intentional or accidental alteration of pak tong’s composition after its importation to the West.

Regarding the distinction between pak tong and German silver, Pinn offers the following important guidelines: pak tong’s composition is concentrated within the range of 40-50% copper, 35-45% zinc and 5-15% nickel; while German silver is within the range of 55-65% copper, 20-25% zinc and 15-20% nickel. These parameters are a significant contribution to our understanding of these two alloys, especially significant for identifying genuine eighteenth century pak tong pieces. Pinn also observes that there are some anomalies (less than 10% of the analysis results), the majority of which fit into the parameters for German silver, but other evidence suggests that they must surely be made of pak tong. A detailed and interesting discussion of these anomalies is then given, showing that pak tong may not necessarily conform to the basic guidelines.
Pinn’s observation is quite acute. If we use his guidelines to look at Gilmour’s analyses of pieces from the Liverpool and British Museums, we can also see that some typical China-made pak tong pieces have compositions that would fall into the parameters for German silver. The existence of these exceptions is not surprising if we realize the fact that pak tong pieces were produced at several different places rather than one place in southwestern China during the eighteenth and nineteenth centuries.

Pinn further notes that iron content could also be significant in helping to distinguish the Chinese alloy from the later European metal. This reviewer (Mei 1995: 51) had already suggested that the existence of a small amount of iron might be regarded as a characteristic feature of Chinese pak tong, in comparison to the typical commercial German silver that usually contained no iron. But Pinn makes it more straightforward by stating that nearly all of the genuine eighteenth pak tong pieces contain about 1% to 2.5% iron, whereas German silver wares almost invariably contain less than 0.5% of this element. He also points out there are exceptions, especially a small group of German silver pieces originating in Austria that have a high iron content. In his opinion, English nickel alloy pieces produced after about 1830 are most likely to have been made of German silver rather than Chinese white copper.

In Chapter 6, Pinn clarifies the confusion between British plate and plated German silver on the basis of advertisements in old newspapers, further showing his capability of digging out useful information from various sources. He shows us that, during the mid-nineteenth century, both plated and unplated German silver wares were produced and traded in Europe under varied names, such as Virginian Plate, Alpaca, Argentan and Packfong. The last name clearly indicates the close association of German silver with Chinese pak tong.

As a professional antique collector and dealer, Pinn devotes a great deal of interest and attention to pak tong and German silver pieces themselves. In the next six chapters (Chapters 7-12), he presents a detailed discussion of pak tong and nickel alloy wares produced during the eighteenth and nineteenth centuries. The themes he discussed include eighteenth century pak tong candlesticks, nineteenth century pak tong candlesticks, domestic and other wares, firegrates and firearms, and nineteenth century nickel alloy wares. These discussions explore the forms, styles, designs and manufacturing techniques of pak tong and nickel alloy wares, successfully showing that their range is far wider than had previously been recognized. His research in Christie’s auction archives is especially rewarding. It has revealed that hundreds of tutenag or pak tong wares were auctioned by Christie’s in the thirty year period commencing about 1770. Pinn’s rich knowledge of pak tong will definitely appeal to a wide audience, especially antique collectors and museum curators.

Though the present volume is a most successful and welcome one in many ways, some points require further comment. For example, Pinn suggests that "Gotha White Metal" was the closest imitation to pak tong, because it was made by utilizing slag that contained a significant proportion of nickel. But no
concrete evidence is given to support this supposition. In Chapter 4 he mentions that Matthew Boulton had asked an associate in Germany "to learn not only the composition but also the art of making it," but the source for this information is not clear. Appendix I includes all letters from and to Boulton, but does not contain a letter from Boulton to his German associate. Pinn also considers that in the letter to His Excellency Rodney Valtravers (pp. 57-58), the white copper Boulton talked about is the Gotha metal. However, Boulton’s letter seems to suggest that the metal was most likely a kind of arsenic white copper rather than a nickel alloy. Boulton clearly indicates in his letter that he was acquainted with "a variety of methods of whitening brass with arsenic and likewise with cobalt." This would be another interesting topic for further research.

It seems that Pinn did not pay much attention to the pak tong artifacts in the collections of Liverpool Museum and other museums in Britain. The research on pak tong carried out by Eldon Worrall for his doctorate during the mid-1990s appears also not to have caught his attention. When he set the guidelines for distinguishing pak tong and German silver, he largely ignored the analysis results of dozens of pak tong pieces already published by Gilmour and Worrall (1995). From the perspective of readership, it would be more stimulating to see how far his guidelines can be confirmed by other analysis data. A quick check with the analysis data offered by Gilmour and Worrall (1995: 272-4) has shown a number of exceptions to Pinn’s guidelines, especially those typical artifacts for Chinese markets made in the nineteenth century, such as opium pipe (AM797), censer (AM798), door knocker (AM853) and kettle (AM856). The compositions of these pieces clearly fall into the parameters for German silver, but they were undoubtedly made in China with pak tong and were traded to Britain sometime during the nineteenth and early twentieth centuries. Therefore, it would seem to be rather too simplistic to consider all those nickel alloy pieces made after mid-1830s to be German silver, because the production of pak tong in China did not cease until the latter nineteenth century. The research by Gilmour and Worrall (1995: 268) shows that there is "an overall drop in the proportion of nickel in pak tong objects of the mid-late nineteenth century." Pinn’s work suggests that the appearance of German silver is the reason for the overall drop of nickel. But that seems not to be the whole picture. Further research is needed to explore what had happened to pak tong production in China since the mid-nineteenth century.

There are also some minor errors. For example, in the text (p. 87) Pinn correctly refers the published date for Gilmour and Worrall’s paper as 1995, but in the bibliography the published date is mistaken as 1993. Pinn also fails to give the page numbers for research papers in the bibliography.

Although more criticisms might be put forward, none are crucial when measured against Pinn’s considerable contributions to our understandings of pak tong. The present volume stylishly combines material certain to be of great interest not only to historians of technology but to a very wide readership.