

Questions on Construction Logistics to Build a Dragon Kiln in South Carolina in 1815

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Introduction

In an archaeological project focused on stoneware potteries in Edgefield, South Carolina, investigations revealed that those enterprises somehow built and operated enormous “dragon kilns.” These structures were revealed only through our archaeological work and represent the only known instances of these facilities being built and operated in the Americas.

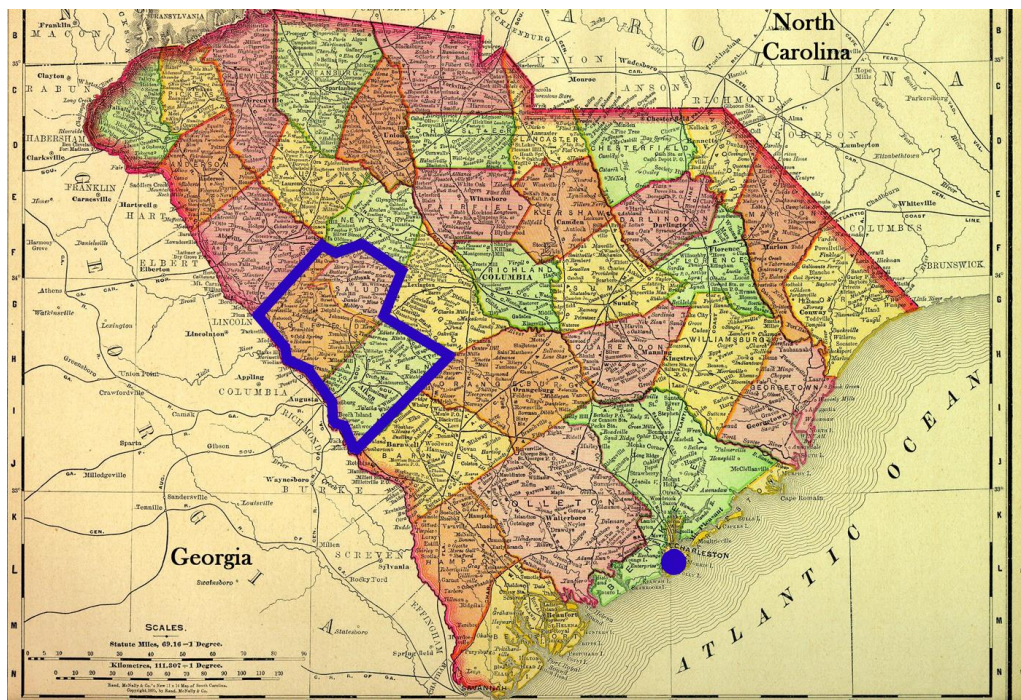


Figure 1. An excerpt of an 1895 Atlas Map of South Carolina, with overlay showing the approximate outline of the Old Edgefield District, in which Pottersville was located, and the location of the city of Charleston. Rand McNally 1895; overlay by the author.

In the summer of 2011, a University of Illinois (UIUC) archaeological field school focused on a pottery production center known as “Pottersville” (Figures 1, 2). We were advised by historians and other archaeologists that the Pottersville kiln would very likely be no more than

20 to 35 feet in length and 9 to 12 feet in width. That design, often called a “groundhog” kiln, was a prevalent form in mid- to late-1800s sites that had been investigated previously.

UIUC commissioned an aerial, high-resolution survey employing Light Detection and Ranging (LiDAR) technology of the area of the Pottersville kiln and surrounding acreage (Calfas et al. 2011; Fennell 2010). This survey was conducted in early 2011 and appeared to detect the remains of a far longer linear structure underlying the surface contours of the kiln location (Calfas et al. 2011). LiDAR surveys are highly useful because they can detect the “bare earth” surface contours and related indications of archaeological remains at a site that are otherwise obscured from visibility by vegetation and ground cover. The hillside on which the Pottersville kiln was located had become overgrown with trees and shrubs over time (Calfas 2017; Fennell 2010).



Figure 2. Excerpt of Robert Mill's (1825) map of the Edgefield District, showing town of Edgefield and nearby pottery and village of Landrumsville (later called Pottersville) based on 1817 surveys by Thomas Anderson.

The Summer 2011 excavations confirmed the preliminary indications from the LiDAR survey. The Pottersville kiln proved to be 105 feet in length and 12 feet in width (Figure 3). The last firing of ceramic vessels was uncovered in the strata of the kiln remains. The excavations identified the major architectural features of the kiln, including the exterior and interior walls, terminus points of the structure, firebox, chimney, apertures for channeling fire and heat, ware

chambers, and partitions (Calfas 2013, 2017; Steen 2011a, 2011b). Archaeological and documentary evidence show that the kiln was likely built around 1815. This was a pottery kiln operation of astounding, industrial scale, which no doubt required extensive labor support throughout its operations over the first half of the 1800s (Calfas 2013).

Each firing of the Pottersville kiln, at 105 feet in length, consumed tons of wood and required nearly a week to complete (Calfas 2013; Mueller-Heubach 2013: 22; Sayer 1951: 46). An extensive community of laborers and craftspeople was required to chop the wood, quarry and prepare the clay, turn the vessels, and load and unload a kiln of this scale (Calfas 2013, 2017). Each firing of that kiln had a profound impact on the cultural landscape surrounding it, from the demands for labor, to the community focus upon the event, to blanketing the area with billowing smoke, radiating heat, and flames erupting from the kiln chimney to light the night sky throughout a week of firing.

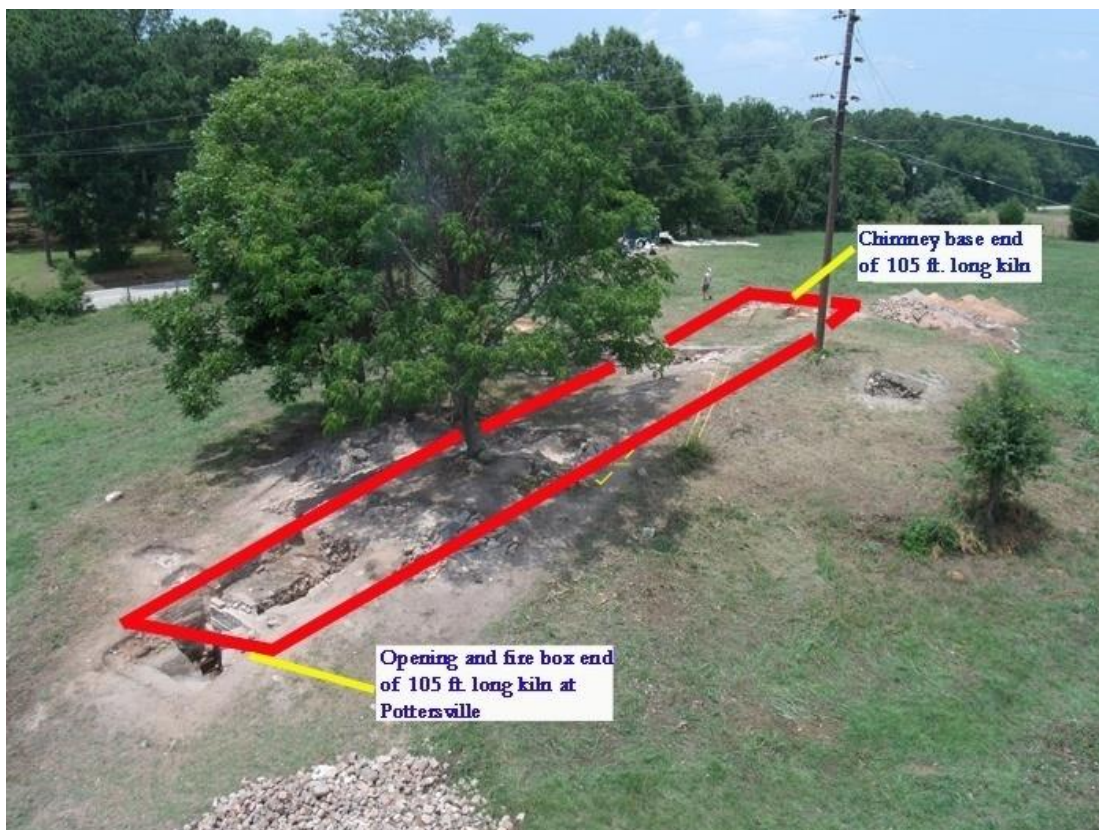


Figure 3. Outline of the dragon kiln at Pottersville exposed by excavations in 2011. Photograph courtesy of George Calfas; overlay by the author.

After analysis of the excavation results at the kiln site from 2011, it appears that Abner Landrum was the first to build the equivalent of an Chinese-style “dragon” kiln in the Americas (Calfas 2013, 2017; Hunter and Mueller-Heubach 2019; Mueller-Heubach 2013; see Kerr and Wood 2004: 350, 767-68). This design of kiln had been used for centuries in industrial-scale production in China, with linear, barrel-vault shaped kilns running over 100 feet in length in an uphill slope to produce large quantities of stonewares. Many such kilns were built and operated in factory towns in southeast China, such as Jingdezhen. The dragon label derives from the dragon as a symbol of a governing monarchy, which subsidized and regulated such production centers to varying degrees over the past centuries (Bradford 2004; Chen 1986; Hsu 1995; Needham et al. 2004).

Targeted research projects in 2012 focused on the architecture of the kilns at three other production sites (referred to as archaeology sites 38AK496, 38AK497, and 38AK854) that had been managed by the Landrums in the antebellum period. Those investigations found that the Landrums constructed three additional dragon kilns of the same size and design as the one built at Pottersville (38ED11) by 1815. Remarkably, they made no mention of these structures in all of the myriad writings they produced over decades. The existence of these dragon kilns was revealed only through archaeological investigations. They may have refrained from writing about their accomplishments to avoid information about their kiln design flowing to competitors elsewhere in the U.S. The four kilns were utilized up through the mid-1800s (Calfas 2013, 2017; Fennell 2017, 2021; Steen 2016a, 2016b).

Thorough analysis by George Calfas (2013, 2017) demonstrated that the Landrum kilns could only have been based on the design of dragon kilns of southeast China. Comparative analysis with other kiln forms utilized in different regions of Europe showed no correlative design (Calfas 2013, 2017; Hunter and Mueller-Heubach 2019). A remaining question is how the Landrums and their labor force built and successfully operated the first of these four linear kilns in Edgefield.

Two hypotheses (among others) are: (1) they obtained information in written and drawn form of the basic design and succeeded in a trial-and-error way in building and operating the first kiln; (2) they had the assistance of an émigré from southeast China with knowledge and experience in the construction and operation of such kilns.

The first hypothesis is supported by evidence of the Landrums having engaged in experimentation in the pottery production techniques at their sites (e.g., Steen 2016a, 2016b). The second hypothesis was suggested to me by archaeologists in Taipei, Taiwan and Beijing, China, who have investigated dragon kilns in those regions. I visited the Graduate University of the Chinese Academy of Science in Beijing in 2011 and the National University of Taiwan in Taipei in 2012. I presented talks on research findings from the Edgefield pottery project up to that time and the new questions which had emerged concerning kiln construction. Those researchers in Beijing and Taipei suggested that a dragon kiln is too complicated of a structure to have been successfully built by the Landrums based on written and drawn information and trial-and error methods. They suggest an experienced kiln manager or kiln builder from the region of southeast China would be needed on-site to succeed.

To further address these questions I conducted an extensive literature search in the late Summer and Fall of 2022 using resources available through the library systems of the University of Illinois and University of Chicago. I also conducted detailed database searches using the proprietary data sets of Ancestry.com and Newspapers.com. These proprietary databases tend to provide more sources and more robust search capabilities than do similar sources available through university library systems. The “References Cited” and “Additional Sources” sections at the end of this paper record most of the books, articles, and databases I reviewed.

This paper presents findings from research exploring these two hypotheses. Part I discusses evidence that people and information were known to have been in movement between southeast China and the east coast of the United States in the late 1700s and early 1800s. Part II explores evidence that could support the hypothesis that the Landrums relied on written and drawn records of dragon kiln designs from China along with trial-and-error methods in building their first linear kiln. Part III explores evidence that an émigré from the factory towns, such as Jingdezhen, in southeast China could have traveled to South Carolina in the late 1700s or early 1800s. This paper presents strong contextual evidence to support both hypotheses, but no direct evidence to demonstrate the presence of an émigré kiln master from China arriving in South Carolina.

I. Movement of People, Goods, and Information in the late 1700s and early 1800s

Popular histories of immigrations from China to the United States often describe the process as beginning in the mid-1800s. For example, a public history page on the Library of Congress takes this approach (Library of Congress 2022). Another popular history news source provided passing reference to earlier immigrations in the 1700s, but again focused principally on the immigrations related to gold rushes of the mid-1800s as spurring the main, first waves of immigration (Voice of America 2010).

However, historical overviews, such as that provided by the U.S. Embassy and Consulate for Guangzhou, China, observe an earlier period of trade, contact, and related opportunities for moving people and goods in the 1700s:

Throughout the past two centuries, dating back to the presidency of George Washington, Consulate Guangzhou (Canton), as America's oldest diplomatic post in China and one of America's oldest posts in the Far East, has played a pivotal role in promoting America's relationship with China. . . . United States diplomatic presence in the Guangzhou area dates back to the founding years of the American republic. In 1784, the American merchant ship *Empress of China* reached what was then known as the port of Canton transporting ginseng to trade for Chinese black tea. The ship also carried on it Major Samuel Shaw, a 29-year old former Revolutionary War artillery officer, who served as the business agent for this first American trade effort to the "Middle Kingdom." Shaw wrote to Secretary of Foreign Affairs John Jay, recommending that the young United States appoint a consul and vice consul to Canton. . . . At that time, Chinese authorities limited trade with the outside world to the port of Canton. (U.S. Consulate General Guangzhou 2022)

A robust line of trade developed in the late 1700s between American merchants and southeast China. This included vessels moving directly between the east coast of the U.S. and Canton, the main port location on the southeast China coast in the late 1700s and early 1800s (Figure 4; Mudge 1962: 9-10, 107; Norwood 2022). Shipments on vessels from Canton were recorded as later being trans-shipped to Charleston, South Carolina and Savannah, Georgia from port facilities in Providence, Rhode Island and Philadelphia, Pennsylvania in the late 1700s and early 1800s (Mudge 1962: 107; Norwood 2022).

Jingdezhen reached its peak productivity and export trade as a pottery production center in the period of 1736-1795 and fell into declining productivity and reduced trade in the period of

1796-1821 (Gillette 2016: 38; Kerr and Wood 2004: 747; Mudge 1962: 46). This decline resulted in large part from increased competition by potteries in England and Europe and a failure of Jingdezhen potteries to adapt and modernize their facilities (Dillon 1976; Priyadarshini 2014: 10). By 1820, “European homes acquired their tablewares from European factories, though China continued to supply wares to North America” (Kerr and Wood 2004: 747).



Figure 4. *The European Factories, Canton*, by William Daniell, 1806, depicting the international trade harbor on the Pearl River outside the city of Canton used by European and American merchants in the late 1700s and early 1800s. Image courtesy of the Yale Center for British Art.

This decline in production in Jingdezhen may have motivated skilled kiln builders and kiln managers to migrate in search of new opportunities, to Japan, the Korean peninsula, and elsewhere. In the late 1700s skilled potters, kiln operators, and likely kiln builders, were known to migrate away from southeast China to new regions to seek new employment opportunities (Boyd 2016; Harrison-Hall 1997: 194; Mudge 1962: 54; cf. Cort 1985). “By 1837, the population [of Jingdezhen] had been reduced by 50 percent, and the number of kilns had fallen considerably” (Mudge 1962: 55).

This sampling of studies and sources provides strong, background evidence that people, goods, and information were in movement between southeast China and east coast of the U.S. in the period relevant to this research.

II. Construction Based on Published Information

Could the Landrums and their workforce have relied on written and drawn records of dragon kiln designs from China, along with trial-and-error methods, in building their first linear kiln?

Feasibility of Trial-and-Error Construction

Some reproduction potters today, who have visited the tourist displays at Jingdezhen and the dragon kilns operated there for the tourist industry, observe that such kilns had a certain simplicity in design, with a barrel vault of brick that was bolstered with stone at the base and covered over with clay-enriched soil. For example, Kevin Grealy is a potter from Australia who undertook an artist in-residency in Sanbao, Jingdezhen, in 2002 and revisited Jingdezhen in 2004 (Grealy 2005: 29). He observed: “All of the dragon kilns I have inspected,” which were in use in the early 2000s in the Jingdezhen area, “closely appear to have been constructed from raw bricks or blocks of a coarsely tempered version of the same clay as is used for making the ware” (Grealy 2005: 27).

Published accounts of the operations of potteries in Jingdezhen present comparable observations of a relative simplicity of construction methods. For example, *Ching-Té-Chên T’ao-Lu, or The Potteries of China, Being a Translation with Notes and an Introduction*, by Geoffrey R. Sayer, presents a detailed account that appears to have been in circulation by 1795 (Sayer 1951; Huang 2016). The *T’ao-Lu* was written by a supervisor of the potteries in Jingdezhen named Lan Pu. This account observes that a variety of family surnames in southeast China were associated with groups who specialized in building and repairing the many dragon kilns in use in the region.

For example, members of the Wei family were dominant kiln builders associated with Jingdezhen (Sayer 1951: 34). In laying bricks in building kilns, they used a “mortar” “thick like

molasses” and slathered it over the surface as well as between the bricks. The mortar they used “is not the same as that used by masons” (Sayer 1951: 35). The *T’ao-Lu* observed:

“Kiln-nest” builders. There is no record of these in earlier times but it was the hereditary occupation of the Wei family which came to the Town [Jingdezhen] in the days of Yuan and Ming. If a kiln was slightly damaged all that was needed was repairs. To-day the townsmen of Tu-yang have acquired the method, and so share the task of kiln repairers. But the Wei are the people who have handed the procedure down from teacher to pupil. I have myself seen them laying their bricks. With one hand they lay one long layer of paste. Each time they paste one brick it only needs three tries and it is firm and will not shift. As for laying the mortar, with both hands together they bale out an armful of it and facing a layer of bricks already laid they divide it into two halves. In this way the mortar of its own accord solidifies and runs down to the foot on either side of the bricks. The bricklayers also pick up bricks and lay and plaster them one by one. The mortar they work with is thick like molasses, yet is not the same as that used by masons. (1951: 34-35)

Kiln bricks are made all along the river at Yang-fu rapids. This is how they are made. The clayey soil after working is stamped out by means of a square wooden box seven or eight inches long and three or four broad. It must be thoroughly baked in the kiln before it can be used. Bricks baked for the first time are “new bricks,” bricks baked several times make “old bricks.” Old bricks are best for building kilns. (1951: 36)

Nonetheless, a barrel vault of such large scale likely was a challenge to properly construct and configure.

Published Descriptions and Drawings

George Calfas’ 2013 dissertation provides details of the early descriptions of Jingdezhen potteries by Father Francis Xavier d’Entrecolles, a Jesuit missionary. Father d’Entrecolles (Chinese name Yin Hongxu) provided descriptions of the steps in production and organization of the potteries in two long letters, dated 1712 and 1722. A number of his observations have proven accurate. For example, he described ingredients used in glazes, and later analytical studies of the glaze contents on vessels produced in Jingdezhen in that period showed his descriptions to be accurate (Scott 1993). However, d’Entrecolles did not describe the construction of the dragon kilns in notable detail.

A number of detailed descriptions of the potteries in Jingdezhen and elsewhere in southeast China were produced by individuals assigned as supervisors of those enterprises. A

variety of “imperial court albums” depicted the production process in the early 1700s (Huang 2016: 7-8, 81-82). An early description of the pottery methods was presented in a text published in 1774 in China, titled *T’ao-Shuo*, by Chu Yen (Medley 1966: 327, citing Bushnell 1910; Vandiver and Kingery 1984). The *T’ao-Lu*, by Lan Pu, was in circulation by the end of the Qianlong reign (1736-1795) and published more broadly by 1815 (Figure 5; Sayer 1951; Wood 1993: 155). Medley (1966: 326) contends that the *T’ao-Lu* appears to have been more detailed and accurate in descriptions of the technologies in use in the Jingdezhen kilns than was the earlier *T’ao-Shuo*. The *T’ao-Lu* also appears to have compiled and presented information from previous accounts in the 1700s (Huang 2016: 81-82). Such accounts were of great interest to potential competitor potteries, both within China and overseas (Gillette 2016; Huang 2012).

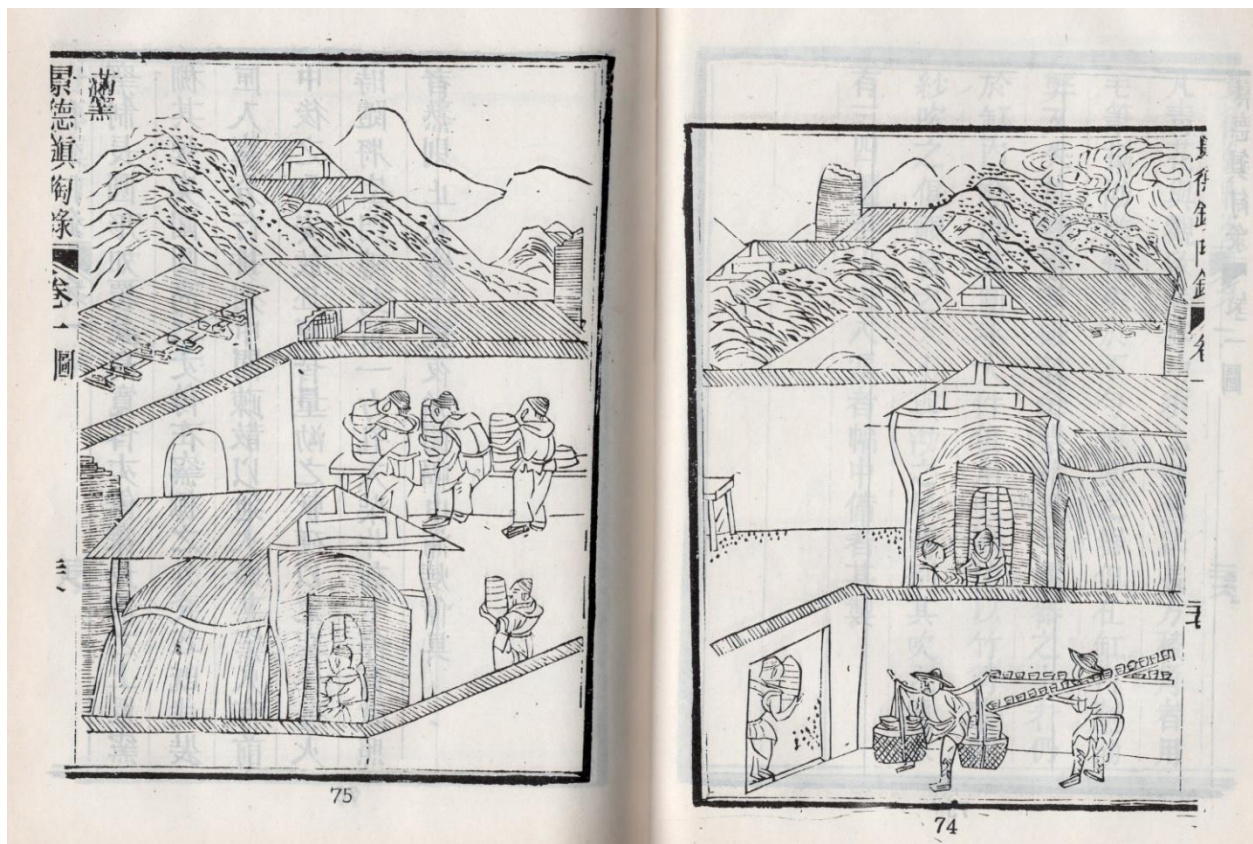


Figure 5. Excerpt from *T’ao Lu* by Lan Pu, circa 1795 book published in Chinese, with illustrations, describing operations of porcelain production in Jingdezhen. Although a highly stylized rendering, one can see the tunnel-like configuration and simple roof covering over each kiln.

Sources such as *T’ao-Shuo* and *T’ao-Lu* describe the production facilities and organizational approaches in Jingdezhen and similar pottery centers in southeast China in the

1700s. These centers hosted numerous dragon kilns. Many kilns were built and operated by one set of entrepreneurs who charged other producers fees for firing their wares. Other clusters of pottery operations functioned in a more integrated approach, with managers who oversaw a chain of steps from ware production to construction and operation of associated kilns. Labor forms became specialized, with enterprises often employing one group of workers to load a kiln and another group to fire the assembly of wares. Other groups specialized in construction and repair of kilns, and provided their services both to monarchy-backed producers and other entrepreneurs. Some accounts suggest that a kiln could be fired between 60 and 80 times, after which it had to be rebuilt to prevent its collapse in continued use (Bushnell 1901; Gillette 2010, 2016; Huang 2016; Medley 1966; Moll-Murata 2018; Sayer 1951).

The region developed “proto-guilds” with certain family names associated with particular specializations. The family names of Wei and Yu were known as dominant in building dragon kilns. The family names of Feng, Yu, Jiang, and Cao were also known as prominent in managing the operation of such kilns, which may have included capabilities in repairing and rebuilding the structures (Bushnell 1901; Gillette 2010, 2016; Huang 2016; Medley 1966; Moll-Murata 2018; Sayer 1951).

III. Evidence for Émigré Kiln Builders

The information discussed above shows that there was a notable movement of people and goods from southeast China to the east coast of the United States in the late 1700s and early 1800s. Declining productivity in Jingdezhen and neighboring pottery centers in the late 1700s also led to a movement of potters and other specialists in the industry in search of new opportunities, moving out to Japan, the Korean peninsula, and likely elsewhere overseas. Accounts also identify the surnames of Wei, Yu, Feng, Jiang, and Cao as being associated with kiln construction, repair, and operation.

In view of this information, I conducted detailed searches of available databases to look for evidence of émigré pottery workers arriving in the eastern United States in the mid-1700s through the 1815 estimated construction date for the Landrums’ first dragon kiln at Pottersville. These searches confirmed a flow of immigrants from China to the eastern United States during that period. However, I was unable to identify a particular case as a potential émigré specialist

being present to assist in construction of the Pottersville kiln. These searches were conducted using the proprietary database of Ancestry.com and Newspapers.com, to which I subscribe. Those databases include advanced search capabilities in the United States Census records, immigration records, and newspapers (among others).

Pertinent questions asked in decennial U.S. census from 1790 through 1880 (Szucs and Wright 2002) –

- 1790 and 1800 censuses did not ask as to occupations or place of birth or nationality.
- 1820 census included a column for number of persons in a household engaged in agriculture, commercial, or manufacture occupations.
- 1830 census included a column for number of aliens in a household.
- 1840 census included a column for number of aliens in a household.
- 1850 census included a question for the occupation of each male over 15 years of age in a household, and a question for the territory of country of birth of each individual.
- 1860 census included questions on occupation of individual over the age of 15 years; name of state, territory, or country of birth.
- 1870 census included questions on the profession, occupation, or trade of each individual; name of state, territory, or country of birth; whether father or mother of the individual was foreign born.
- 1880 census asked question on whether each individual was white, black, mulatto, Indian, or Chinese; occupation of each individual; name of state, territory, or country of birth; parents' birthplaces.

I ran searches for surnames associated with kiln building or kiln management in the U.S. census records. I used Ancestry.com's "Soundex variations" feature along with each surname of interest: "Soundex is a common algorithm used to generate alternate spellings of a surname. If you choose this option, any record that contains one of the Soundex variations for a surname might appear in your results." I also used Ancestry's "Phonetic variations" feature in regard to those surnames: "There are other name matching algorithms that we can use to help identify records to consider for your results. If you choose phonetic, we will identify appropriate algorithms that apply to specific data collections and if a record has one of those names, we will use it as a possible record for your results set."

The census listings occasionally include parenthetical notes with the names which indicate occupations of the individual (e.g., "carpenter") or ethnic background (e.g., "Indian").

Therefore I also searched for a “wildcard” string of “Chin” in the surname field to capture such parenthetical notes that might list “China” or “Chinese.” I ran similar searches using the regional phrase of “Canton.” Each search typically yielded hundreds or thousands of results, which I then scanned through for strong candidate results. I found no strong candidate results.

I searched by the surnames identified in the secondary studies and added “South Carolina” and “Georgia” for area “lived in.” I also searched for variants of occupations in pottery making. The search results provided listings throughout the U.S., and not just South Carolina.

Ancestry also presents databases of “immigration” and ship “passenger” records. Another data collection concerns birth, marriage, and death records. Ancestry.com also has collections of historical newspapers through Newspapers.com. I ran searches for keywords such as “Landrum” and “pottery,” but found no strong results for newspapers located in Pennsylvania, South Carolina, or Georgia for the relevant time periods.

IV. Conclusion

As a result of this overall research effort, we have additional, *general* evidence supporting the two hypotheses: (1) the Landrums obtained information in written and drawn form of the basic design and succeeded in a trial-and-error way in building and operating the first kiln; or (2) they had the assistance of an émigré from southeast China with knowledge and experience in the construction and operation of such kilns.

However, I did not succeed in identifying a strong candidate record for a particular émigré specialist being present in the relevant region and time period for the construction of the Pottersville kiln.

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