Documents and Digs: Investigation of the Copper and Clay Industries in New Zealand

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This paper assesses the value and constraints of historical archaeology, and examines some of the criticisms prevalent in the literature with particular reference to industrial sites. It looks specifically at examples of the heavy clay and copper industries of New Zealand. The author is with the Department of Anthropology, University of Auckland.

INTRODUCTION

Historical archaeology has come in for considerable criticism over the past decade from many quarters, often from within its own ranks.[1] This is largely owing to its apparent lack of a theoretical framework and the limited scope of its investigations. Deetz feels that the bulk of historical archaeology follows one of two roads: either the confirmation of written documents, or determining the reflection of some artefactual pattern in the historic record. He cites as an example the relationship between a class of expensive ceramics and the value of the estate owner;[2] if the estate value is known from documentary records the recovery of such artefacts adds nothing to the state of knowledge. Instead he recommends a multi-evidential approach where archaeological and historical data are synthesised to produce conclusions unobtainable from either source alone.

Walker concentrates on the lack of a theoretical approach and the resultant 'mindless collection of data that might be of value'.[3] Perhaps such compilation is insufficient, though in fact evidence is rarely collected in a theoretical vacuum. There is always a theoretical perspective no matter how poorly developed. However, although critical, Walker recognises the constraints of 'rescue' excavation and the limitations of government funded archaeology on the formulation of adequate research designs. What he fails to recognise is that the theory oriented approach (hypothetico-deductive) was largely based on years of such 'mindless' (inductive) collecting.

It is apparent that a good deal of the problem stems from the traditional perceptions of history and archaeology. 'From the outset, historians and archaeologists work with different databases: the historian with documents and the archaeologist with material culture – that sector of our physical environment that we modify through culturally determined behaviour'.[4] Material culture and archival data are treated as separate entities and the private property of the respective disciplines, while both should be seen as different forms of data (at times complementary) to be evaluated. Co-operation between the two disciplines, history and archaeology, is the only route to a more complete understanding of our historic sites and their context.

To a considerable degree historical archaeology in New Zealand is at the level of identifying the archaeological correlates of the documentary record, and describing the materials utilised and imported by the European settlers. However, the investigation of historic sites is a comparatively new development and attempts are being made to examine the sites in their overall economic, social and environmental settings. The problem lies in the narrowness of the database and the pressures (time and funding) of public archaeology. Many of the higher level questions suggested by Cleland, such as the correspondence between control of production and social differentiation, cannot be approached until we have a broader database of survey, excavation and archival research.

Another common criticism is that excavation is unnecessary when we have the archival evidence. As Deetz stresses excavation is of little value if it largely serves to confirm what is already known from the documentary record (although even this has its place, for example in the interpretation of historic sites for public display). In fact archival evidence is rarely (if ever) complete enough to enable a full reconstruction of a site in all its aspects.

There is one particular area of historical archaeology, however, where the importance of excavation and the interactive nature of the two forms of evidence becomes obvious, and that is the investigation of industrial sites. A good deal of information concerning the general history of an industrial site may be available in the documentary record, since much of it is prejudiced in favour of the activities of the entrepreneurs, or 'capitalists' as they were then known, who controlled New Zealand's early industries.

In the mining, timber and ceramic industries, for instance, it was often the activities of the few wealthy men (including some shady deals) that established the industrial basis of many of our present towns and cities.

However, little if any information records details of the technology and operating history of industrial sites. We therefore rely heavily on excavation to reconstruct the history of the industry including, for instance, technological innovations, and the adaptation of old techniques to new settings and to changing economic and political variables.

JAMES WRIGHT'S POTTERIES

An example of the extent to which archaeology can expand our knowledge of an industry is the excavation of James Wright's potteries at the Pollen Brickworks and Potteries, Whau Peninsula, West Auckland.[5] Documentary evidence relating to the pottery of James Wright is slight. We know that he arrived in New Zealand from Staffordshire in 1863 as one of the Albertland settlers, and that he chose to remain in Auckland in the employ of Dr Daniel Pollen (Premier of New Zealand in 1875) as one of New Zealand's

first known commercial potters. While his pottery is briefly described in the catalogue of the 1865 Dunedin Exhibition, we are left with little information as to the techniques employed, materials such as glazes used, or the range of his products as very few pieces survive in private or public collections.[6] The excavation has provided us with such information. A large collection of potters' tools and stamps, fragments of various vessel forms, including stoneware bottles, and some complete telegraph insulators were recovered. Lead glazing was used with various pigments to produce items such as decorative encaustic tiles. Many of the tools were forming ribs used for the production of specific items such as cups, jugs, plates and other items of tableware. In addition, three decorating tools were recovered: two sprigging moulds and one master which were used to transfer thin clay designs to the vessel.[7]

THE HEAVY CLAY INDUSTRY AND EXCAVATION OF POLLEN'S BRICKWORKS AND POTTERIES

The excavation of industrial sites should enable us not only to gain information about techniques and products, but to observe the relationship between these sites and contemporary political and economic conditions. Auckland, established in 1840, was a rapidly growing town, but like many early towns in Australasia, went through variable rates of growth, with periods of boom and bust. Building materials are urgent requirements of a new settlement and as a consequence the building industry is often seen as a finely tuned indicator of these periods of changing economic fortune.[8] We would expect such changes to be reflected in the heavy clay industries.

To what extent will the excavation of the brick production sites reflect changes in the economy? The answer is complex as it rests in part on the fortunes of individual capitalists, their perceptions and ability to invest in expansion (upgrading plant and equipment), and their maintained interest in the venture. Also, exceptions will always be encountered; an industry may be established against the economic trend, where inappropriate technology is introduced. There also might be, as Connah points out, 'a certain nationalism that spurred on some industrial enterpreneurs, even when profits eluded them'.[9]

Excavation of one production site, though informative, will only provide answers to low-level questions as it is only part of an overall development. A good illustration is Pollen's Brickworks and Potteries, founded circa 1855 and continuing in production until the mid-1870s.[10] Its eventual demise cannot be directly related to a depression or decline in the building industry at large without reference to other heavy clay industries in Auckland. Its success or failure is linked not only to political growth and stability but also to the availability of its raw resources (clay), the quality of those resources, the quality of the product (consistency, colour, etc.) and the efficiency (productivity) of the establishment relative to other works supplying the same market. However, although archaeology can observe modification and changes occurring at a specific site, unless detailed documentary evidence is also available to date these events it is not possible to relate, for instance, one brickworks to another. The techniques of archaeology, seriation or typology, are not finely tuned enough to be of value in dating changes on historic sites.[11] For example, ceramics usually send archaeologists into fits of classification and seriation, but as Dollar observes, during the nineteenth century Staffordshire alone (the source of much of the ceramic material exported to the colonies) had literally hundreds of potteries producing innumerable styles with different potters producing the same designs. There was a beginning (alpha) and termination (omega) date for the production of any particular style, and these differed between potteries. Such complexity and the difficulty of attribution makes the use of these traditional archaeological tools of dubious value in the field of historic sites archaeology where dating within a narrow time span (less than five years?) is required. Dating information with this degree of accuracy can only be provided by the documentary evidence.

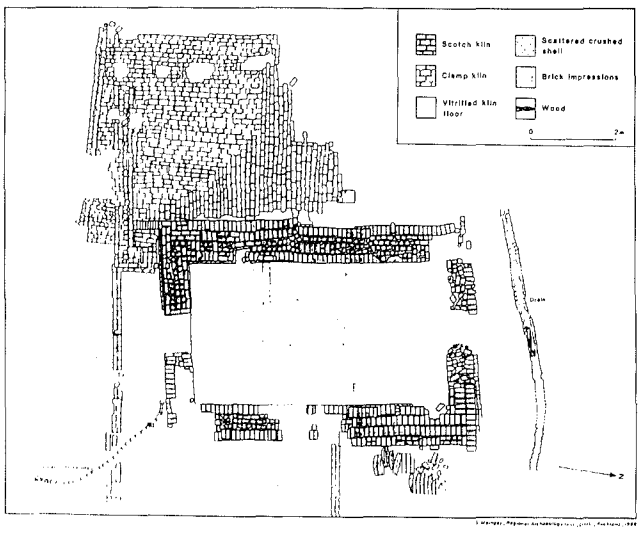

Fig. 1: Pollen brickworks: plan of clamp and Scotch kilns.

Little is known of the earliest attempts at brick production in Auckland. Some of it was carried out at the building site since suitable clay was available througout the Auckland area. Thus clay was quarried, formed and fired in clamps on the construction site and would have left little if any evidence of the process. Although we know from documentary sources that this occurred, no archaeological evidence of these early clamps has been found.

The Pollen brickworks is one of the earliest brickworks in New Zealand for which we have good archaeological evidence. It is also one of the few industrial sites to have been excavated. The works were in operation for some 20-25 years, although exact beginning and terminal dates are uncertain. For the most part it was operating during a period of economic growth. From 1865 to 1875 Auckland and Thames boomed because of the Coromandel goldfields, and thus while the Maori Wars of the 1860s generally slowed development in the north, and a recession followed the peace in 1870, the gold booms kept Auckland relatively buoyant. This appears to be reflected in the modifications to plant at the site during its lifetime, particularly to the kiln installations.

The final kiln on the site was a Scotch kiln, essentially a rectangular structure some 8m by 5m with 80-cm thick walls and evidence for twelve fireholes, six on each of the long walls, operating on updraft principles (Fig. 1). The kiln was fired with coal, and the bricks were exposed directly to the flame with the heat escaping through the roof, a temporary structure usually of tiles.[12] In this case there was good evidence for a roof of corrugated iron as a covering of calcined shells was excavated immediately above the kiln floor, and interpreted as collapsed roof.

According to early reports, shell was collected from nearby shell banks and used for paving.[13] However, from the above evidence it seems that the shell was used also for the production of lime, a practice common in many early yards. Shell would have been thrown on the roof of the kiln during firing and the heat from the kiln would have caused calcination or the breakdown of the carbonate and the formation of lime: ($CaCO_3 = CaO + CO_2$. This would then have been used as the basis for mortar. This method of production makes a good deal of economic sense, utilising the heat of the kiln to manufacture an essential product

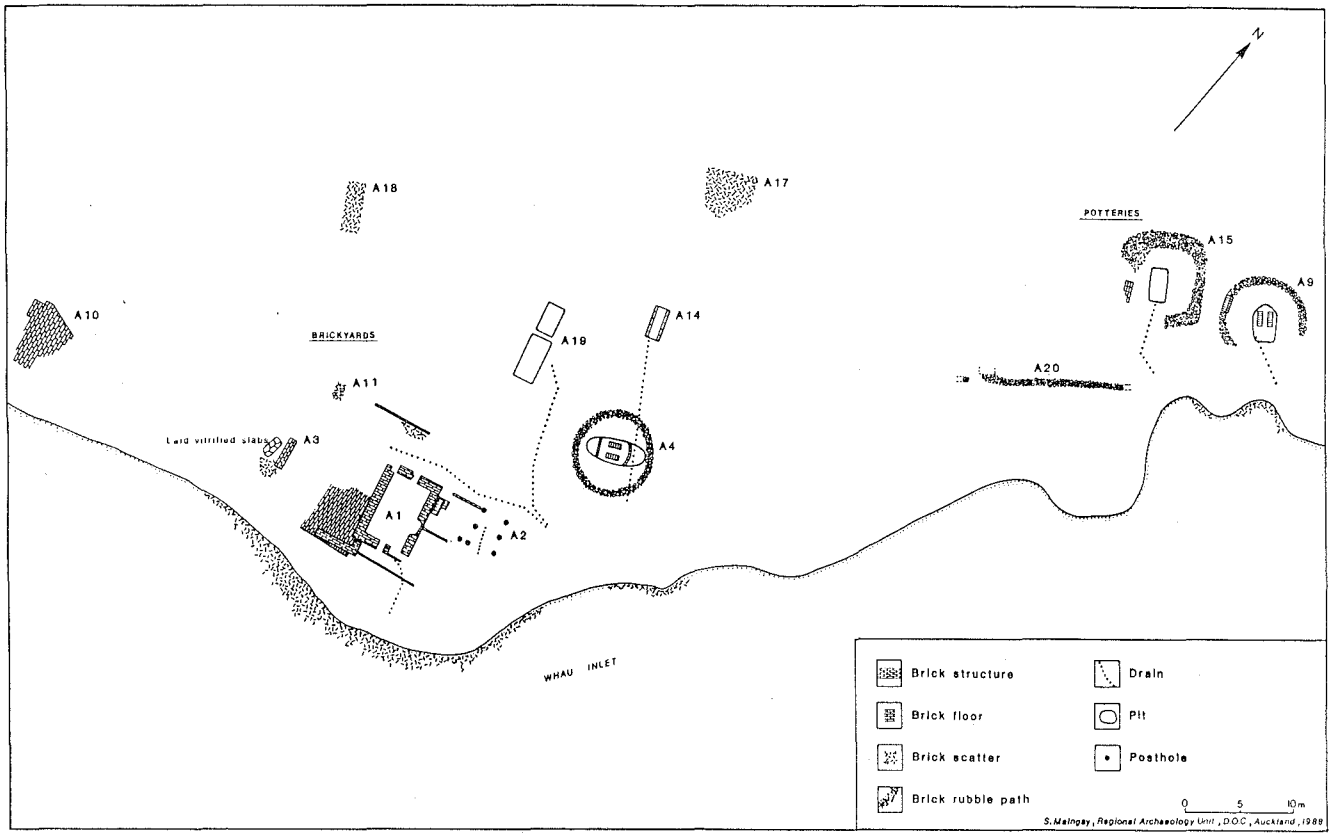

Fig. 2: Pollen Brickworks and Potteries site: excavation plan.

both for on site construction of various installations, including the kiln, and for a saleable commodity along with the bricks. Its use around the site was confirmed in areas adjacent to the kiln wall where a calcareous deposit (concretion of lime mortar) had been laid after the construction of the foundation layers of the Scotch kiln.

Normally Scotch kilns consist only of two long walls,[14] but here there were also the remains of walls at both ends (Figs 1 and 2 feature A1). At the wicket (loading) end the wall construction was relatively crude, reflecting its temporary nature, as it was this end that was built up before and broken open after each firing to enable loading and unloading of the kiln. At the opposite end there was a solid wall with the remains of a drain, blocked intentionally after its last use and designed to remove the water from the roof when the kiln was not being fired (Fig. 1).

A cobbled brick floor to the west of the Scotch kiln was an earlier feature as it had been cut into during construction of the latter (Figs 1 and 3). Post holes dug into the cobbles indicated that this floor had been modified by the addition of a superstructure and the presence of coal particles suggested that it had been used as a coal bunker and workshops, possibly a drying floor, contemporary with the kiln. Close examination of the brick surface showed it to be patinated and in parts deteriorating through fire damage. The damage areas occurred in strips across the floor and were approximately the same distance apart as the fire holes seen in the later Scotch kiln. It is suggested that the damaged surfaces represent areas exposed to burning fuel, and the relatively undamaged areas are those where the bricks had been stacked in a clamp. The patination was all over the surface and appeared to represent heat damage, surface vitrification and later weathering of this surface. Thus, it seems probable that the cobbled area was originally the base of a clamp.

A section beneath the east wall of the Scotch kiln revealed clear stratigraphic evidence for its construction, including a layer of earthy clay that had been levelled as part of the foundation layer for the lower course of the kiln wall (Fig. 4). However, beneath this layer was a level surface of burnt clay, itself above a layer of brick rubble. In association with similar evidence from under the cobbled floor, it would appear possible that the burnt clay represented the remains of a still earlier clamp, with a levelled clay floor in contrast to the later brick-cobble construction. The fact that this overlay brick rubble suggested that there might have been yet earlier firing installations on the site. In addition, there was evidence that the Scotch kiln itself had been modified on many occasions.

James Wright took over the running of the Pollen Brickworks and established a pottery during the early 1860s As pottery production requires clays of greater plasticity than that used in brick manufacture we would expect to see the introduction of new technology with his arrival. Several of the installations excavated can be related to this event as they are best interpreted as washing mills or blungers, plant specifically designed for the production of finer clays (Fig. 2 features A14 and A15, Figs 5-6).

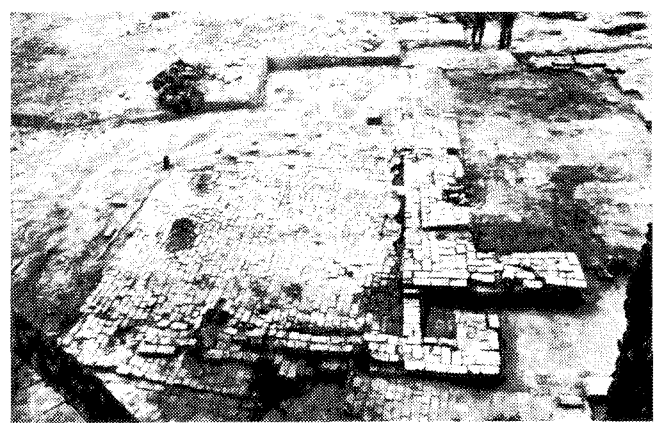

Fig. 3: Scotch kiln (right) and cobbled floor of clamp kiln.

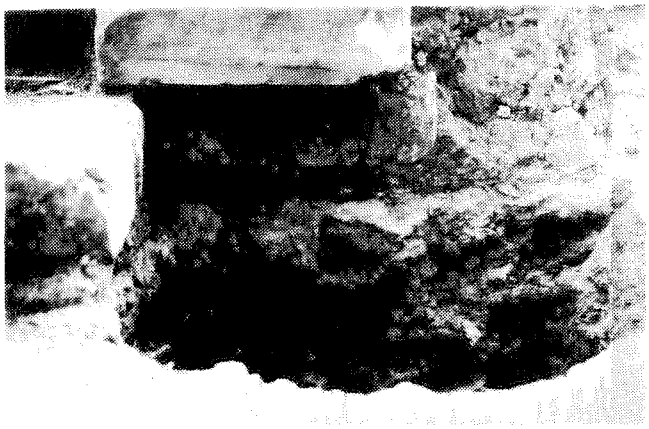

Fig. 4: Section beneath the wall of the Scotch kiln showing burnt clay floor.

Overall, the excavation provided excellent evidence for the upgrading and modification of kiln installations and other plant such as a pug-mill (Fig. 2 feature A4, Figs 7-8). The importance of this information needs to be stressed, not only because it relates to new developments in the industry or to the importation of new equipment, but also because the changing technology would have altered the impact of 'external' influences, such as labour availability, on the industry. For example, a shortage of skilled labour would not have been so disastrous to a mechanised industry.[15] Thus, awareness of the level of technology and any changes that may have occurred enable us more clearly to interpret the relationship between specific industries and their economic-political environment.

As far as output is concerned, one cannot assume that the quality and range of products manufactured at the site are accurately represented by the material recovered during excavation. While it is possible that the range of material produced will be recovered from debris, it is unlikely that it will be representative as regards quality. For example, many bricks were almost certainly discards, 'the worst of the bunch', and do not reflect the quality of the material shipped out for construction work. They would have been useful in rebuilding the kiln and other installations at the works and providing material for such needs as fill, paths and grog. This is borne out by the variable quality of the material used in the construction of the kiln and other installations around the yard. The very nature of the clamp, and to a lesser extent the simple updraft kiln, results in poor control over atmospheric conditions during the firing process. This is reflected not only in the surviving kiln structure which revealed differing degrees of vitrification, but also in the quality of the bricks. Both friable underfired and vitrified overfired bricks were used in the structures excavated. It would be easy to understand the demise of this particular brickworks if these were to be considered representative of its products. However, the archival material gives us no indication of either the range or quality of the goods produced, and excavation is the only source of such information, even allowing for the problems outlined above.

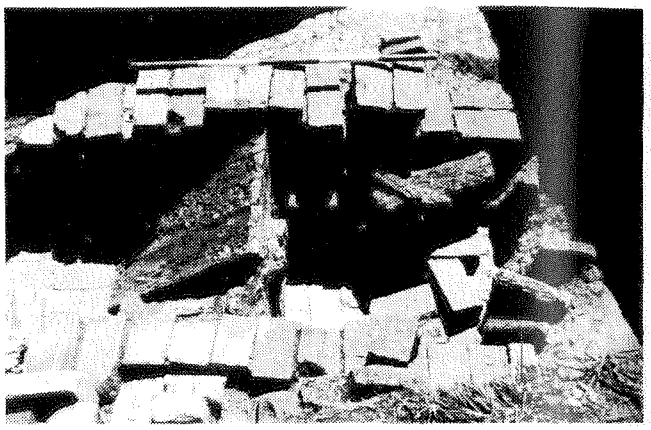

Fig. 6: Clay preparation plant.

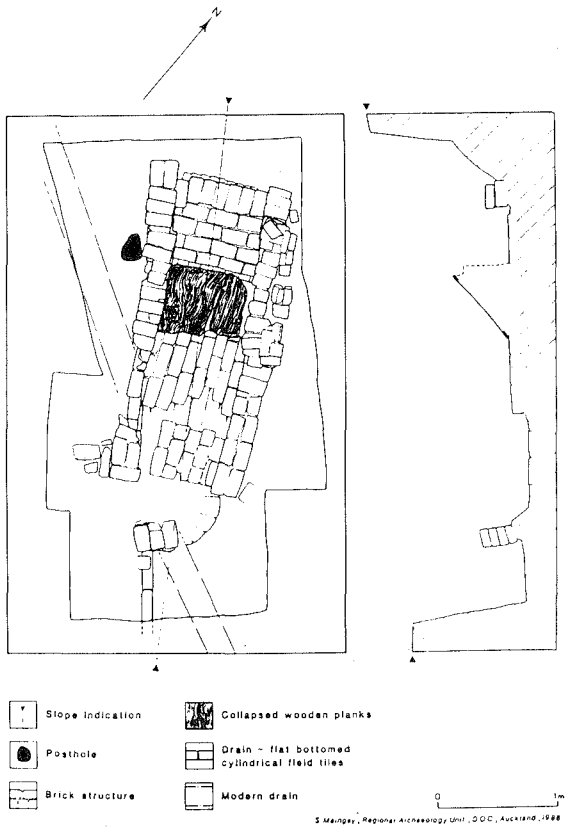

Fig. 5: Plan and profile of the clay preparation tank.

THE COPPER INDUSTRY ON KAWAU

The copper industry on Kawau Island, New Zealand, provides another example of the value of archaeology to historic sites.[16] In this case, however, there is a great deal of documentary evidence available regarding dates of operation and changes in operating techniques.

Kawau Island was the centre of one of New Zealand's earliest historic industries. At times between 1843 and 1855 over 200 people were engaged in the mining and smelting of copper, and remains of various aspects of the industry are still to be found at several locations on the island: such as Smelting House Bay, Miners Bay, Mansion House Bay and South Cove. Although the industry finally failed because of legal and technical problems, it played a significant part in the history of the island and of New Zealand's industries.

Mining began in 1843 when samples of the ore were sent to Britain for assessment. It was intended to ship the ores to smelting and casting facilities in Wales. However, this came under question because of the sulphidic nature of the ore: like many sulphides it had a tendency towards spontaneous combustion – a problem in the hold of a ship! This, plus the costs of shipping, influenced the decision to construct a smelter on the island. Initially there was a 'Welsh' system with batteries of roasting furnaces. This proved not to be cost-effective. The Welsh works manager was discharged and a German, Mr Berger, took charge, doing away with many of the existing furnaces and introducing a simpler technique based on a German system. Thus, we see an example of the initial use of a system unsuited to the new

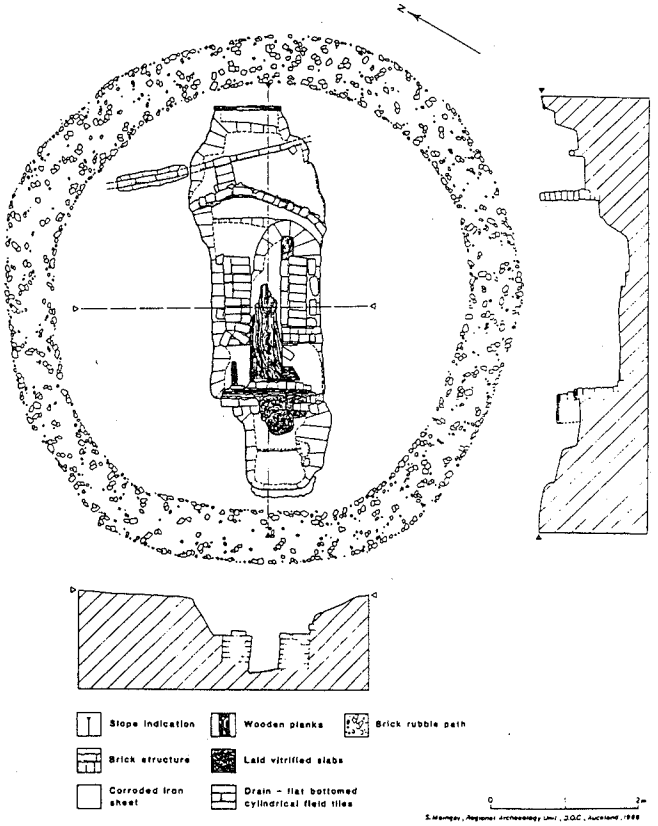

Fig. 7: Plan and profile of the pug mill.

environment and its replacement with an alternative system more suited to the local conditions. The main factor was production versus transport costs to the market. By the mid 1850s the mining venture had failed and Berger had returned to Europe, leaving a small team operating the smelter.

Investigation of the industry was prompted by the deteriorating condition of the smelting installation. It had been constructed of a soft local (Maharangi) sandstone which had weathered extensively, resulting in partial collapse of the structure and concern about the safety of the remainder. As part of the preservation process it was necessary to excavate the areas which would be affected by the shoring, and in doing so to assess the potential for a more extensive excavation. Even from limited test squares the potential of further excavation was evident. A casting floor of fine sand and large slag blocks and pieces of matte (a sulphidic product of the roasting processes) were revealed. Analysis of these will enable detailed reconstruction of the process and metallurgical evaluation of its efficacy. In addition, many of the bricks found at the smelter and mine were Australian imports, and one of the firebricks with the stamp of 'COWEN' was imported from England, most probably manufactured at Stourbridge, thus providing information about sources of construction materials.

In the current project, rather than limit excavation to the smelting site it is planned to approach the industry as a whole. The investigation will cover all aspects: the smelter, mine and mining village (about which there is little information in the documentary records), and this information will be integrated with the documentary evidence for eventual public access.

The failure of the copper industry on Kawau cannot be seen only in technical terms of depleted or poor quality raw materials, as both technical and social factors played significant parts in bringing the industry to a halt. Labour was a problem, with losses to the goldfields of Australia and

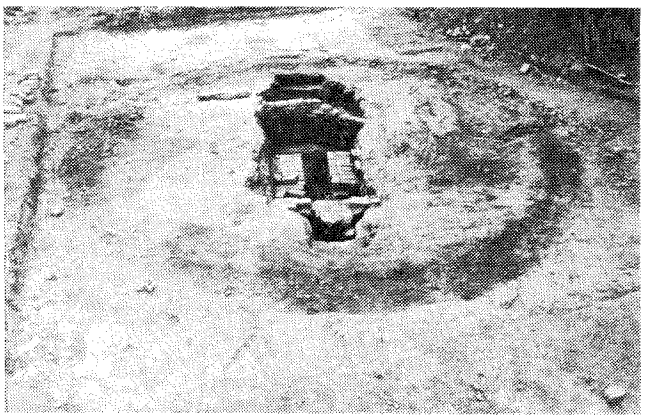

Fig. 8: Horse-drawn pug mill.

California, and from the early documents pertaining to the copper venture it is evident that shady deals and a bitter struggle for ownership for over a decade between the two main protagonists, Taylor and Whittaker, played a major role in condemning the venture to failure.[17] In a broader context, part of the problem initially was also the attempt to establish an industry in a region devoid of the necessary backup facilities, in this case, smelting and casting technology.

TECHNOLOGICAL ADAPTATION

A study of adaptation is one of the suggested lines of approach if we are to move beyond mere confirmation of documentary evidence.[18] One of the difficulties in studying the ways in which traditional techniques have been modified to suit a new setting and different materials concerns the point of origin of these techniques and also which traditions are being modified. Technological traditions by their very nature overlap, with a range of techniques being employed synchronically. This consequently leads to difficulties in using technological types to establish either the contemporaneity or the date of sites. For example, Dollar[19] observes that in addition to the sheer number of potteries in nineteenth century Staffordshire around 1829 significant improvements were made in the glazing and firing techniques of certain English wares, but that we have no way (at present) of knowing how many works adopted these new techniques nor how long others continued with the older methods. This is a recurring problem in the study of prehistoric industries[20], and perhaps even more so in the vastly more complex historic (industrialised) period.

Another example can be seen in the historic iron industry at Ironbridge, Shropshire, which played a major role in developing steam power for blowing furnaces. At the same time, the works themselves, partly because of the capital investment involved and the ownership of the raw materials required, retained a complicated and outmoded system based on water power until their demise, well into the age of steam.[21]

Such overlaps of tradition would equally have occurred among brickworks, where age, size, location and other factors would have influenced the techniques employed. Dobson in his discussion of brick manufacturers in England in the late nineteenth century gives examples of the wide variety of current practices resulting from variation in clays and regional traditions such as those observed in Staffordshire, Nottingham, London and Suffolk.[22]

In Australia, the brick industry reflects a similar pattern with the erratic adoption of innovations. It is often linked to rapid building development near urban areas, while the

country cousins continued to use simple hand-forming techniques into the middle of the twentieth century.[23]

In New Zealand a similar pattern is emerging with machine-pressed bricks coeval with hand production, Hoffman kilns coeval with Scotch, and so on. Survey of Carders' brickworks in Hobsonville (Auckland) uncovered a brick stamped: 'Clayton and Co. Patented'. Documentary evidence of 1865 referred to 'a Clayton and Co. patented brickmaking machine capable of producing 350 per hour, imported by George Boyd's brickworks (Newton, Auckland) and operating during the same period as Carders'.[24] Therefore, these two companies producing efficient machine-pressed bricks were contemporary with the hand-moulded and wire-cut techniques in evidence at the Pollen Works. Thus, in any attempt to assess 'adaptation' of technologies to new 'environments' one must be aware of the complexity and range already existing at the point or points of origin.

In studying adaptations of technology to new environments there is a danger that we might limit ourselves to the evolution of specific species of plant or technology. While we observe changes in kiln technology at the Pollen site, these can only be understood in relation to other changes on the site, to developments within the industry as a whole, and in their wider context, the social and economic realms. For instance, the observed dynamic nature of the site reflects in part the destructive nature of the industry, involving quarrying of massive amounts of raw material and relocating plant (installations) around the site. But it is also a reflection of a complex web of economic and political considerations.

At the Pollen site kiln modification and the adoption of a new type relates in part to the efficiency of the process and better control over the end product. A similar change in process at the Kawau smelting site had no effect on the end product and was entirely related to cost effectiveness. In neither case did these adaptations represent innovation, but rather selection from a range of existing technological systems as considered appropriate to the scale or economics of the industry.

THE ROLE OF TRANSPORT

Another line of enquiry is the relationship between early industries and transport systems. In Australia we see changes in the location of heavy clay industries as different transport networks develop.[25] The definition of what is an 'economic' source is needless to say intimately bound up with the cost of transport. Location of early industries in New Zealand, as elsewhere, was primarily determined by their raw material requirements and the ability to transport the product to the intended market. In the case of industries such as ceramics and metals, both raw materials and the end product are often difficult to transport (especially overland), and an adequate transport system was necessary a prerequisite for the establishment of industries. Many of the early brickworks, if not located at the site of the construction work, had to be located close to water transport as the unmetalled roads were impassable for much of the year.

The Pollen site and many subsequent brickyards in Auckland were located to utilise the mobility provided by waters of the Waitemata harbour and the rivers running into it. They succeeded when others who relied on road transport failed because of the difficulties of passage and the imposition of tolls. In the 1860s complaints were voiced by Boyd (brickmaker) concerning the existence of tolls on the North Road, eventually causing bankruptcy of some brickyards which used the road.

The impact of transport on the copper industry was also significant. The difficulties in shipping the ores influenced the decision to construct a smelter on the island and the cost of shipping the product to Wales played a part in its failure. Communications, along with New Zealand's dependence on the British legal system, considerably delayed legal decisions over mine ownership, resulting in flooding of the mine and increased operating costs.

CONCLUSIONS

Rescue archaeology often leaves little time for research design or background documentary research. The problem is exacerbated by the employment of archaeologists who are untrained in the field of historic sites and are unfamiliar with the material they are excavating. This is currently being rectified in the Auckland central city area where the early regions of settlement are being evaluated for their archaeological potential and researched as far as possible in anticipation of redevelopment as part of the role of the Regional Archaeology Unit, Department of Conservation.

Excavation of the Pollen Brickworks and the limited test excavation of the Kawau smelter have provided technological and commercial details not available from documentary evidence. Archival material relating to the Pollen Brickworks influenced both archaeological survey and excavation techniques. Title deeds and brief descriptions provided reasonable evidence of the location and extent of the works, but no fine details as to the site layout, plant or operating procedures. Using probes (gum spears) it was possible to define the outline of many of the features for excavation. Excavation not only provided details of some of the expected plant and equipment but also revealed a range of installations not described in the documents, such as the 'blunger'/washing feature (Fig. 3). It also revealed a history of drastic modification to site layout with continuous upgrading of technology to more efficient processes.

The relationship between documentary research and excavation is evidently a dynamic one, for just as documents influenced the methods of excavation, many of the artefacts recovered also gave direction to archival research. For example, a ceramic stamp with the inscription 'Onehunga, Storey & Co. New Zealand' referred us to street directories for Onehunga in the 1860s to unearth the nature of the contract. An English telegraph insulator (Varley) was found in association with those produced on site and had obviously been used as a template for the first local products. The recovery of numerous potter's tools and design elements gave direction in the search for nineteenth century English analogues.

The Kawau industry is a case where the documentary evidence is variable. It is informative for the smelting operation and certainly the legal battles and some of the technology of the mine, but provides very little information on such areas as the mining settlement and living conditions of the miners. However, even with good documentary evidence, preliminary excavations (test pits) at the copper smelter on Kawau have provided both fine technological details and expanded our knowledge of the international nature of the industry. The early copper industry in New Zealand has many foreign links: miners from Cornwall, smelters from Wales, refractory bricks from England, along with bricks and coals from Australia. Future excavation of the smelter, mine and settlement should be seen in this broad context.

Confirmation and description are still very much part of historical archaeology in New Zealand. Although we are moving away from such limited studies and attempting more complex approaches it is evident that the answers to

many higher level questions regarding socio-political and economic interpretations await the development of a larger archaeological database.

Analysis of the Pollen data and resultant archival research is still in progress, while the study of the copper industry has just begun. It is hoped that as this progresses we will be able to approach some of these broader issues.

It is unlikely that the imposition of a biological model of adaptation is of value in the field of historical industrial archaeology. Only in a very general sense can we look, for instance, at the heavy clay industries in New Zealand, and assess the ways in which they have been adapted from their homeland or evolved *in situ*. The genes of brickmaking machines are perhaps more elusive than the workers themselves.

Apart from the normal criticisms aimed at historical archaeology, industrial archaeology receives additional flak from engineers, metallurgists and other specialists who ask what is new, or question the competence of untrained personnel to interpret industrial remains. Such criticisms can easily be answered for, as Clarke observes, many of those in the forefront of industrial archaeology are engineers, metallurgists and geologists, and consequently there has been considerable emphasis on the evaluation of technology.[26] This can result in a very limited approach – a 'history of the three-pronged fork' or an excessive concern for 'firsts', thereby disguising, even ignoring, the variety at any one point in time and with little reference to the economic, social and political context of the technology. The historical archaeologist can always confer with other specialists on points of technical detail, while better qualified to ask and answer the higher level contextual questions.

NOTES

1. Deagan 1988, Cleland 1988.
2. Deetz 1988.
3. Walker 1978: 211.
4. Deetz 1988.
5. Best & Clough 1988.
6. Reynolds, D. and S. 1985.
7. Best & Clough 1988.
8. Birmingham 1983:55.
9. Connah 1988:126.
10. Best & Clough 1988.
11. Dollar 1978, Deagan 1988.
12. Birmingham 1983.
13. Scott 1979.
14. Birmingham 1983.
15. See Lawson 1971 for relationship of potteries with Australian goldrushes in the 1850s.
16. Clough 1988.
17. Wright 1984.
18. Davies & Egloff 1986.
19. Dollar 1978.
20. Clough 1986.
21. Clarke 1988.
22. Dobson 1903.
23. Birmingham 1983.
24. *Weekly News* 14th January 1865, Supplement.
25. Birmingham 1983.
26. Clarke 1988.

BIBLIOGRAPHY

ANON. 1985, *The Catalogue of the 1865 Dunedin Exhibition.*

BEST, S. & CLOUGH, R. 1988, *Pollen Brickyard and Wright Potteries: Early colonial ceramic industries of the Whau Peninsula.* Science and Research Internal Report No. 21 (unpublished). Science and Research Directorate, Department of Conservation, Wellington.

BIRMINGHAM, J. 1983, 'Brickmaking and other clay using industries', in Birmingham and others. *Industrial Archaeology in Australia: Rural Industry,* 53-94.

CLARKE, C.M. 1987, 'Trouble at t'mill: industrial archaeology in the 1980s', *Antiquity* 61, 169-179.

CONNAH, G. 1988, *'Of the hut I builded': The Archaeology of Australia's History.* Cambridge University Press.

CLELAND, C.E. 1988, 'Questions of substance, questions that count', *Historical Archaeology,* 22.1: 13-17.

CLOUGH, R.E. 1986, *Iron: Aspects of the Iron Industry during the Iron Age and Romano-British Periods.* Unpublished Ph.D. thesis, Institute of Archaeology, University of London.

CLOUGH, R.E. 1988, *The Historic Copper Industry in Kawau Island, 1840–1855.* Science and Research Internal Report No. 16 (unpublished) Department of Conservation, Wellington.

DAVIES, M. & EGLOFF, B. 1986, 'The Commandant's Residence at Port Arthur: an archaeological perspective', in Ward, G. (ed.) *Archaeology at ANZAAS,* Canberra. Canberra Archaeological Society.

DEAGAN, K.A. 1988, 'Neither history nor prehistory: the questions that count in historical archaeology'. *Historical Archaeology,* 22(1): 7-12.

DEETZ, J. 1988, 'American historical archaeology: methods and results', *Science* 239: 363-367.

DOLLAR, C.D. 1978, Some thoughts on theory and method in historical archaeology, in Schuyler, R.L. (ed.) pp.216-222.

DOBSON, E. 1903, *A Rudimentary Treatise on the Manufacture of Bricks and Tiles,* 11th edition, Crosby Lockwood and Son, London.

LAWSON, W. 1971, A History of Industrial Pottery Production in New South Wales. *Journal of the Royal Australian Historical Society,* 57.1: 17-39.

REYNOLDS, D. & S. 1985, The colonial potteries of James Wright. *Historic Places,* March, 11-13.

SCHUYLER, R.L. 1978, 'Historical and historic sites archaeology as anthropology: basic definitions and relationships', in Schuyler, R.L. (ed.) pp.27-31.

SCHUYLER, R.L. (ed.) 1978, *Historical Archaeology: a Guide to Substantive and Theoretical Contributions.* Baywood, New York.

SCOTT, D. 1979, *Fire on the Clay,* Southern Cross Books, Auckland.

WALKER, I.C. 1978, Historic archaeology – methods and principles, in Schuyler, R.L. (ed.) pp.208-216. Baywood, New York.

WRIGHT, J. 1984, *Overview of the Coppermine History of Kawau Island 1840–1855.* Unpublished manuscript held by the Regional Archaeology Unit, Auckland, research file N/A 15/6.