The Highgate Wood pottery kiln experiment 2010

Nick Peacey with Mooki Hurst

Introduction

It is strange to pick up an interest almost 40 years after you put it down. I have been lucky enough to do exactly that. As a young English and Classics teacher working in Hackney, I joined an Inner London Education Authority (ILEA) sponsored archaeological experiment in 1971.

Antony Brown and Harvey Sheldon had discovered the site of the Romano-British Highgate Wood pottery some years earlier, and were approaching the end of several seasons of excavating the ten kilns they had found.[1]

Harvey Sheldon and the ILEA Art Inspectorate recruited fifteen potters and historians for a fortnight of experiments in the summer holidays that year. Under their careful direction, we set out to recreate a pottery of the second century AD.[2] The materials were authentic: fallen branches of Highgate timber were used for the firings and clay dug in the wood was the material for both the pots and the three replica kilns. The replicas were based on Kiln 2, one of the best preserved updraught kilns found in Highgate Wood. It had produced grey reduced ware in Highgate fabric C, probably between AD 140 and 160. The team had been able to remove Kiln 2 intact from the ground to conserve it.

As I had no skills in potting, I became a kiln-builder. This often just involved manual labour, beating wet clay into bricks to be incorporated into the walls, but also involved sorting out technical problems in shaping the dome and arch (see glossary) of the kilns. The firings went well: temperatures comparable to those achieved by the Romano-British potters were equalled; the pottery was well fired and handsome. Many issues about pottery manufacture and the structure, building and firing of the kiln were resolved.

However, one or two matters continued to puzzle us.[3] The most significant was our failure to reproduce consistently the black-grey colour right through the clay, that is so typical of Highgate ware. To achieve this, 'reduction' firing (see glossary), when all the oxygen is used up and drawn out of the clay as it 'cooks' in the kiln, is necessary.

Making and firing kilns in Highgate Wood was interesting, so with the support of the excavation team, John Bell, one of the original team of potters, and I did trial firings in the woods during the next two summers to see if we could crack the problem. We never really did, though we certainly produced our fair share of blackened pottery. But we did not feel we had achieved sufficient consistency in reduction to claim that we had a successful and replicable technique. The Highgate potters, in contrast, were producing reduced wares in quantities that suggested a straightforward and economic methodology.

A second bite at the clay

I have lived near Highgate Wood for a long time. I saw Harvey Sheldon fairly often because we worked near one another. Three years ago I said to him 'I would like to try to solve that reduction problem with the Highgate pots before I get too old to tackle it'. Harvey agreed that a further experiment would be valuable.

I was soon surprised and delighted to be invited to be involved in a project called the *Haringey Potter.* This youth project, part of the *Stories of the World* programme, was based on the great tradition of pottery-making across the London Borough of Haringey. A new reconstruction of the Romano-British pottery in Highgate Wood in July 2010 would be a focal point.

Planning meetings soon started. The Bruce Castle Museum team was in overall control; the indefatigable Rob Waite was the project leader. Archaeologists and curators from the Museum of London gave generous expertise and the proper working kit. We had excellent support from the multi-talented team who look after the Wood for its owners, the City of London. And of course a kiln is no use without a potter. Another friend, Mooki Hurst, who also lives near the Wood and makes wonderful fine art pottery, was persuaded to take on this role.

Defining the programme

Harvey Sheldon, the Museum of London team and I were naturally concerned to resolve some remaining technical problems of kiln firing, principally the matter of reduction, but had to plan our programme within the overall structure of the project. We isolated the archaeological questions to be resolved before the work started, decided on the conditions in which we could properly be said to have tested our hypotheses, and stuck to them. In addition to sorting out an effective approach to reduction, we wanted to see how much wood we would use for a firing.

Aims and objectives

The project aimed to give young people from Haringey the opportunity to take an active role in appreciating and celebrating the history of the Highgate Wood Roman site and the borough by: taking part in the recreation of the making of the kiln at Highgate Wood; working with a potter to make and fire pottery in the kiln, using clay from Highgate Wood (if possible); recording the process and celebrating their project work with an exhibition at Bruce Castle Museum and Highgate Wood.

Specific objectives included:

- To bring the past to life for children, young people and visitors through the experience of being part of or watching the pottery making and kiln firing,

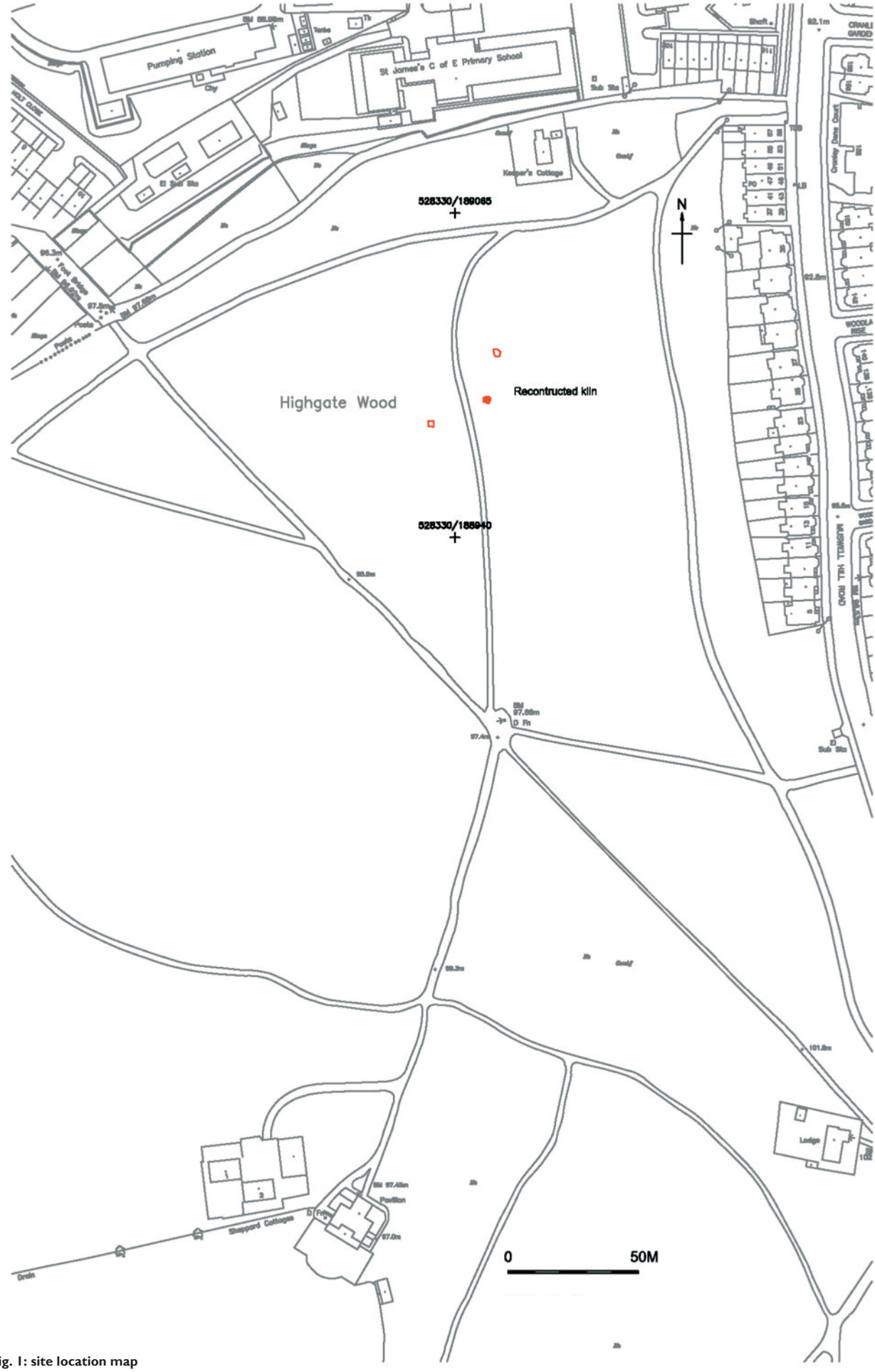

Fig. 1: site location map

- To give young people a basis of understanding and some skill in recording archaeological and similar experiments in terms of surveying, mapping, noting, photographing, drawing and painting the story of the project and its result,
- To keep the project sufficiently true to the original archaeology to allow some outstanding issues about the Highgate kilns and their pottery to be clarified.

Preparation: going backwards to make progress

I was able to remind myself of the firings of the 1970s, because I had retained the records of our experiments and the literature I had collected on firing kilns over that time.[4] I needed to learn what had been found out in the 40 years or so since our experiments. I hoped I would find straightforward explanations of successful reduction of pottery in Romano-British types of wood-fired kilns.

But nothing obvious emerged from an early scan of literature. Visits to the UCL Institute of Archaeology library confirmed this impression. Since Bryant's summary in 1973,[5] little new on the manufacture of Romano-British ware had appeared among the vastly improved and extended comparative typologies of such pottery. During the course of our work in 2010 someone pointed out that most archaeological pottery specialists are classifiers and identifiers rather than potters; this may help explain the rather sparse results.

However, more generic literature on historic pottery,[6] and the work of researchers into medieval potteries,[7] shed light on the issue. The websites of tiny wood-burning potteries in obscure places in the United States, usually owned by large bearded men in check shirts, added to the mix.

The results began to coalesce into patterns:

- Reduction does not need high temperatures,
- Reduction does not need strong draughts. It is most successful with a gentle draught. These two statements imply that a draught is required,
- The drawing out of oxygen from kilns[8] and the clay of the pots must be set up by sealing the kiln when the fire is at a high point in its trajectory, with the kiln gaining heat and more oxygen available than the fire needs to keep going.

This last point had made perfect sense to us in the 70s, but the problem was that when we sealed the kiln the fire went out. Once it was out, the oxygen could rush back into the kiln through the cracks in the kiln's clay fabric. We repeatedly blocked these, but it seemed to make little difference to the results. Our tentative conclusion was: ''An interesting finding of these experimental firings was the difficulty in replicating the dark colour of the original vessels and that one of the reasons for this was not keeping the kilns sealed long enough at the end of the firing."[9] This was to be challenged by the approach adopted in 2010.

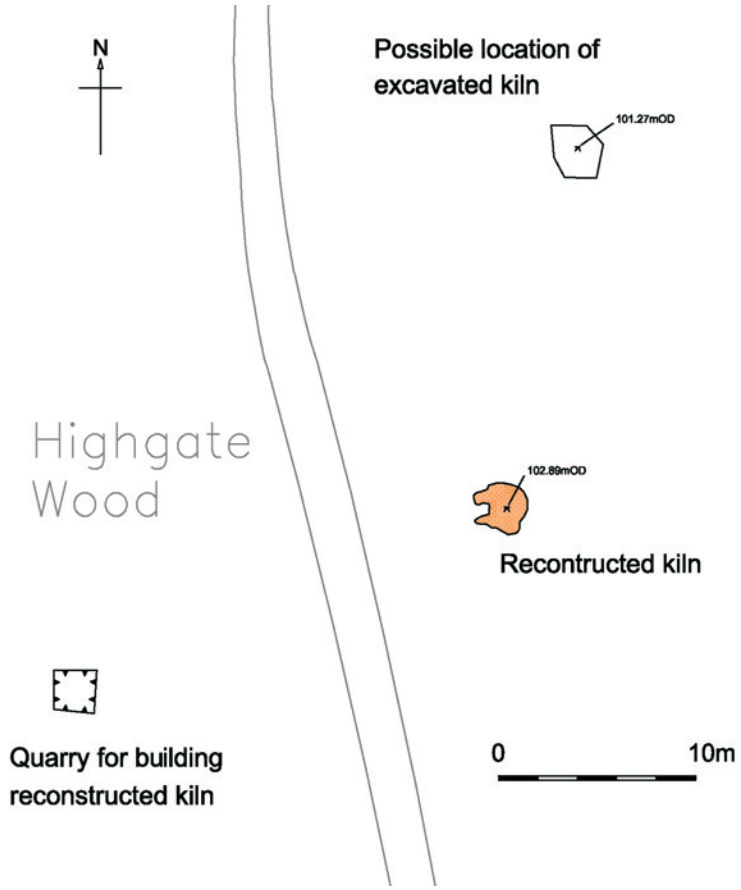

Fig. 2: detailed location plan of working areas

The wood used for each firing

This was to be a fairly straightforward calculation based on the weight of logs used at each firing. The literature on other firings would give us some comparative data. Our fuel was almost all well-dried hornbeam and oak branches that the wind had brought down in the wood.

Preparations for potting

Mooki Hurst and I began to familiarise ourselves with elements of kiln-building. We dug holes in Highgate Wood and took clay samples. With advice from the Highgate Wood team, we chose a good spot to build a kiln and dig the clay (very near the original sites, but not on them!) and admired the magnificent woodpile collected by the team; we visited Kiln 2 in Bruce Castle Museum; and we had the huge pleasure of looking at perfect examples of Highgate ware from excavations all over London at Mortimer Wheeler House.

This reinforced how elegant and almost modern the Highgate pots of the type made in 'our' kiln were. Fiona Seeley, the Heads of Finds and Conservation for Museum of London Archaeology (MOLA), who showed us round, explained how the burnishing (polishing) before firing was almost certainly intended to give the pots a metallic sheen, so that they could be marketed, to those who aspired to metal pots, but could not afford them.

Mooki Hurst had much more to do in preparing for the first batch of test

pots and worked with the young people of the project on many aspects of her preparation. This group of young people were potters, kiln-builders, kiln-firers, artists and labourers throughout the programme. Their commitment inspired all of us.

Mooki describes her work below:

'My introduction to the project started with being shown the original Roman kiln [Kiln 2] from Highgate Wood, preserved in pieces, at Bruce Castle Museum. The students and I had the opportunity to make drawings, take notes and photographs of examples at the Museum of London and Bruce Castle as part of our study of Roman pottery made in Britain from AD 50–160. Some of us were also privileged to view a most impressive collection at the LAARC, which provided us with more photographs for reference. A whole range of shapes and styles of decoration had been produced at Highgate Wood in ancient times.

My preparations for potting started some months earlier by digging three buckets of local clay (with permission) for some test pieces. Processing the clay to make it workable for pottery proved too lengthy a process for the time-scale of the project. While there was a small amount of Highgate Wood clay available for each student to try, it was decided to buy in ready-made clay to start work immediately. Highgate Wood clay was used for the key samples in the reduction experiments.'

The start

Rob Waite, MOLA and Highgate Wood colleagues dealt with many of the practical matters. So all sorts of useful things appeared for our first day including security fences, hi(gh) vis(ibility) jackets, hefty boots, hard helmets, tables to pot on and so on.

The Highgate Wood team provided water on a tractor trailer, spades and shovels and a complete tool kit. They had also booked a mechanical digger and a driver and so this time, unlike on other occasions where spade and shovel had to do the job, we soon had a fast growing pile of Highgate clay to work with. While this excavation was going on, I marked out the dimensions of the kiln, using the measurements and other documents from the project in the 1970s. You can see the location of the kiln, its relation to the 1960s/1970s excavated kiln and the pit we dug for clay in Figs. 1 and 2.

The building

While Mooki Hurst worked with some of the team on potting, I began to induct my kiln-builders into the work of creating the kiln. The layout and design of the kiln were clear, because I had precise working drawings and photographs to draw on. But working the clay to give the right balance of strength and flexibility to the 'bricks' was another matter. The Bruce Castle young people set to work on mixing and belting the clay into brick shapes and our kiln began to rise, row on circular row, from the ground (Fig. 3). The tricky part comes when you edge the rows inward to begin to form the dome. We thought we were doing well. But I had allowed the brick-makers to mix some bricks with too much water and we had not left them long enough to dry out before building them into the kiln's dome. We had a demoralising partial collapse.

Mooki Hurst writes:

'The clay excavated on site was suitable for making bricks to build the kiln. Lots of bricks! All shaped and assembled by hand. With enthusiasm students worked in teams preparing the clay, rather like mixing cement, and shaping bricks for building the kiln. With a dedicated workforce, the envy of many a building firm, the kiln took shape. We learned, however, by trial and error that the bricks needed to dry out over night, required protection from rain and to be of a more uniform shape.'

Day-to-day activity

We soon settled into a pattern of working, as Mooki describes:

'While one team worked on the construction of the kiln, the remainder made Roman-style pottery and individual pieces that expressed imagination and playful originality. Everybody took turns willingly. Since students were not professional potters who could use the wheel we resorted to another Roman method of production, the plaster mould. I had made moulds that allowed for the production of bowls and composite shapes to be assembled. It enabled students to realise their research material, experiment with decoration, allowed for innovation and personal expression.

Without exception students were helpful and cooperative, worked as a team. Their community spirit and

Fig. 3: Jennifer, Tom and Mathew building the kiln. This is the first attempt and the kiln was soon to suffer a partial collapse due to excess water in the clay. (Photograph: Bruce Castle Museum, Haringey Cultures, Libraries and Learning)

cheerfulness did not desert them even when the work was dirty or repetitive. Their dedication was expressed by turning up every day on time and often staying some hours longer, notably Omar, and Tom. Nobody though, could rival Rob Waite, who was the first on site and last to lock up.'

The activity in the woods drew lots of curious visitors, journalists, invited guests and dignitaries. They explained with courtesy and knowledge what was going on. Sightseers were frequent, certainly curious, and enthusiastic about the educational and practical effects of the project; they rarely knew anything of the history of the substantial Romano-British pottery in the Wood and were pleased to hear about it from the young people. Local visitors also enjoyed getting their hands dirty making pots and small clay items to be fired. They returned eagerly to hear how their creations had turned out.

Fig. 4: hornbeam and oak have been the most common trees in Highgate Wood since Roman times. Tom is building up the heat under the arch during the first firing. (Photograph: Bruce Castle Museum, Haringey Cultures, Libraries and Learning)

The first firing

After much more hard labour on brick-making and kiln-building, and a trial firing to allow an initial drying-through of the kiln, on the 17th July 2010, the kiln was ready for its first full firing with a load of pots. This took place on Tuesday, 20th July (Fig. 4). It ran from 8.30am to 4.30pm, when the kiln arch became unstable and it was felt that it would be best to seal it off. Mooki describes the results when the kiln was opened next day:

'The highlights of our endeavour were the firings of the kiln. Could we achieve the temperature required and a 'reduction' firing like Highgate Roman pots? In our first firing of a completely loaded and closed kiln the temperature reached was too low which resulted in very fragile and some broken pots. But an unexpected wood-ash glaze had formed on some pieces. There had been too much wood debris inside the kiln to reach a high temperature.'

The records of the pots taken out form a clear pattern:

- They were mostly oxidised (see glossary) and red in colour,
- Many had, as Mooki points out, a degree of vitrification: a wood-ash glaze, caused by the ash swirling around in the kiln and settling on the pots. This differs from the vitrification (see glossary) of the clay body,
- Pots were not fired at a high enough temperature for vitrification to take place.

We now had a kiln that had been cooked through and hardened. So once the arch was repaired and the whole thing had been cleaned out and restacked with pots, we were ready to go again.

The second firing

At 11am on Friday, 23rd July the fire was lit in the mouth of the kiln for the second firing. This was a very different experience. The structure was stable, we had a clear methodology for making the most effective fire (drawn from Rob Waite's time as a reserve serviceman) and everyone knew their roles. As with the first firing, the weight of logs used (normally hornbeam) was recorded regularly. This time we could fire steadily over an extended period, and maintained a fiercer fire throughout (see notes on wood use below). The firing continued from 11:00 to 22:20, over eleven hours.

By 22:20 it was necessary to make some decisions. As I reflected on my experiences of firing kilns and the studies I had read recently, it seemed that one approach, given all the conditions of our experiment, would be likely to produce the reduction we sought. We followed this procedure:

1. Once the kiln had reached a good temperature, we created a fierce hornbeam fire in the stoking area, with masses of wood fuel burned in a short time. This was to use up as much oxygen in the kiln as possible before sealing it.
2. We sealed the arch at the front of the kiln with bricks and earth.
3. We sealed the top of the kiln ('the chimney') with earth and clay.

Thus far, the technique was very much the one used in earlier experiments. The difference this time, however, was that we sought to keep the gentlest of draughts going, so that the combustion through maintaining a reducing atmosphere would continue to use up the oxygen fin the kiln and draw any remaining oxygen from the pots' clay bodies. The process continued:

4. While making sure that the large cracks that inevitably appear in a new clay kiln's fabric were sealed (Fig. 5), we ignored the smaller ones.
5. We also ignored the smaller holes in the front of the kiln.

This was to make sure combustion would continue at a slow but steady rate. We left the kiln, hoping that nothing would happen to it overnight.

We were back by 11:15 the next morning. The kiln was still very hot. Combustion had clearly continued for a long time. Interestingly, photographs on

Fig. 5: Mathew, Nathalie, Omar, Tom and Jennifer repairing the fissures in the kiln. (Photograph: Bruce Castle Museum, Haringey Cultures, Libraries and Learning)

that day show that even more cracks in the surface had developed overnight. We had to wait until 14:30 when the kiln was cool enough to open. Mooki and I with Tom in support broke open the top and began to extract the pots. This time they had definitely been fired through. But more to the point, we had a reduction firing, consistent all through the kiln. When you compared the edge of a broken piece of the Highgate ware with a broken-off piece from our firing, it was hard to tell the difference. *Mooki Hurst describes this firing:*

*'*As the final firing the temperature rose, the whole kiln appeared to heave, and cracks were continuously patched. Alternating teams were sawing wood, stoking the kiln and closing cracks. The anticipation and excitement of opening up the kiln next day were almost unbearable. Like a miracle all the pots were unbroken, and we had achieved a reduction firing as well. Brilliant!'

The results and the aims and objectives

Full aims, objectives and outcomes are shown in Table 1.

Final reflections

1. Sealing a kiln *completely* while it is gaining heat, having given it more fuel than is needed to keep the fire going, is a workable way of producing reduced pottery. The necessary level of sealing was not possible in the Highgate 1970s experimental kilns for two reasons:

- During experiments lasting only a few days, a clay kiln is unlikely to achieve the level of hardness – and therefore imperviousness –- that a kiln heated repeatedly over a longer period would have,
- The domes of the 1970s kilns, like the 2010 one, were left substantially open at the top for ease of loading. Once pots were inside, the hole was narrowed to act as a chimney. For the final phase, the chimney hole was sealed with clay. This clay was wet, so would crack as the heat reached it.

A firing technique that maintained a reducing atmosphere in a way that anticipated the development of cracks in the kiln throughout the cooling phase of the firing was more likely to succeed.
2. The successful 2010 firing used far less weight of wood than the firings of similar sized kilns recorded as successful in the literature. This probably relates partly to the fact that in 2010, unlike in the 1970 experiments, we were not seeking to fire at high temperatures. It could also relate to the dryness of the wood used. Even so, the substantial differences suggest that further investigation is needed.

Conclusion

The mapping of the outcomes and outputs suggests that this short programme, thanks to the hard work and commitment by all the participants and effective collaboration between agencies, with effective leadership from the Bruce Castle museum staff, succeeded on many different levels. It was a privilege to be part of it and the energy and learning that it generated. I am grateful to Harvey Sheldon for his help in preparation of this article.

Nick Peacey studied classics at Oxford a long time ago. He taught English and Latin in comprehensive schools for several years, then spent 20 years educating young people who had been, or were at risk of being, excluded from schools in Inner London. From 1990 to 2011, Nick ran a consortium at the Institute of Education, University of London involving 40 local authorities working on special education, as well as leading government-commissioned national programmes on this area. He is now semi-retired and can give more time to his interests in ancient and modern history.

Aim	Outcome/outputs	Evidence *
To give young people from Haringey the opportunity to take an active role in appreciating and celebrating the history of the Highgate Wood Roman site and the borough by:		
taking part in the recreation of the making of the kiln at Highgate Wood	All were involved; almost all for the whole fortnight	Bruce Castle attendance log. Project records
working with a potter, to make and fire their own pottery in the kiln, using clay from Highgate Wood (if possible)	All learned about pottery making and firing in a wood-fired kiln	Pots and other artefacts made and fired successfully. Project records
designing their own modern-day Highgate Wood pottery.	As above. They also learned about Roman pottery making	Pots and other artefacts made and fired successfully. Project records
recording the whole process on film/ multi-media	Members of the team made regular film and other media records of the processes involved	Films, stills etc. of all the work
celebrating the end of their project work with an exhibition at two venues in the borough: Bruce Castle Museum and Highgate Wood.	The exhibitions were most successful. The work was also highlighted in an exhibition at the Museum of London.	Records of the exhibitions.
To explore the cultural environmental and industrial life of Romano-British Haringey	All those involved gained additional understanding of the history of the site and the pottery.	The visitors book. Recorded comments from the young people involved
To bring the past to life for children, young people and visitors through the experience of being part of or watching the pottery making and kiln-firing	Many of those involved and the visitors were excited by the chance to re-discover an ancient technology and willingly experimented with its possibilities.	The visitors book. Recorded comments from the young people involved. Completed pots and other artefacts
To give them a basis of understanding and some skill in making and firing pottery in a wood-burning kiln	All young people and many visitors learned something of the skills of making and firing pottery in a wood-burning kiln.	Recorded comments from the young people involved. Completed pots and other artefacts
To give young people a basis of understanding and some skill in recording archaeological and similar experiments in terms of surveying, mapping, noting, photographing, drawing and painting the story of the project and its result	The young people were all involved in experimental archaeology for the first time. They learned something of its techniques and procedures, particularly in connection with recording.	Project records
To keep the project sufficiently true to the original archaeology to allow some outstanding issues about the Highgate kilns and their pottery to be clarified	Great care was taken to distinguish whether the practices of potting, kiln-building, firing etc. were clear from previous work or otherwise not relevant to the archaeological questions the project hoped to resolve.	Project records
The archaeological issues 1. How did the Romano-British potters achieve reduction firing?	The final firing successfully produced reduction, using a method that can be replicated; used only resources available to the Romano-British potters in Highgate Wood.	Project records The completed pots
2. How much wood was used in firing a clay kiln of the size we built?	The first firing used 23 kg of dried wood over an eight hour period = 2.8 kg per hour. The second and successful firing used 63.25 kg of dry wood over 11 hours and 20 minutes = 5.6 kg per hour.	Project records
3. What was 'the stokehole' for?	No resolution possible. Use as a stokehole, to clear embers from the front of the fire, or a point to introduce bellows, remain possibilities.	

* NB Project records include multi-media recording as well as written reports and notes

Table 1: Aims, objectives and outcomes

1. A.E. Brown and H.L. Sheldon 'Highgate Wood: the Pottery and its Production' *London Archaeol* **2** no. 9 (1974) 222–31.

2. *Ibid.* 230.

3. A. Appleby, A. Brightwell, G. Demetriou, M. Massey, N. Neacy, and H. Sheldon 'The Horniman Museum kiln experiment at Highgate Wood - part 1' *London Archaeol* **2**, no. 1 (1971) 12–17; and 'The Horniman Museum kiln experiment at Highgate Wood - part 2' *London Archaeol* **2**, no. 3 (1971) 53–9.

4. Including *op cit* fn 3.

5. G.F. Bryant 'Experimental Romano-British Kiln Firings' in *Current Research in Romano-British* (1973) Archaeology CBA Res Rep 10.

6. For example, O.P. Gosselain 'Bonfire of the Enquiries, Pottery Firing, Temperatures in Archaeology: What For?' *Journal of Archaeological Science* **19**, 243–59; Y. Maniatis 'The emergence of ceramic technology' in A.J. Shortland, I.C. Freestone and Th. Rehren (eds.) *From mine to microscope: studies in ancient technology* (2009) 109–14; M.S. Tite (1999) 'Pottery Production, Distribution, and Consumption – the contribution of the physical sciences' *Journ Archaeological Method and Theory* **6**(3) (1999) 181–233.

7. For example, O. Kent and D. Dawson 'Experiments in reduction firing: the Bickley experiment' *Bulletin of the Experimental Firing Group* no 5 (1987); O. Kent and D. Dawson 'Bickley, Historic Technology for Contemporary Potters' *Ceramic Review* 115 (1989).

8. G.F. Bryant 'Experimental kilns at Barton-on-Humber' *Current Archaeology* 31 (1972) no 8, 212–4.

Glossary

Arch: the excavated Highgate Kiln 2 and the Highgate experimental kilns have an arch-shaped hole cut through the kiln wall so firing can take place (see Fig. 4).

Dome: the Highgate experimental kilns have a more or less dome-shaped top.

Oxidisation: the state of pottery when the firing has not drawn the oxygen from the clay.

Reduction: the state of pottery when the firing has drawn the oxygen from the clay.

Updraught kiln: a kiln in which heated air from the fire at the base of the kiln is directed through the pots to be fired and out the top of the kiln.

Vitrification: the state of clay which has become dense and stone-like after firing.