

## **KILN SUPERSTRUCTURES - THE BICKLEY EXPERIMENTS**

**DAVID DAWSON**

**&**

**OLLIE KENT**

Bristol Museum & Art Gallery

Bristol Polytechnic

This paper outlines the reasoning behind the design of the kiln superstructures used in the Bickley experiments and describes their performance. It also explains why it is felt that no satisfactory link can be made between a particular design of kiln and the characteristics of a particular type of ware and to reinforce the view that an explanation of the diversity of kiln design still eludes us.

There is a multiplicity of forms of kiln substructure excavated from Romano-British, Medieval and post-medieval contexts. Where kiln substructures survive, they are often badly damaged and difficult to interpret. Evidence for superstructures, that is the part of a kiln above the floor, is much scantier. It is scarcely surprising that although Swan (1984) proposes nine systems of supporting the floors of Romano-British kilns, only four types of kiln superstructure are suggested: a permanent dome with a single flue, a temporary superstructure with an open top, a permanent structure with an open top and temporary/permanent structure with a back-vent (a pseudo cross-draught kiln) (Swan 1984, 30-31, 34-38). As Swan (1984, 120) points out, the evidence for the fourth type is tenuous.

Whilst being aware of the dangers of using parallels from present and recent use, a review of such examples is essential if the range of possible types of kiln superstructure is to be determined. Our review is far from exhaustive, but does seem to show that kilns of the European/African tradition are updraught kilns, rather than

Oriental cross-draught kilns, and that this tradition was transferred to other areas such as South America. Although there is considerable variation in the detailed design of their superstructures, they can be divided into three main types: a) permanent superstructures, b) superstructures with a temporary capping and c) ring walls.

The permanent top is a structure which is intended to last for the working life of a kiln and is normally provided in the side of the ware chamber with a loading door which is blocked during each firing. The large, more complex examples have multiple flues in either rectangular barrel-vaulted superstructures such as those at Fostat near Cairo (Caiger-Smith 1973, plate 188) and Castel Durante (Caiger-Smith 1973, plates 175 & 176), or circular domed superstructures such as those at Les Recoins (Maine-et-Loire) (Bavoux 1983, 51) and Ewenny (Lewis 1982, 51). The smaller simpler examples, such as the kilns at Raquira, Colombia (Litto 1976, 71) and Silkstone (Brears 1971, 104), have a single flue in the crown of a domed top.

The second type consists of a permanent superstructure provided with a temporary top, that is, a capping built after each loading and before each firing, and dismantled before each unloading. Access to the ware chamber is often facilitated by the provision of a cutaway in the side of the permanent part of the superstructure. Again, there are wide variations in detailed design. Some are large cylindrical kilns as at Margueritas, Crete (Rhodes 1968, plate 8), Pucara, Peru (Litto 1976, 38), Huayculi, Bolivia (Litto 1976, 67), Pucara II, Peru (Litto 1976, 39), Verwood (Young 1979, 112-113), New Delhi (Olsen 1983, 140-143) and the demonstration kiln at Checca Pupuja, Peru (Litto 1976, 34), all of which are capped with potsherds during firings. The kilns working now sporadically at Thrapsano, Crete, are capped

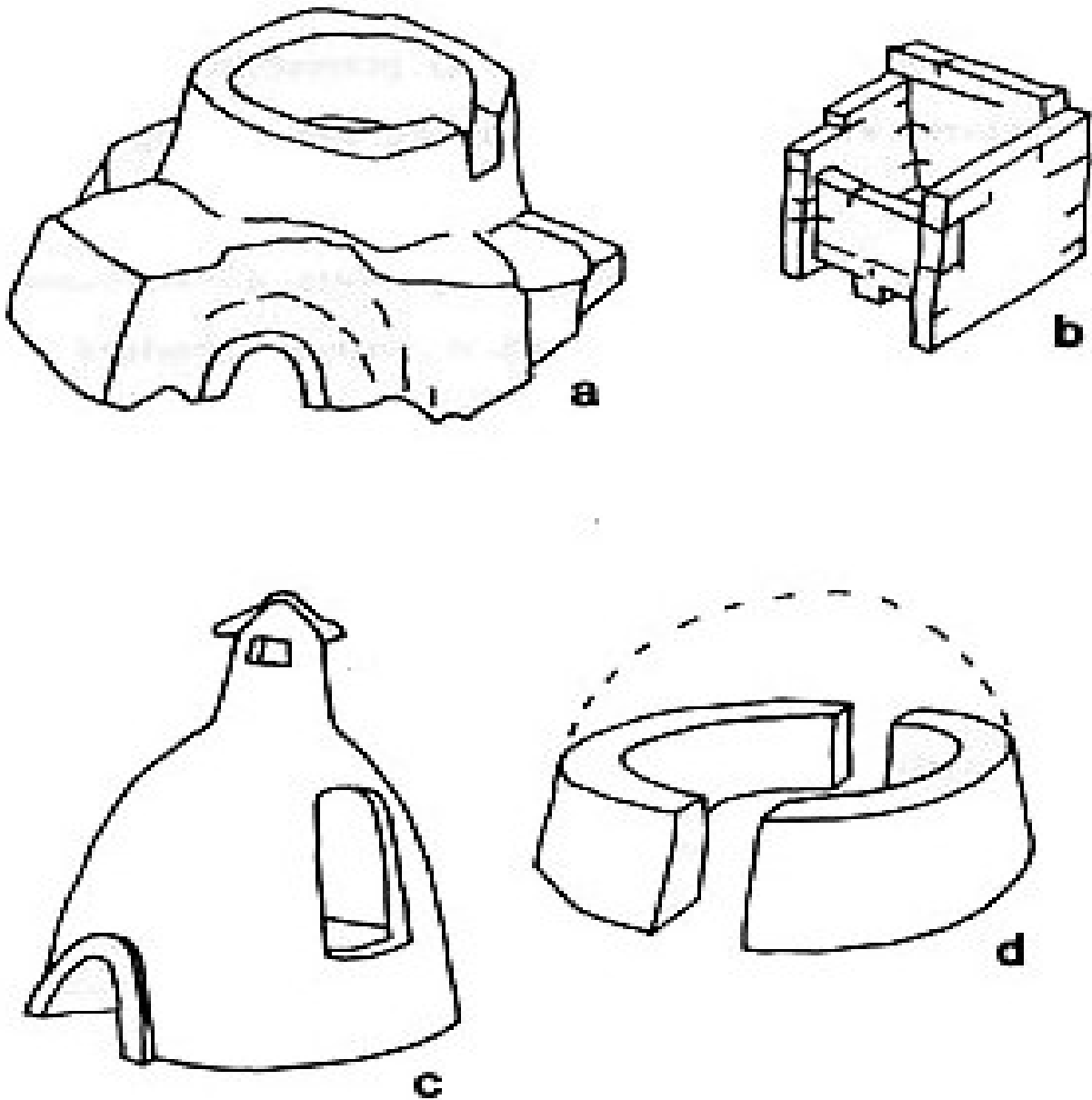


Figure 1. Kilns and approximate height of permanent structure: a) Huayculi, Bolivia (2m); b) Pujilí, Ecuador (1m); c) Raquira, Colombia (3m), (after Litto); d) Consuegra, Spain (1m) (after Rhodes).

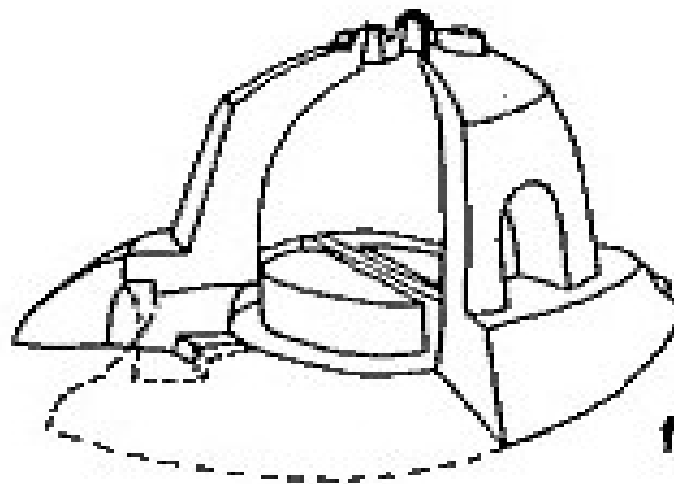
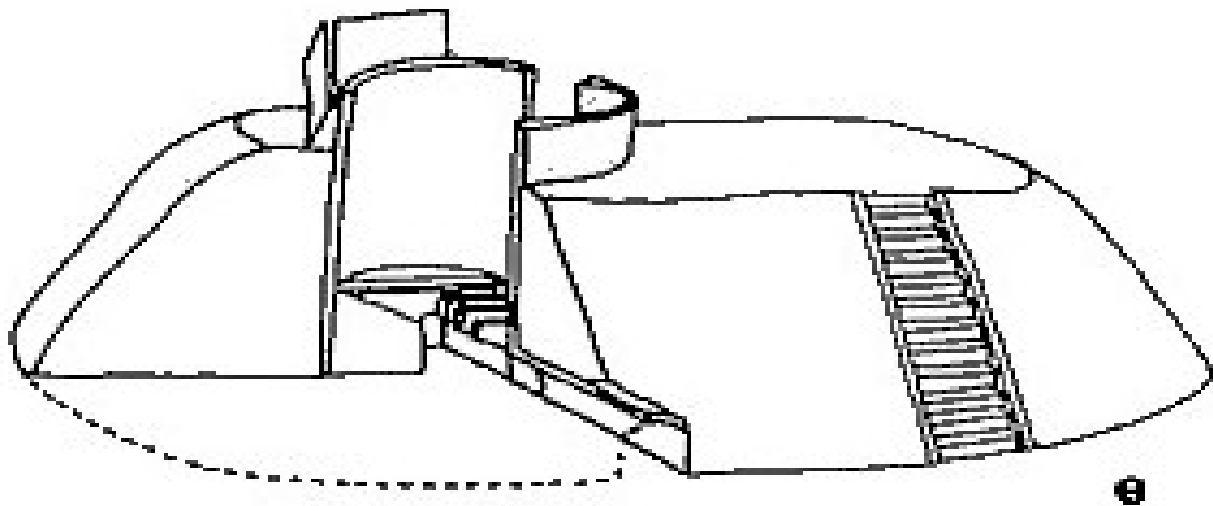


Figure 1 cont. e) Verwood (5m) (after Young); f) Ewenny (5m) (after Lewis).

with sheets of corrugated iron (Voyatzoglou 1973, 16; Casson 1976, 38).

The third type consists of a simple low ring wall with firing ports. The ware is packed interspersed with fuel within the structure and little attempt is made to contain the heat by a capping. Round examples have been noted at Sokoto, Nigeria (Rhodes 1968, plate 8), Consuegra, Spain (Rhodes 1968, plate 10) and square at Pujilí, Ecuador (Litto 1976, 103).

Swan (1984, 125) suggests that the Derbyshire type of kilns are unusual for their extreme height, but are they? Might this accident of survival reflect the more normal ratio between height and diameter of R-B updraught kilns. Swan (1984, 125) comments that such kilns would fire better than shorter ones. Whilst this is in part true, the Derbyshire kiln's performance would be inefficient in having considerable temperature variation between top and bottom. In practice, the majority of recent parallels broadly exhibit the principles of modern kiln design enunciated by Fred Olsen (1983, 54-63). His ideal updraught kiln is a cube or cylinder whose width is equal to its height exclusive of any arched or domed roof.

This optimum relationship between height and breadth provides a good draw whilst maintaining an even temperature through the ware chamber. The cool spot frequently found at the rear of an over-broad kiln may be cured either by extending the firebox under the length of the kiln as at Castel Durante and New Delhi or by the addition of further fireboxes as at Ewenny and Silkstone. Later two-tiered kilns such as that at the Winchcombe Pottery, Gloucestershire, conform to the same principles. The upper chamber is essentially a

tapered flue above the main ware chamber.

It was with these considerations in mind that we undertook to explore the principles of kiln design and operation by building a series of kilns at Bickley. From the start we felt it would be unproductive to use a precise reconstruction from the archaeological evidence of one particular site until we had begun to rediscover the skills to understand what was happening during a firing and to rehearse the effects that specific differences in design might have in constraining the firing. For the last two years the same substructure was used to compare the behaviour of three different designs of superstructure. The substructure consists of a pair of grated fireboxes on either side of the central combustion chamber which is immediately below the floor of the cylindrical ware chamber 1.3m in diameter and 1.2m high. The three types were:

1. A conical dome with single flue in its crown
2. A dome with four flues of equal height
3. A capping of loose tiles and potsherds

The nature of the project compelled us to remove each of the structures after each firing although types 1 and 2 are more suited for permanent use on a larger kiln. The construction of the third type of top, tiles and sherds laid over the ware and covered with daub, provided a structure which, once it fired in and the ware shrank away, proved to be self-supporting and durable enough to have been kept as a permanent feature.

The performance of the kiln in each of these firings was remarkably consistent over most of the firing cycle. Once the kiln

had been fired in, a rise of 100°C per hour was easily attained up to about 800°C. Indeed during the early stages the firing had to be restrained to avoid the dangers attendant on too rapid a rise before all free water had been driven off. After 800°C the rate dropped. Type 3 finally stalled at about 1000°C but types 1 and 2 could be persuaded farther. The second firing of type 2 was stopped at about 1150°C when the tiles used in the roof and as separators began to melt. On this occasion the kiln and its contents displayed all the characteristics of an abandoned Cistercian ware kiln.

In terms of efficiency, type 1 did suffer from considerable variation in temperature between the bottom and the top, perhaps as much as 100°C which is unacceptable for consistent glazed ware production, but this fault could be eliminated by a slight change in the design and is not necessarily inherent in this type of top. Although in practice the kiln was too small to observe the effect of the selective blocking of some of the four flues, type 2 did ensure more even distribution of heat throughout the ware and produced the best glazed wares of all in the series of firings.

The products of these firings were similar in being reduced and partially reoxidised. Many sherds exhibited the characteristic 'liquorice allsort' section with a dark core. It is clear that there is no correlation between a particular type of kiln and whether the finished wares will be reduced or reoxidised. However, there is abundant evidence from the pots that certain ancient potters could exercise close control over their firings and used limited reoxidation to produce special effects. The makers of Attic black figure wares and medieval glazed wares such as those at Ham Green near Bristol must have used this technique (Noble 1966). It seems to be clear

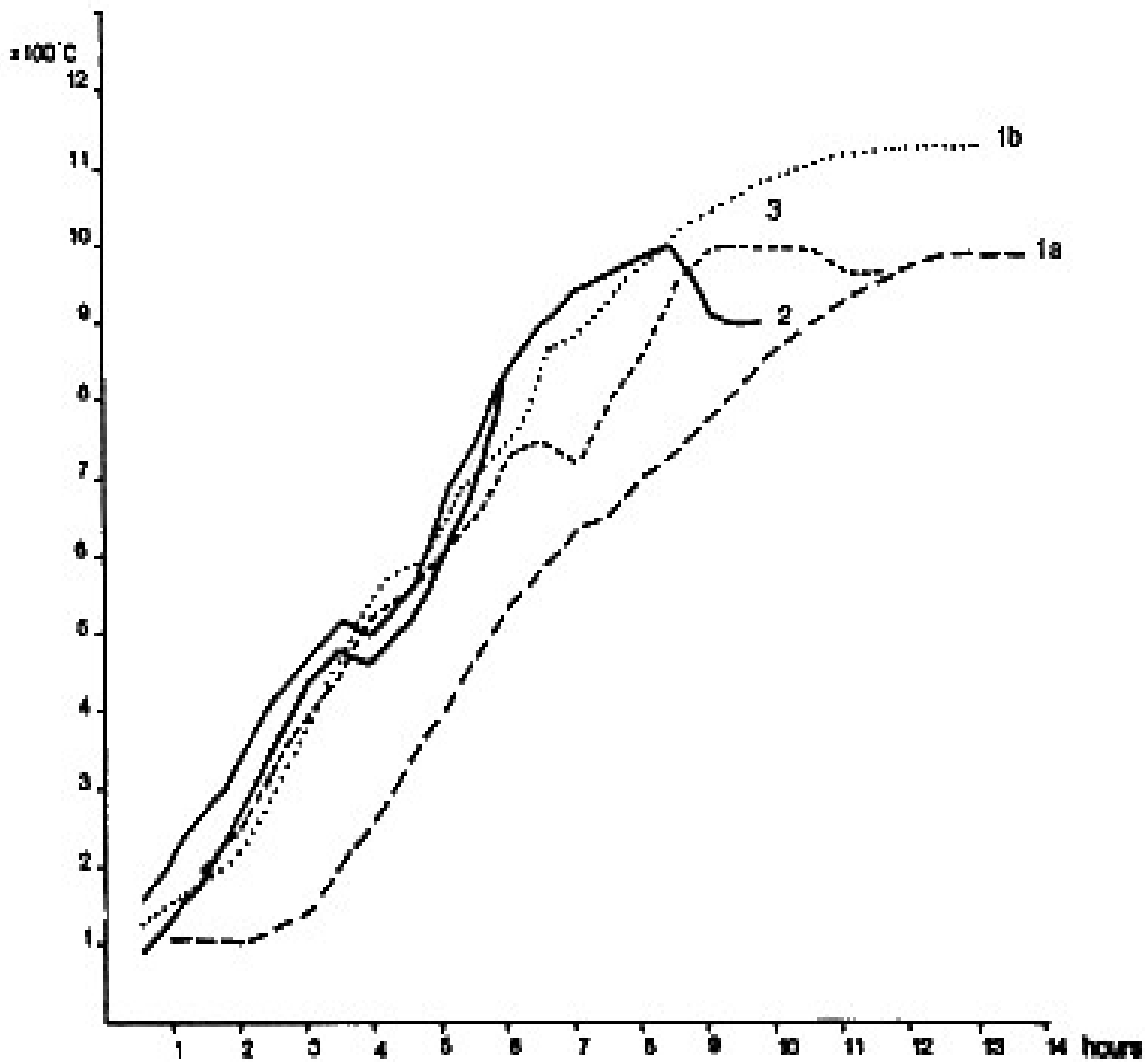


Fig 2

Figure 2: Comparative performance of the three types of top: 1a, type 1 first firing; 1b, type 1 second firing; 2, type 2; 3, type 3.

from the archaeological evidence of sites such as Nuneaton (S. Moorhouse, pers. comm.), where similar wares are produced in a wide variety of kilns, from the evidence of modern practice in places such as South America where consistently similar types of ware are made all over the area of the former Spanish colonies in different types of kiln, and our own experimental experience at Bickley, that it is purely a matter of the decision and application of the skill of the person firing the kiln which determines the final effects on the wares of reduction and reoxidation and that the actual design of kiln may not be relevant. A review of the archaeological evidence, especially such a body of material which has been assembled by Swan, would be desirable and consideration given to other factors which might explain the apparent diversity of kiln types. Certain design features may be imposed by the product, such as the heavily-built substructure of a tile kiln which needs to support the considerable weight of its load, but in the end it might be that kiln designs in an archaeological context are subtle cultural indicators, differences in design being sustained and reinforced by the ways in which the craft has been transmitted from one generation to another.

#### ACKNOWLEDGEMENTS

We should like to record our gratitude to Mary Campbell and Anne Clark for their generosity in providing both the site and the supply of fuel and their patience with our pyromaniacal habits; to the Head of the School of Adult Art Studies, Bristol Polytechnic; and to the Directors of Bristol City Museum and Art Gallery for their support of the Bickley Project.

## REFERENCES

- Bavoux, A. 1983. *Potiers et Poteries*. Paris.
- Brears, P.C.D. 1971. *The English Country Pottery*. Newton Abbot: David and Charles.
- Caiger-Smith, A. 1973. *Tin-Glaze Pottery in Europe and the Islamic World*. London.
- Casson, S. and Casson, M. 1976. Cretan Potters. *Crafts* 19, 36-38.
- Lewis, J. 1982. *The Ewenny Potteries*. Cardiff: National Museum of Wales.
- Litto, G. 1976. *South American Folk Pottery*. New York.
- Noble, J.V. 1966. *The Techniques of Painted Attic Pottery*. New York: Faber and Faber.
- Olsen, F.L. 1983. *The Kiln Book*. (2nd ed.). London.
- Rhodes, D. 1968. *Kilns; Design. Construction and Operation*. London: Pitman.
- Swan, V.G. 1984. *The Pottery Kilns of Roman Britain*. R.C.H.M. Supplementary Series 5.
- Voyatzoglou, M. 1973. The Potteries of Thrapsano. *Ceramic Review*
- Young, D. 1979. The Verwood Potteries. *Proceedings of the Dorset Natural History and Archaeology Society* 101. 103-120.