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Chinese Technology in Eighteenth-Century American Eyes

WU YIYI

INTRODUCTION

Eighteenth-century China had long been closed to the outside world, its inland areas even less well known to Westerners than the coastal regions. But on the inauguration of the sixtieth year of the Emperor Ch'ien-lung's reign (r. 1736–1795), along with many other foreign guests, an American was invited to observe the celebration in Peking. Andreas Everaardus van Braam Houckgeest (1739–1801), the ambassador of the East India Company and later of the United States, thus had an opportunity to travel about two thousand miles across inland China.

During his journey in China, van Braam kept a detailed day-by-day diary in which he described the Chinese bureaucratic system, the everyday farm life, and technological inventions. These inventions were van Braam's favorite topic. He documented with illustrations agricultural instruments, transport vehicles, buildings, and bridges, as well as craftsmen at work. Van Braam's journey does not sound a total pleasure, but his journal is obviously a rich mine of information for present-day sinologists.¹

THE AUTHOR

Van Braam was born in 1739 in the province of Utrecht, the Netherlands, and served in the navy until 1759, when he joined the East India Company and sought his fortune in Canton and Macao, China. His interest in China presumably dated from this period.² But the 1760s were not a good time for Western visitors to China. The empire was intoxicated with its recent pros-

perity and paid little attention to foreigners, who in the eyes of the Chinese bureaucrats were “uncivilized.”

Van Braam stayed in Canton for about fifteen years with only two brief returns to his native land. No evidence shows that he entered inland China during his long stay in the southern cities, which were open to foreigners at the time. Inspired by the news of the American revolution, he decided to move to the United States and was appointed Dutch consul to North Carolina, South Carolina, and Georgia. He settled down in Charleston and started to operate a rice plantation. Four years after becoming a naturalized American citizen, van Braam decided to leave for China again, partly because of a series of tragic events affecting his family. He arrived in Canton in the summer of 1790, and soon heard the news that George III had sent his representatives to the Manchu monarch, Ch’ien-lung. With much difficulty, he had himself appointed the second ambassador to visit Peking on the occasion of the sixtieth anniversary of Ch’ien-lung’s reign in 1794. At that point van Braam was fifty-five years old.

He returned to Philadelphia early in the winter of 1795, half a year after the trip to Peking. He bought a farm at Mount Bergen near Bristol in Pennsylvania where he built a fifteen-room house which he named China’s Retreat. He took pains to maintain the lifestyle he had enjoyed in Canton. Because of the great variety of objects he brought back from China, this site was regarded as “undoubtedly the first comprehensive Chinese collection seen in the United States.”³

But van Braam was not financially successful in the United States. His wife divorced him, and he had to auction off the beloved articles he had brought back from China only three years before. Van Braam died in 1801 in Amsterdam. The auction catalogue prepared by Christie’s survived him,⁴ inducing memories about the legendary trip of this former second ambassador to the “unknown land” exactly two hundred years ago.

THE JOURNEY AND THE JOURNAL

Van Braam and his party, known to consist of at least one other representative of the East India Company and several servants, left Canton on November 22, 1794, and reached their destination on January 9, 1795. The schedule was hectic, with the envoys covering some two thousand miles in fifty days. They had to squeeze themselves into small carts and hurry in order to reach the

capital before the New Year Ceremony. For more than eighteen days they had to travel over sixty miles daily. They made their way mainly by land because the water level of rivers and canals and the strong winds were not favorable for water travel in winter. The journey was uncomfortable, and supplies did not always reach them on time. Sometimes the situation was so “indescribably bad” that they “even had no wine at dinners.”⁵

But by traveling overland van Braam was able to see more of China. From December 10 on, he enriched his diary with observations about bridges, pagodas, boats, wheelbarrows, and carts with sails. He even had the opportunity to acquire various articles and bring them back to the United States. Some of them were used as models for drawings when Moreau de Saint-Méry, an emigre bookseller and publisher, was translating van Braam’s manuscript into French for publication. American engravers, such as John Vallance, Samuel Seymour, and A. P. Folie, collaborated in preparing drawings for the publication.

Van Braam’s descriptions and discussions of Chinese technological inventions are especially noteworthy because they were not made by a layman or a curious traveler, but by a professional. His service in the navy and his extensive travel made him a keen and open-minded observer. The accuracy and variety of his records are rare compared with those of other contemporary travelers. On the other hand, it is plain that most of the information in van Braam’s work was obtained from observation alone. Presumably, he did not know Chinese and thus could not communicate directly with Chinese farmers and officials.

Van Braam wrote his journal in Dutch, and the original is preserved in the Rijksarchief at The Hague. The first published edition, however, was in French. Its title page announced that the book was based on the author’s personal experience and contained descriptions “de plusieurs parties de la Chine inconnues aux Européens” (see illustration 1). Van Braam was described as the former director of the Society of Sciences and Arts of Haarlem in Holland, and of the Philosophical Society of Philadelphia, whose library is still proud to possess one copy of this rare journal.

The French-language edition was published in Philadelphia in 1797–1798. It was in two volumes in octavo and contained engravings depicting subjects as diverse as the Chinese court and mule wagons. The publisher was to be found at “the corner of First Street South and Walnut,” in Philadelphia, not far from the dock on the Delaware River where van Braam had concluded his

V O Y A G E
DE L'AMBASSADE
DE LA
COMPAGNIE DES INDES
ORIENTALES HOLLANDAISES,
VERS L'EMPEREUR DE LA CHINE,
DANS LES ANNÉES 1794 & 1795 :

Où se trouve la description de plusieurs parties de la Chine
inconnues aux Européens, & que cette Ambassade à
donné l'occasion de traverser :

LE tout tiré du Journal d'ANDRÉ EVERARD VAN BRAAM HOUCKGEST,
Chef de la Direction de la Compagnie des Indes Orientales Hollandaises à
la Chine, & Second dans cette Ambassade; ancien Directeur de la Société
des Sciences & Arts de Harlem en Hollande; de la Société Philosophique
de Philadelphie, &c. &c.

Et orné de Cartes & de Gravures.

Publié en Français par M. L. E. MOREAU DE SAINT-MÉRY.

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1797.

journey from China about a year earlier. The journal was translated into a two-volume English edition, which was based on a private Paris edition of the first volume of the Philadelphia edition.⁶ The translation is faithful, but materials other than the journal itself, such as drawings and appendixes, were all omitted, except for a map of the “route of the Dutch Embassy to and from Peking in 1794–5,” engraved by T. Foot.

Judging by the number of published translations that came out within a decade of the French edition, this diary must have been popular in the late 1790s. The copies preserved in Princeton University are gifts to the university from Walter van Braam Roberts, a descendant of A. E. van Braam and a Princeton student of the class of 1915. On the page facing the cover of the original French edition, there are notes in pencil: “Presented to J. E. Baker by the g.g. grandson of the author, . . . [here there are three groups of letters or signs that I cannot decipher]. E. T. Roberts, London, July 10, 1908.” Immediately beneath, two lines, which seem to be a postscript, in the same handwriting read: “This book is paid for by me in London. ETR.” Far below is another “note”: “given back to E.T.R. by J.E.B. before his death.” On the front page of the English translation is a formal dedication: “To Erastus Titus Roberts, this work, written by his ancestor, is now, in commemoration of the one hundredth year of its issue, presented by his friend, J. E. Baker. Oct. 3rd., 1898.”

CHINESE TECHNOLOGY AS SEEN IN THE DIARY

The Chinese inventions and technical devices van Braam recorded on his way to Peking fall into three main groups. (1) Means of transportation: sail-carts received much attention in the diary, and vehicles are often described with detailed specifications. Mule- or horse-drawn wagons are also noted and compared with their counterparts in the West. (2) Agricultural devices: instruments designed for deeper and more effective plowing, as well as seeding machines and other tools, are described. (3) Miscellaneous devices, such as tinkers' equipment. This paper compares van Braam's descriptions of certain Chinese devices with those in the relevant Chinese sources so as to further our knowledge of Chinese technological inventions.

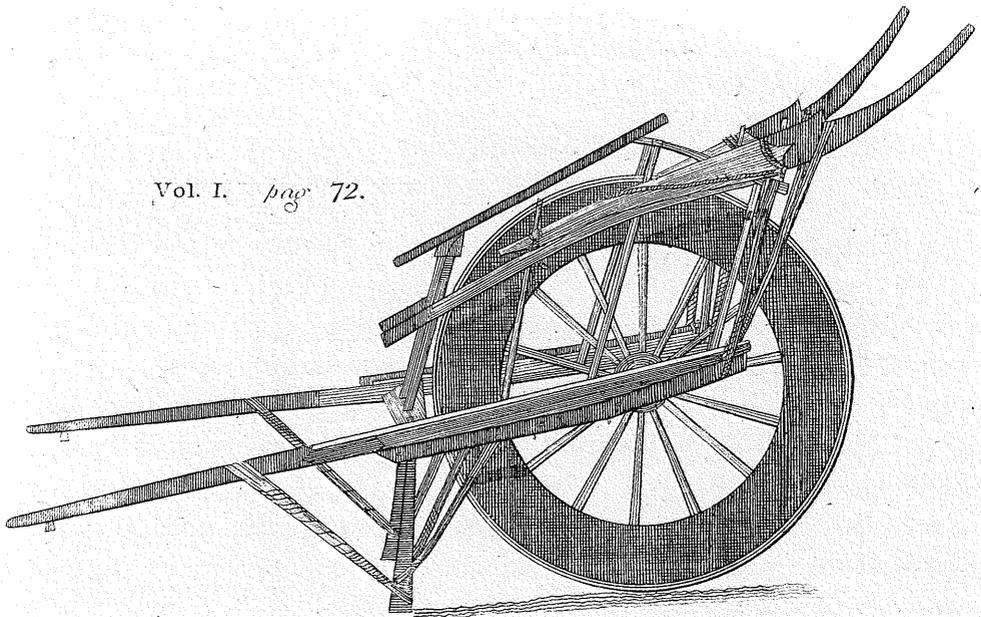
Small Cart (La brouette)

Van Braam began traveling in a small cart on December 11, 1794, a week after he entered Chiang-hsi Province.⁷ During the long and tedious journey to

Peking, he must have had time to observe and study the cart offered by his Chinese hosts, and it became one of his favorite topics in his diary. He often used comparisons to illuminate his observations and to reveal the significance of seemingly unimportant details. Here is an example of his method:

It is equally easy to see that there is a difference in the men, particularly in the color of the skin. In general they are here of a much ruddier complexion than the inhabitants of the south of China; a circumstance that is still more perceptible among the women, whose cheeks are as red as those of European females, in the full bloom of youth and health.⁸

Then wheelbarrows, used to transport both people and goods in Chiang-hsi Province, caught his attention (see illustration 2).⁹ This vehicle was operated in a way different from what he had observed in Kuang-tung Province, so he described it carefully: "a wheel-barrow, singularly constructed, and employed alike for the conveyance of persons and goods.



2. Single-wheel barrow drawn by A. P. Folie, Jr., presumably after a real model brought home by van Braam. From van Braam, *Voyage*. Rare Books Collection, Firestone Library, Princeton University.

According as it is more or less heavily loaded, it is directed by one or two persons, the one dragging it after him, while the other pushes it forward by the shafts.”

Actually what van Braam saw was one of the most popular means of transportation in rural China in the Middle Ages. Even today wheelbarrows of this kind are still in use in certain parts of China. Van Braam went on to describe the single wheel with professional accuracy:

The wheel, which is very large in proportion to the barrow, . . . is as it were cased up in a frame made of laths, and covered over with a thin plank, four or five inches wide. . . . In addition to this, I should say that the wheel is at least three feet in diameter, that its spokes are short and numerous, and consequently, that the felloes are very deep; and that its convexity on the outer side, instead of being nearly flat, like common wheels, is of a sharp form.

Experienced in engineering, van Braam found the design of the wheel interesting: the edge was narrow compared to its European counterpart.¹⁰ At first he thought the narrowness of the outer edge of the wheel “unsuitable” for a clay-soil road. But after comparing these carts with those used in Java, which he must have visited when he was in the navy, he realized that in rainy seasons narrow felloes may cut through heavy ground and thus make the cart move better. Van Braam mentioned that “the learned M. Hooyman” had experienced such problems with broad-wheeled carts when he was in Batavia. Van Braam found himself “obliged to follow the custom of the country,” and was “convinced that the Chinese wheel is the best suited to a clayey soil.”

Not only the structure of the cart but its operation was “new” to van Braam: “The wheel . . . is placed in the center of the part on which the load is laid, so that the whole weight bears upon the axle, and the barrow men support no part of it, but serve merely to move it forward and to keep it in equilibrium.”

His report was precise. But to maintain equilibrium was not easy. I had a chance to try the cart some years ago, and therefore can appreciate van Braam’s account of the way it is loaded, which is an equally important factor in keeping the cart balanced:

On each side of the barrow is a projection on which the goods are put, or which serves as a seat for the passengers. A Chinese traveler

sits on one side, and thus serves to counterbalance his baggage, which is placed on the other. If his baggage be heavier than himself, it is balanced equally on the two sides, and he seats himself on the board over the wheel, the barrow being purposely contrived to suit such occasions.

The barrow cart impressed van Braam. He repeatedly admired the "singularity" and "simplicity" of this invention. But the barrow was nothing new for the Chinese. Illustration 3 gives a comparison found in the *T'ien-kung k'ai-wu*, a popular book by Sung Ying-hsing (1587-?) published in the late Ming.¹¹ The cart had only one wheel, which made it suitable for narrow and winding trails in mountainous areas, as the background of the drawing suggests, and in paddy fields. It had two handles, with which the cart-man shared part of the weight and, more important, directed the cart along the road. It looks identical to what van Braam observed in Chiang-hsi Province where, according to the *T'ien-kung k'ai-wu*, these carts were used. Some scholars have asserted that the use of such carts, which were referred to as "wooden cattle," can be traced back as far as the third century A.D., as described in the *Dynastic History of the Three Kingdoms* (*San-kuo chih*), and in the popular work based on it, the sixteenth-century novel *Romance of the Three Kingdoms* (*San-kuo yen-i*).¹²

Cart with Sails

By the end of 1794, the envoys entered north China where a seemingly endless plain extended north and east. Not only was the environment different from the mountainous provinces south of the Yangtze River, but, van Braam noted, the carts were "much larger than that I have already described, and drawn by a horse or mule," instead of by men. In particular, the sail-cart (*fan-ch'e*) aroused his sincere admiration. He discussed it in detail in his diary on the last day of 1794, when the embassy traveled in southern Shan-tung Province:

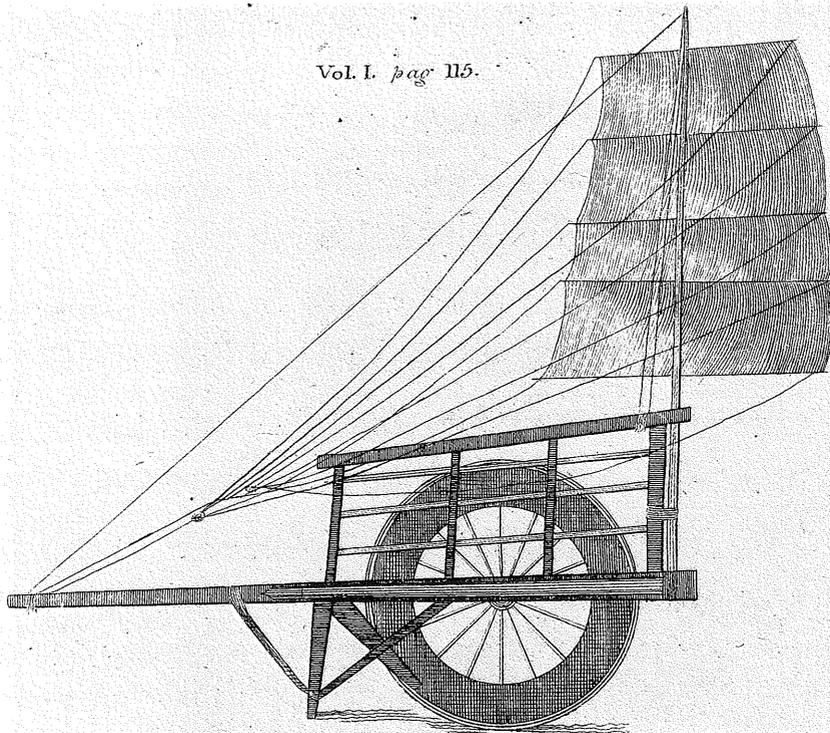
But how great was my surprise when I this day saw a whole fleet of wheel-barrow, all of the same size. I have good reason to call them a fleet, for they were all under sail; having a little mast very neatly inserted in a hole or step cut in the forepart of the barrow. To this mast is attached a sail made of matting, or more commonly of canvas, five or six feet high, and three or four wide, with reefs, yards, and



3. Single-wheel barrow shown in Sung Ying-hsing (1587-?), *T'ien-kung k'ai-wu* (1637 edn. published by T'u Po-chü), b, p. 43a. Block 15 x 22 cm. Facsimile. Collection of the Gest Oriental Library.

braces, like those of the Chinese boats. The braces lead to the shafts of the barrow, and by means of them the conductor trims his sail.¹³

An experienced sailor, van Braam could understand the function of the sail. He said that the sail was not merely “a momentary matter”; it was an “additional contrivance [*combinaison*] in the carriage” to help the cart-men. He gave detailed survey data as well as a drawing (see illustration 4), showing the structure of this “memorable thing” (*chose momentanée*.)” Father Marin once claimed in his *Description géographique de la Chine* that the Chinese sailing barrows, or wagons, did not really exist.¹⁴ Van Braam’s accounts and illustration now provide convincing evidence that they were real Chinese inventions. Seeing these sailing barrows rolling along one after another, the former sailor said in his diary that he “felt real pleasure.”



4. Cart with a sail. The string fastened at the top of the mast shares the weight loaded on the handles when the wind is strong. Two shorter strings from the bottom of the sail are “controllers” of the sail. From van Braam, *Voyage*. Rare Books Collection, Firestone Library, Princeton University.

It is easy to see the difference between these two kinds of carts. The smaller Chiang-hsi cart was easier to operate than one equipped with a sail, important in a mountainous area like Chiang-hsi. In contrast, the sail-cart, larger, heavier, and demanding more power, was good for Shan-tung Province where flatlands spread out hundreds of miles east to the sea. Seasonal winds there were strong and steady, providing an inexhaustible source of energy for the barrows.

In the early 1950s investigators from Ch'ing-hua University, Peking, found sail-carts near the port city of Tsingtao. They photographed and documented them,¹⁵ and their investigation confirmed what van Braam saw on the first day he entered Shan-tung Province. In fact, a similar device, a sail-on-ice-sled, was used in Manchuria where snow covers the ground four or five months a year.

Passenger Cart (La charrette)

Van Braam later described with the same accuracy the *charrette* used in Shan-tung Province:

It appears that carts and wheel-barrows are the only carriages known in this province, either for the conveyance of persons or goods. If the cart were not so small and hung so low upon the wheels, which are not of more than four feet diameter, and which are of singular form, it might be compared to the Hessian cart; but the felloes of the wheel are at least six inches deep, and, in the direction of a whole diameter, is a large piece of wood, more than six inches square, crossing the axle, while two other pieces of wood, shorter and thinner than that I have just spoken of, cross it in their turn at right angles, and are inserted at each end in the corresponding felloes. The axle, of which the end is square, is let into the first of these three pieces, so that the axle and wheels all turn together.¹⁶

Because the water level of the Yellow River was seasonal and the smaller rivers almost all flowed eastward, inland waterway transportation was difficult. Carts were thus the major means of transportation until railroads and other modern forms of transportation were developed early in the twentieth century.

Van Braam reported that carts were powered by five oxen, or horses, or mules. The strongest beast was always placed between the shafts, and

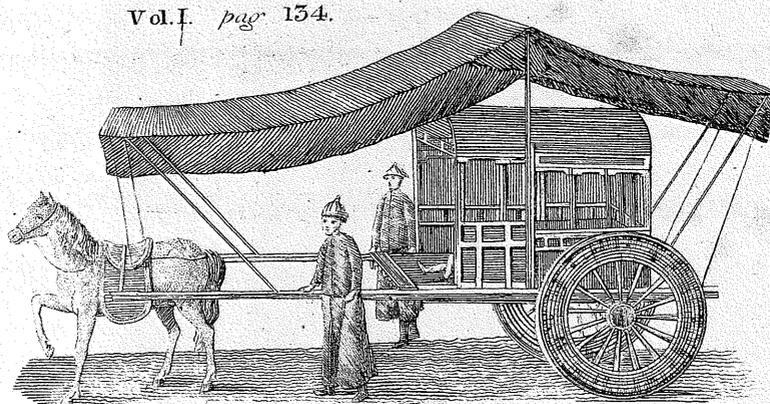
another “abreast of him.” Although a shortage of large domestic animals had long been a problem for economic development in China, van Braam seems not to have experienced this shortage.

Van Braam and the other envoy had the honor of using special carriages (illustration 5) provided for them when they arrived in Peking on January 10, 1795. Van Braam described the two *charrettes* as follows:

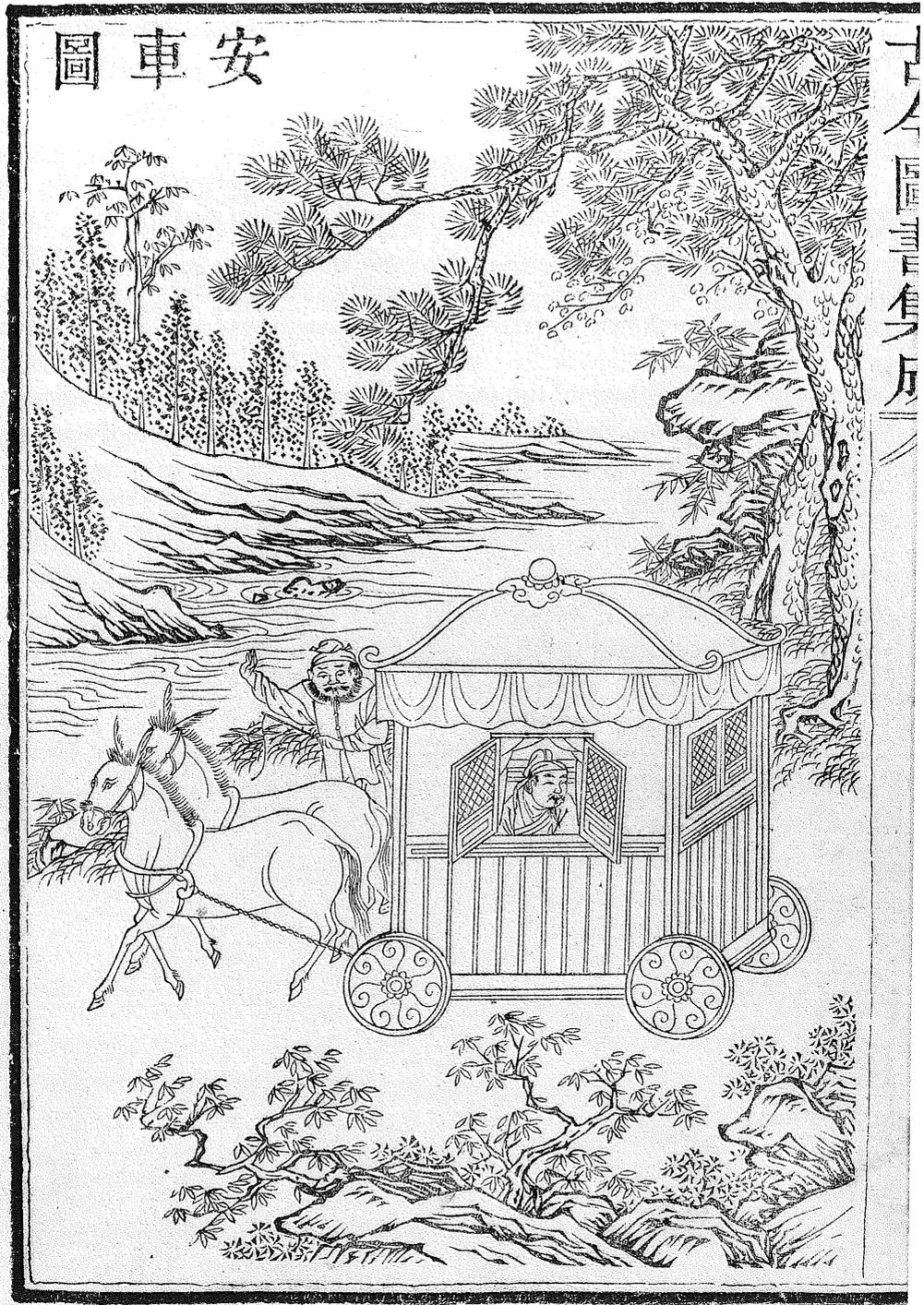
They [the carts] are only intended to carry a single person. The outside is neat and covered with cloth, and in the sides are little windows, by means of which the person within can see everything while sitting on a cushion laid in the bottom of the carriage, according to the Chinese custom.¹⁷

This kind of vehicle was also recorded in the Ch’ing imperial encyclopedia published in 1726 (*Ku-chin t’u-shu chi-ch’eng*), where it was named “comfortable vehicle” (*an-ch’e*; see illustration 6), and the idea of the design was explained:

The design of the *an-ch’e* does not use high wheels because the body of the cart would not be steady while traveling if high wheels were employed. The cabin is six *ch’ih* [about two meters] in length so that



5. Passenger cart with windows and blind. From van Braam, *Voyage*. Rare Books Collection, Firestone Library, Princeton University.



6. *An-ch'e* as shown in the *Ku-chin t'u-shu chi-ch'eng* (1726 edition), "K'ao-kung tian," ch. 174. Collection of the Gest Oriental Library.

passengers can lie down in the cart, and as wide as the distance between the wheels.¹⁸

The encyclopedia goes on to explain that the cabin was covered with varnished cloth and oilpaper. At the rear of the cabin was a door; the passenger could climb aboard through it with the help of a rail and stair. Inside the cabin was a deluxe mattress to make the trip comfortable. By the side of the mattress was a movable long narrow table (*chi*), to facilitate eating and reading in the cabin. The window that van Braam particularly enjoyed was also described:

There is a window toward the rear axle, through which the passenger can enjoy the scenic view while lying on his side in the cabin during his trip. At the rear part of the car is installed a blind of oilpaper. Two wooden beams are set at each end of the blind. The blind can be opened fully to keep the passenger from rain, or partly toward either the front or one side to lessen the wind [to make travel more comfortable]. When in use, the blind is fastened with iron buckles to the roof and the base of the cabin; when not in use, it can be wrapped up and stored at the rear part of the cart.

Although the Ch'ing encyclopedia discusses extensively the blind of the carriage (*hsien*), regrettably it does not illustrate it. In contrast, van Braam's book has a clear and accurate illustration of the blind. The drawing matches perfectly the written description of the blind in the encyclopedia, thus offering reliable supplementary data.

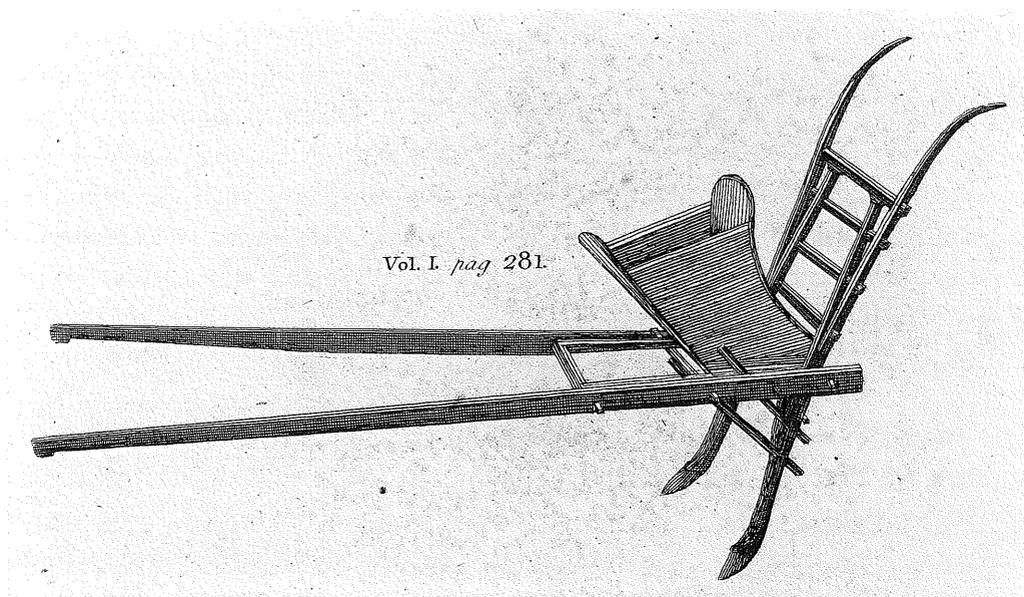
Seed-drill (La semoir)

Van Braam and the other envoy made it to the capital in time to attend the celebration of the sixtieth year of Ch'ien-lung's reign. During their stay, they were treated hospitably and were invited to various festivities, some of which were presented by the emperor himself. On January 29, 1795, a state banquet was held for foreign envoys, during which the Dutch and the Korean ambassadors each received a cup of wine from the emperor's hands, the greatest honor that the Ch'ing emperor would accord to "barbarians." They were also granted lavish gifts. Later the ambassadors had several other opportunities to pay their respects to the emperor and to visit the Manchu princes, who showed great interest in the small articles, such as a watch, used by foreigners.¹⁹

When the celebration was eventually over, the Ch'ing court wasted no time in sending the foreigners back to the remote southern province. Van Braam had to leave the capital where he had stayed only thirty-six days after his exhausting fifty-day journey. The return trip, however, was more comfortable and leisurely. An imperial edict to officials of all the provinces that the envoys were to pass through ensured a courteous reception in every city they stopped in.²⁰

It was already early spring when the ambassadors entered Shan-tung Province. There farmers were busy "*sur la terre qui doit être fécondée,*" van Braam noted with admiration. On February 20, he was able to examine an instrument used by the farmers for sowing, which he called a *semoir* (illustration 7) and described in his diary as follows:

It consists of two sticks or pieces of wood about four feet long, the lower extremities of which are shod with a kind of iron wedge that serves to open the furrow. A little above is a square box placed between the two sticks, and tapering downwards in the shape of a funnel. Behind this is a plank put across for the purpose of covering up the furrow after the seed has fallen in.²¹



7. Sowing machine. From van Braam, *Voyage*. Rare Books Collection, Firestone Library, Princeton University.

According to van Braam, this instrument was operated by three men; two pulled it forward and the third directed it along the furrow. This machine, van Braam remarked, "*J'avais déjà conçu,*" because he had noticed that the quality of planting was high for the whole field.

This instrument is called "*lou-li*" in Chinese, and is known to have been in use as early as Emperor Han-wu's reign (140–86 B.C.).²² During the Sung dynasty, the *lou-li* was widely employed by Chinese farmers. Wang An-shih (1021–1086), a well-known Sung reformer in government administration and agriculture, highly praised its efficiency in his poems.²³ In a Yüan-dynasty work, *Nung-shu*, compiled in 1313, Wang Chen included a detailed description of the *lou-li*. According to Wang, this instrument was animal powered and capable of sowing thirty-five *mu* (about 5.34 acres) per day.²⁴ Wang also described different models of the *lou-li* employed in other areas of China. The model used in Shan-tung Province and the method of its operation were accurately confirmed by van Braam's work. For instance, both authors said that the instrument was operated by three men. As to its size, van Braam reported that the machine was "about four feet high," whereas in Wang's book its height is said to have been "approximately three *ch'ih*," which is about three feet, five inches.²⁵ The sowing machine functioned as a combination of plow and drill. Seeds were deposited in the seed box. There were channels and holes at the bottom of the box. When the machine jerked forward, the seeds were shaken down through the holes. As the distance between the holes was preset, the device would produce regular furrows without special attention from the farmer. Wang mentioned in his book that some "recent" models used two boxes, one for seeds and the other for manure pills. If the machine was operated properly, the right number of pills would drop with the seeds, no more and no less, to provide the necessary fertilizer. Van Braam was apparently amazed at this "extremely simple" machine. He said it was "*très-agréable*" to see it in operation.

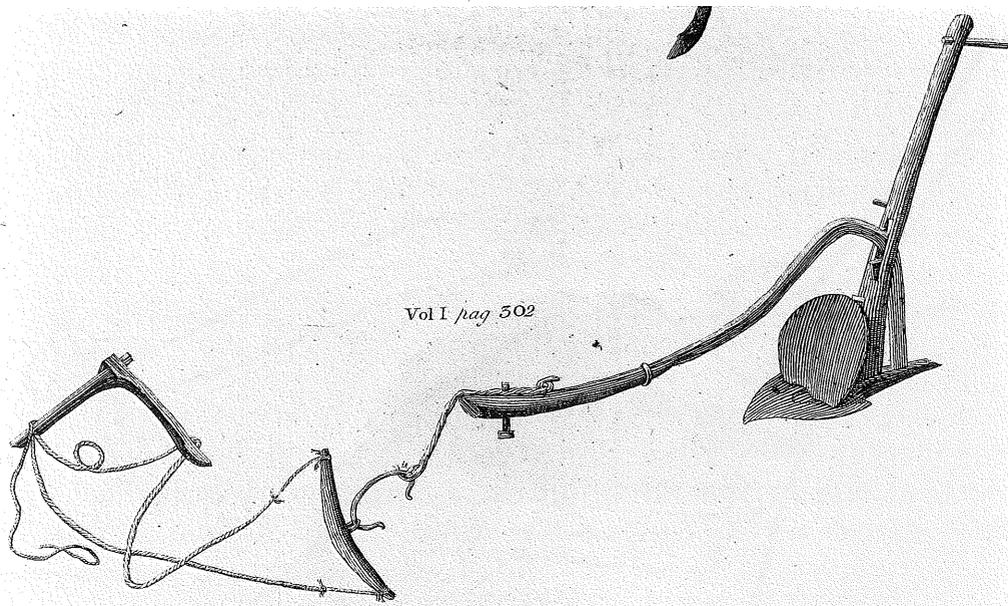
Chinese Plow (La charrue chinoise)

The envoys traveled through Shan-tung Province in early spring, and "all the country we have this day travelled through consists of arable land, a great part of which having been sown in the autumn, begins already to be covered with a delightful verdure."²⁶ Van Braam also saw farmers work with plows, which, though simple, were "sufficient to turn up the strongest ground." He was so amazed by the instrument that he admitted feeling that the Western plow was

“inferior to theirs,” and was “resolved to buy one the first opportunity to carry out of the country with me.” So he did. The one he brought back became the model for drawings (see illustration 8), which enable today’s readers to visualize this “excellent instrument for indifferent land.”

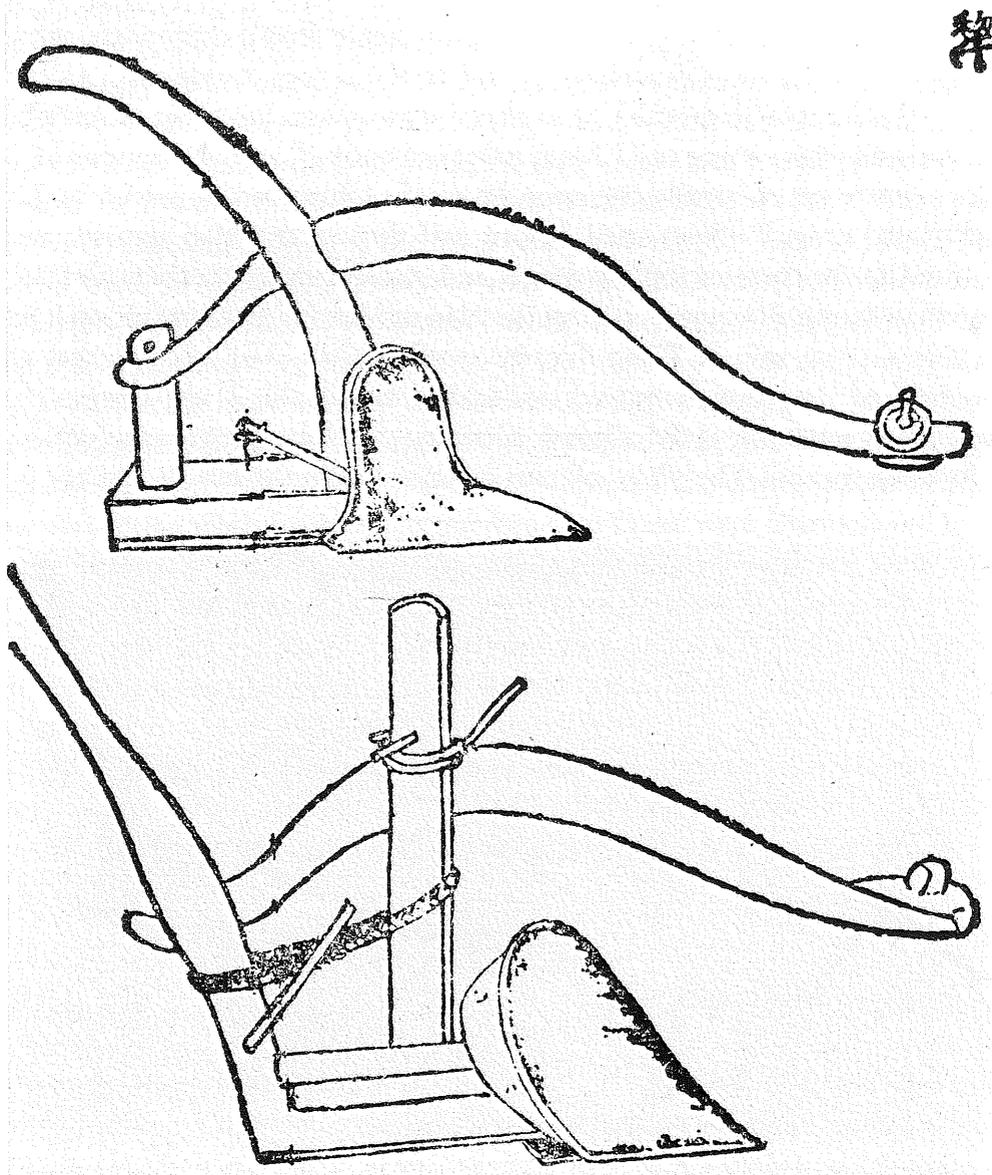
This plow is extremely simple. An iron plowshare is attached at the far end of the plow. The plow sole is also clearly visible. The shaft and the set of harness show that cattle were probably the source of power. The angle of the plowshare and the moldboard is just slightly larger than a right angle, which is appropriate for the soft and fertile soil in Shan-tung Province.

As the most important agricultural instrument, the plow is described in almost all major Ming and Ch’ing reference books,²⁷ and illustrations of the plow tend to be essentially the same. Its use in China can be traced back to prehistoric times.²⁸ Plows used before and during the Han dynasty were pictured in frescoes on tomb passages and engravings on earthen tiles. Iron plowshares were also employed. But the Han models did not contain such fine parts as a plow sole. A T’ang-dynasty work, *Lei-ssu ching*, records that the structure of the plow improved noticeably during the T’ang dynasty.²⁹ A moldboard appeared, as did a minor plowshare, making plows more efficient in forming furrows. The plow sole was separated from the handle and became



8. Plow recorded by van Braam in his *Voyage*. Rare Books Collection, Firestone Library, Princeton University.

an independent part, which made the plow steadier while plowing. Later scholars considered this a fully developed plow, and named it the “*chiang-tung li*” (illustration 9). Few improvements had been made to this plow since the T’ang dynasty, for the plow that van Braam observed and recorded is almost identical to this model.



9. A reconstructed *chiang-tung li*. Adapted from *K'ao-ku*, no. 7 (1964), plate 9-8.

Van Braam noticed that the "husbandmen" were working with the plow, but he did not specify whether the plow was powered by man or animal. On other occasions, he did mention that the *semoir* was man powered: "This instrument is put in motion by means of two wheels. Two Chinese draw it, while a third who guides with his two hands, first sows one, and then the other furrow."³⁰ At the two ends of the field were sets of pulleys. A long rope was used to connect the sowing machine and the pulley sets. Two men operated the pulleys to provide power for the machine and made it move back and forth along the furrows over the field. This device was also described by a Ch'ing-dynasty scholar, Ch'ü Ta-chün, in his *Kuang-tung hsin-yü*.³¹ According to Ch'ü, the device was equivalent to two men's power. Local farmers praised the device and named it "wooden cattle."

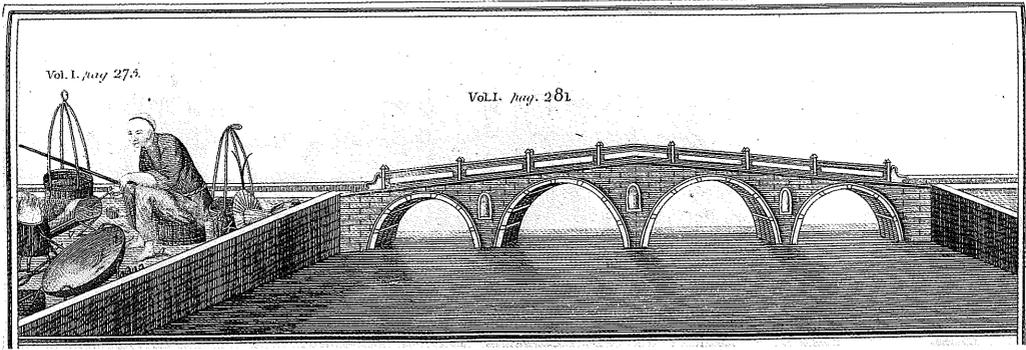
The Tinker

Van Braam's curiosity was not limited to machines. He observed and recorded men at work as well. On his journey back to Kuang-chou, he encountered a tinker in Fang-kuan Village.³² The tinker was busy repairing frying pans, which were "cracked and full of holes." He "restored them to their primitive state, so that they became as serviceable as ever." The skill astonished van Braam. He carefully examined the tinker's equipment and found that

all the apparatus of the workman consists in a little box sixteen inches long, six inches wide, and eighteen inches in depth, divided into two parts. The upper contains three drawers, with the necessary ingredients; in the lower is a bellows, which, when a fire is wanted, is adapted to a furnace eight inches long and four inches wide. The crucibles for melting the small pieces of iron intended to serve as solder are a little larger than the bowl of a common tobacco pipe, and of the same earth of which they are made in Europe; thus the whole business of soldering is executed.³³

This description corresponds precisely to what I saw some thirty-five years ago in China, when craftsmen were still offering their services in small lanes and back streets in cities and towns. It is truly amazing that the tinkers did their job thirty-five years ago in exactly the same way that their predecessors had some two hundred years before:

The workman receives the melted matter out of the crucible upon a piece of wet paper, approaches it to one of the holes or cracks in



10. Tinker at work as depicted in van Braam's *Voyage*. Rare Books Collection, Firestone Library, Princeton University.

the frying-pan, and applies it there, while his assistant smooths it over by scraping the surface, and afterwards rubs it with a bit of wet linen. The number of crucibles which have been deemed necessary are thus successively emptied in order to stop up all the holes with the melted iron, which consolidates and incorporates itself with the broken utensil, and which becomes as good as new.³⁴

Van Braam thought that this process was unknown in Europe. He admired the skills of the craftsmen so much that he claimed their accomplishments “must indeed appear impossible to any one who has not been witness to the process.” To increase the credibility of his description, he added an engraving (see illustration 10). In the drawing the man has set up his business at one end of a bridge, as most craftsmen would. His shoulder pole was behind him, and he was operating the bellows, which increased the heat of his furnace. A big wok was sitting to one side waiting to be repaired. A small box to his right presumably contained the solder he was going to use. The box for the “apparatus” served as a stool for the man. His clothing, his hairstyle, the bamboo hat that he would need when it rained, and other objects in the picture all encourage the presumption that this is a drawing from life.³⁵

DISCUSSION

The value of van Braam's diary to modern scholars is manifold. It covers a wide variety of topics, including bridges, pagodas, city walls, boats, the layout of the capital, and landscape painting, as well as different lifestyles, and the geography and agriculture in the areas the ambassadors traversed. Many of

these topics have not been touched on in this paper, nor have they received enough attention in the traditional Chinese references. Van Braam's work is therefore an important supplement to these sources. The value of his diary lies first of all in his unusual qualifications. An experienced sailor who had traveled extensively over the world and a knowledgeable, open-minded, and keen observer, van Braam was able to understand quickly the objects he observed through comparisons, to pick up professionally the technical details, and to gauge and record them accurately. More important, his work makes it possible for modern scholars to conduct comparative studies of the relevant Chinese books that deal with similar topics: means of transportation, agricultural instruments, and other articles of everyday life. Many of these books also contain illustrations.³⁶ A perusal of those books indicates, however, that most of the illustrations were not the original work of the compiler, but copies of those in the *Nung-shu*. This immediately casts doubts on their accuracy and reliability. Van Braam's independent and reliable work provides modern scholars with engravings of the highest technical standards and the rigorous principles of Western perspective. They will considerably facilitate the further study of inventions and devices in late eighteenth-century China.

NOTES

Mr. Roy Goodman, librarian at the American Philosophical Society, Philadelphia, first drew my attention to van Braam's book. F. W. Mote, emeritus professor in East Asian Studies at Princeton University, gave me his notes on the journal and other materials. The Rare Books Collection of Firestone Library at Princeton provided convenient access to various versions of this book, including the French-language first edition of 1797-1798. Professor Emeritus D. Lacey, Rutgers University, helped make the paper more readable in English. Mr. Cary Liu, Art and Architecture, Princeton University, helped with the illustrations, and Barbara Westergaard helped spare me from a possible blunder. My sincere thanks are due them all.

1. The relation between the embassy and the Ch'ing court, the author, and his journey has been studied by J.J.L. Duyvendak in his "The Last Dutch Embassy to the Chinese Court (1794-1795)," *T'oung Pao*, no. 34 (June 1938), p. 1, and a supplementary note in *ibid.*, no. 35 (1940), p. 329. George R. Loehr, "A. E. van Braam Houckgeest, the First American at the Court of China," *Princeton University Library Chronicle*, no. 15 (1954), p. 179, studied the book as well as the life of the author.
2. The main source of his biography is Moreau de Saint Méry's *Advertisement* attached to his translation of van Braam, *Voyage de l'ambassade de la Compagnie des Indes Orientales Hollandaises, vers l'Empereur de la Chine, dans les années*

- 1794 & 1795 (Philadelphia, 1797-1798); hereafter referred to as *Voyage*. It is an important translation into French by Moreau de Saint Méry from the original Dutch manuscript.
3. Loehr, "A. E. van Braam," p. 188.
 4. Duyvendak, "The Last Dutch Embassy," appendix 2, pp. 116-131.
 5. *Ibid.*, p. 43.
 6. A. E. van Braam Houckgeest, *Voyage de l'Ambassade de la Compagnie des Indes Orientales Hollandaises* (Paris, Garnery, and Strasbourg: Levrault, 1798), 2 vols. This is a pirated edition of volume 1 of the Philadelphia edition. The English translation is entitled *An Authentic Account of the Embassy of the Dutch East-India Company, to the Court of the Emperor of China, in the Years 1794-1795* (London: R. Phillips, 1798), 2 vols. See Howard C. Rice, Jr., Shih-kang Tung, and Frederick W. Mote, *East & West, Europe's Discovery of China, & China's Response to Europe, 1511-1839* (Princeton, N.J.: Princeton University, 1957), p. 74. The quotations in this paper are based on the English-language edition; each has been checked with the original French-language edition.
 7. Duyvendak, "The Last Dutch Embassy," p. 43. During the fifty-day journey, van Braam traveled by water only one or two days. See *ibid.*, appendix 1.
 8. *Voyage*, p. 72; English translation (hereafter abbreviated as E), vol. 1, p. 96.
 9. *Voyage*, pp. 72-73; E, vol. 1, pp. 96-97.
 10. George Stubbs's "Labourers" (1785, enamel on biscuit and earthenware, Tate Gallery, London) shows European wheelbarrows with a much wider wheel.
 11. Sung Ying-hsing, *T'ien-kung k'ai-wu* (1637 edn., rpt.; Peking: Chung-hua shu-chü, 1959), 2, p. 246. The edition most modern authors use, however, is slightly different from the original 1637 edition, which had been lost for hundreds of years until its reappearance in the late 1950s. The drawing adapted in this paper is from a 1637 edition. I examined the corresponding drawing (drawing 70) in the later Ch'ing editions. No significant difference can be discerned for the barrows; the backgrounds are, however, entirely different. But both show a mountainous landscape. See also the English translation of the work: *T'ien-kung k'ai-wu, Chinese Technology in the Seventeenth Century*, trans. E.T.Z. Sun and S. C. Sun (University Park: Pennsylvania State University Press, 1966), pp. 183-185.
 12. Ch'en Shou, *San-kuo chih* (Peking: Chung-hua shu-chü, 1959), 33, p. 896. But what "wooden cattle" actually were is controversial. The term has also been used to refer to seed-drills (see the section "Seed-drill [*La semoir*]" below). Luo Kuan-chung, *San-kuo yen-i* (Peking: Jen-min wen-hsüeh ch'u-pan-she, 1985), 102, pp. 876-878, provides a detailed description of "wooden cattle." Most scholars refer to the records in Kao Ch'eng's *Shih-wu chi-yüan* (Hsi-yin hsüan edn., preface dated 1447), 8, pp. 2-3, and Ch'en Shih-tao's *Hou-shan t'an-ts'ung* (Pao-yen-t'ang mi-chi edn.), 4, pp. 1a-b. Both Kao and Ch'en were Sung scholars.
 13. *Voyage*, p. 115; E, vol. 1, p. 152.
 14. Father Marin's work is quoted in the English version of the *Voyage*. The quotation appears in the "glossary" prior to the translation. Pages of this glossary are unnumbered. In the glossary, items of Chinese technological invention are arranged alphabetically, and a brief comment is attached to each of them.

- The author of the glossary is not identified, although it seems possible that he was one of the English translators.
15. Liu Hsien-chou, *Chung-kuo chi-hsieh kung-ch'eng fa-ming shih* (Peking: K'ohsüeh ch'u-pan-she, 1962), p. 58, photograph by Chou Hsü-tung. Judging by the picture, the present sail-cart is larger than that described by van Braam. I attempted to find a mention of the device in the Ming-Ch'ing "informal jotting" (*pi-chi*), but to no avail.
 16. *Voyage*, p. 124; E, vol. 1, p. 164.
 17. *Voyage*, p. 134; E, vol. 1, p. 178.
 18. Ch'en Meng-lei, "K'ao-kung tien," *Ku-chin t'u-shu chi-ch'eng* (1726 edn., rpt.; Taipei: Wen-hsing ch'u-pan kung-ssu, 1964), 174, pp. 435-436; the English translation is mine.
 19. Duyvendak, "The Last Dutch Embassy," p. 69.
 20. *Ibid.*, pp. 86-88. The edict was dated December 22, 1794, and took two months to reach the embassy.
 21. *Voyage*, p. 281; E, vol. 2, p. 85. Van Braam mentioned here that two wheels were attached to the machine. When the drawing he provided is compared to information from other Chinese sources, however, the use of the term "wheels" becomes confusing.
 22. *Han-shu* (Ssu-pu pei-yao edn.), 24a, p. 13. It is worth noting that in a different edition of the *Han-shu* (Peking: Chung-hua shu-chü, 1962), 24a, p. 1139, it is called "ou-li."
 23. Wang An-shih, *Lin-ch'uan hsien-sheng wen-chi* (Ssu-pu ts'ung-k'an edn.), 11, p. 4b, "Lou-chung."
 24. Wang Chen, "Nung-ch'i t'u-p'u chi," *Nung-shu* (1313 edn., rpt.; Peking: Nung-yeh ch'u-pan-she, 1981), 2, pp. 211-212.
 25. For metric equivalents of ancient Chinese measurements, see Ch'iu Lung, *Chung-kuo ku-tai tu-liang-heng t'u-chi* (Tokyo: Misuzu shobō, 1985), p. 66. Later, in the Ming dynasty, Hsü Kuang-ch'i cited Wang Chen in his *Nung-cheng ch'üan-shu* (Peking: Chung-hua shu-chü, 1956), 21, pp. 426-427. For further discussions of the "sowing machine" (seed-drill), see Joseph Needham, *Science and Civilisation in China* (Cambridge: Cambridge University Press, 1984), vol. 6.2, pp. 262 ff.
 26. *Voyage*, pp. 302-303; E, vol. 2, p. 114.
 27. Pei-ching t'u-shu-kuan ts'an-k'ao-pu, "Chung-kuo li-tai nung-chü t'u i-lan piao," *T'u-shu kuan*, no. 3 (1963), pp. 21-24.
 28. Fang Chuang-yu, "Chan-kuo i-lai chung-kuo pu-li fa-chan wen-t'i shih-t'an," *K'ao-ku*, no. 7 (1964), pp. 355-362.
 29. Lu Kuei-meng, *Lei-ssu ching* (I-men kuang-tu edn.), pp. 2-3. Unlike most traditional Chinese writings, this book is not divided into *chüan*.
 30. *Voyage*, p. 281; E, vol. 2, p. 85. A man-powered plow was first recorded by Wang Cheng. See his "Tai-keng t'u-shuo," in *Chu-ch'i t'u-shuo* (Ssu-k'u ch'üan-shu edn., rpt.; Taipei: Shang-wu yin-shu-kuan, 1983), 3, pp. 58-59.
 31. Ch'ü Ta-chün, *Kuang-tung hsün-yü* (preface by P'an Lei, dated 1700), 16, p. 17b.
 32. In van Braam's diary, the village is referred to as "Fan-koun."
 33. *Voyage*, p. 275; E, vol. 2, p. 78.
 34. *Voyage*, p. 275; E, vol. 2, p. 79.
 35. Van Braam was not the only European visitor attracted by the way a Chinese tinker worked. John Henry Gray also recorded a Chinese tinker in his book *China: Laws, History, and Customs* (London: Macmillan, 1878). A drawing of a tinker in which the furnace and the box for his apparatus are clearly shown appears in vol. 2, p. 192. Two pots and two candlesticks sitting at the top of

the box were apparently what the tinker would work on or had just repaired. The box, the furnace, and the bamboo hat all confirm van Braam's descriptions of the same objects.

36. For example, Wang Chen, *Nung-shu*

(1313); Sung Ying-hsing, *T'ien-kung k'ai-wu* (1637); Hsü Kuang-ch'i, *Nung-cheng ch'üan-shu* (1639); Emperor K'ang-hsi, *Keng-chih t'u* (1696); Ch'en Meng-lei, *Ku-chin t'u-shu chi-ch'eng* (1726); and Eh-erh-t'ai, *Shou-shi t'ung-k'ao* (1742).

GLOSSARY

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|--------------------------------|--|
| an-ch'e 安車 | <i>Ku-chin t'u-shu chi-ch'eng</i> 古今圖書集成 |
| chi 几 | <i>Lei-ssu ching</i> 耒耜經 |
| Chiang-hsi 江西 | lou-li 耬犁 |
| chiang-tung li 江東犁 | Ming 明 |
| Ch'ien-lung 乾隆 | mu 畝 |
| ch'ih 尺 | <i>Nung-shu</i> 農書 |
| Ch'ing 清 | <i>San-kuo chih</i> 三國志 |
| Ch'ing-hua 清華 | <i>San-kuo yen-i</i> 三國演義 |
| Ch'ü Ta-chün 屈大均 | Shan-tung 山東 |
| fan-ch'e 帆車 | Sung 宋 |
| fang-kuan 方官 | Sung Ying-hsing 宋應星 |
| Han 漢 | T'ang 唐 |
| Han-wu 漢武 | <i>T'ien-kung k'ai-wu</i> 天工開物 |
| hsien 噐 | Tsingtao 青島 |
| K'ang-hsi 康熙 | Wang An-shih 王安石 |
| Kuang-chou 廣州 | Wang Chen 王慎 |
| Kuang-tung 廣東 | Yüan 元 |
| <i>Kuang-tung hsün-yü</i> 廣東新語 | |