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The Sleaford Bay Tryworks: Industrial Archaeology of Shore Based Whaling Stations

ADAM PATERSON

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Front cover illustration: Tryworks Floor, northern end of Trench 1, and Trench A, facing west, Sleaford Bay 2001 Excavation (Photo by Charlotte North)

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Department of Archaeology
Flinders University
GPO Box 2100
Adelaide, SA 5001
AUSTRALIA

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Biography

Adam Paterson has been actively involved in the archaeological community since 1998. During this time he has studied archaeology at Flinders University (South Australia) and Leicester University (United Kingdom) specializing in historical and industrial archaeology.

Since graduating in 2004 he has been working as a heritage consultant in Sydney, NSW. His research interests include the archaeology of shore based whaling, contact archaeology, archaeozoology and the archaeology of maritime and industrial communities.

Abstract

In recent years historical and industrial archaeologists have discussed the importance of interpreting archaeological sites with reference to a detailed historical and archaeological context. Such approaches typically recognise that context is multi layered; in the sense that past processes occurring at any particular site will probably have been affected by forces operating at local, regional and global levels. This approach has been used to investigate the social, economic and practical forces that may have influenced the methods of construction of a tryworks (a small furnace used to render whale blubber to oil) at Sleaford Bay, South Australia.

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Introduction

The Sleaford Bay whaling station is located in what is now known as Fishery Bay. Fishery Bay is a small bay located within the greater Sleaford Bay approximately 35km south west of Port Lincoln (Figure 1).

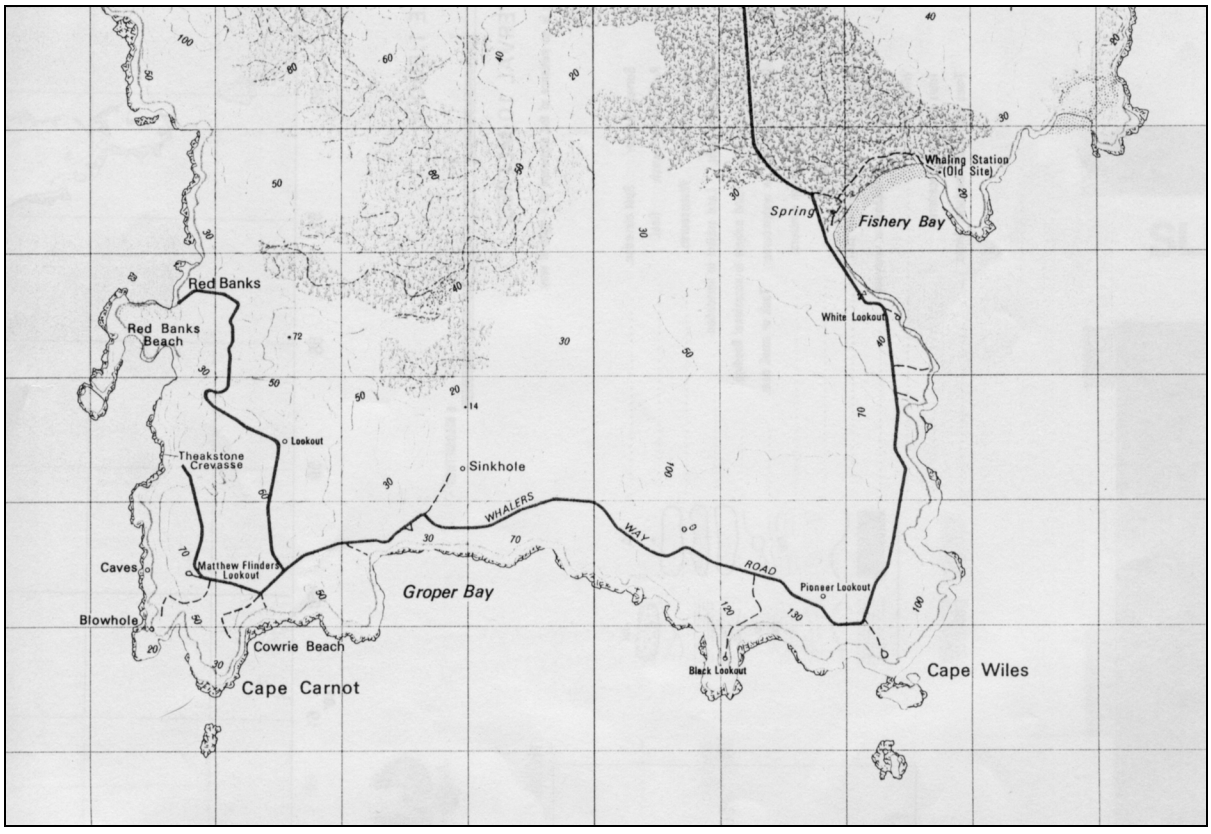

Figure 1. Fishery Bay, Eyre Peninsular, South Australia, Scale 1:50 000 (South Australian Government 1980)

Fishery Bay is about 1 kilometre wide and is open to the south east. A wide sandy beach extends across the northern and western sides of the bay. A tall calcareous limestone cliff, approximately four to six metres high, surrounds the bay on all three sides. The limestone is overlying granite which is exposed in places along the eastern side of the bay. A belt of vegetated sand dunes, roughly fifty to sixty metres wide separates the beach from the cliff line. Previous archaeological

surveys identified two functionally separate sites, a domestic area and an industrial area which included a flensing platform and a tryworks (Kostoglou & McCarthy 1991). A tryworks is a small, stone or brick furnace which is used in the rendering of whale blubber to oil (Figure 2).

Figure 2. A Drawing of a Brick Built Shore Based Tryworks (May 2001, p 7)

This study presents the results of an archaeological and historical investigation of the Sleaford Bay tryworks. The significance of the research has been discussed with reference to the wider archaeological context, specifically the Archaeology of Whaling in Southern Australia and New Zealand (AWSANZ) project (Lawrence & Staniforth, 1998). Attention has been paid to theoretical trends in historical and industrial archaeology and their relevance to this research is discussed below. A number of different sources of data have been considered including, primary and secondary historical material, with particular reference to global economic perspectives and local accounts of whaling at Sleaford Bay. Comparative archaeological material has been used to determine the nature of wider trends in tryworks technology. Finally the structural remains of the tryworks and the materials used in its construction have been analysed. The interpretation of the Sleaford Bay tryworks is made with reference to this framework of comparative historical and archaeological data, allowing locally acting social process which was not evident in the historical record to be identified.

Significance of the Study

Whaling has been identified as the largest and most productive industry in early colonial Australia (Lawrence & Staniforth 1998, p 7, Blainey 1976, p 115). While its economic development has been addressed by a number of authors, the social parameters and technological development of the industry have been largely ignored by researchers (Lawrence 1998, pp 111-112). In 1998 the Archaeology of Whaling in Southern Australia and New Zealand, (AWSANZ)

project was established to allow some of these issues to be addressed. AWSANZ identified four main aims; these include but are not limited to the development of an integrated analytical framework and the use of this framework to address several research priorities (Lawrence & Staniforth 1998, p 7).

While the Sleaford Bay "station complex" has received archaeological attention, publication regarding the site has been limited (Kostoglou & McCarthy 1991, Staniforth 1998) and since the excavation of the tryworks in 2001 there has only been a single brief report (Bishop & Thomas 2002). The Sleaford Bay tryworks is the most complete, of two brick built tryworks excavated in South Australia and is one of five similarly constructed tryworks in Australia. Therefore, the tryworks itself is of significance and a detailed site report alone would be of value. This study contributes to the development of an integrated analytical framework as outlined by the AWSANZ project by presenting the results of the 2001 excavation. Furthermore, it explores the social, economic and technological context through the use of an existing framework of historical and archaeological data. The primary research question stated below was developed after the literature review and the social, economic and technological context was partially explored.

Primary Research Question

What are the social, economic and practical forces which led to the construction of a brick built tryworks at Sleaford Bay, South Australia, 1837-1841?

Before the primary research question could be addressed, however, a number of related secondary research questions had to be answered.

Secondary Research Questions

1. Has tryworks technology changed over time? And how has it changed or remained the same?
2. What were the materials and methods used to construct the Sleaford Bay tryworks?
3. How is the Sleaford Bay tryworks different or similar to other known shore based tryworks?

Methodology

The methodology consisted of three phases: a literature review, an archaeological investigation, and a discussion of the results.

Literature Review

The literature review had four main aims.

1. To identify theoretical trends and points of contention relating to historical and industrial archaeological research throughout Australia, Great Britain and the United States.
2. To research the structural design, methods and materials used to construct tryworks throughout the world.
3. To research the social and economic processes affecting the whaling operations at Sleaford Bay.
4. To identify possible techniques for the analysis of the archaeological material recovered from the Sleaford Bay tryworks.

To achieve these aims, a variety of historical and archaeological texts and journals were located and assessed. The search began in the Flinders University Archaeology Department map room, where an extensive collection of reference material is held. From here it was possible to undertake directed searches of the Flinders University library, the Barr Smith library, the University of South Australia library and the State Library of South Australia. The personal collection of Associate Professor Mark Staniforth was consulted and internet search engines were utilised with some degree of success. The literature review was an ongoing process which continued throughout the writing of this study. As new sources of information became apparent to the author they were considered and included where appropriate. The majority of the data identified through the literature review is presented in chapters 4, 5 and 6; however, all of the references included within this research were located using this methodology.

The Sleaford Bay Tryworks: An Archaeological Investigation

The primary aim of the archaeological investigation of the Sleaford Bay tryworks was to gain a comprehensive understanding of the materials and methods used in its construction. To achieve this goal a number of different forms of archaeological inquiry were used. The specific aims, method and results for each individual technique are presented as discrete reports in chapter 7 which includes a written report of the 2001 excavation of the tryworks and an analysis of the artefacts recovered from the excavation. The field note books of Associate Professor Mark Staniforth and the author were consulted, and the aims, method and results of the excavation, were discussed. The excavation report includes a number of photographs, survey drawings and plan drawings of the site. The analysis of the artefacts consists of two sections, a statistical analysis of 455 brick fragments and microscopic analysis of the mortar used to bond the brick work.

Structuring the Data and Discussion of the Results

The third phase of the methodology required the various sources of data to be brought together in a way which allows the primary research question to be answered. This has involved the organisation of the various sources of data into a logical and structured progression. Structuring the data in this manner enables disparate sources to be drawn together allowing informed and meaningful interpretations to be made. The final interpretation of the data and its perceived limitations is presented in chapters 8 and 9, the “Discussion” and “Conclusion”.

2

Previous Approaches to Historical and Industrial Archaeology

The terms historical and industrial archaeology are in many ways interchangeable with one another; however, in some respects they are different and both are applicable to this study. The development of historical and industrial archaeology began at different times in different parts of the world. In recent years there has been a general reflection on the approaches used by researchers in these fields; the relationship between historical inquiry, archaeology and cultural heritage management, and how this is perceived to have shaped past research has been given considerable attention. Concerns have been expressed regarding an apparent tendency towards descriptive approaches in historical and industrial archaeological research and the limitations which are inherent in such approaches. Future directions for research have also been suggested and their application to this study will be discussed below.

Historical Archaeology

Historical archaeology was first practiced in America as early as the 1850s (Deetz 1988 p 362; Orser & Fagan 1995, p 23) and by 1935 was linked by legislation to cultural heritage management (Orser & Fagan 1995, pp 23-25). In Australia the establishment of historical archaeology as a discipline began in the 1960s and was also related to cultural heritage management (Lawrence & Karskens 2003, p 1). There are many ways in which the term historical archaeology can be defined, usually by method, period or theme but predominately it is a combination of all three (Orser & Fagan 1995, pp 6-14). The method of inquiry used in historical archaeology refers to the use of a combination of historical and archaeological evidence. There are certain complexities regarding the definition of the period and theme with which historical archaeology is interested. Essentially the beginning of the period has become defined by Columbus' 1492 voyage to the West Indies. An end point is somewhat harder to pin down and depending on the criteria which are used, can extend right up until the present day. The theme of Historical archaeology has been defined by Charles Orser & Brian Fagan (1995) as the study of the development of the modern world (pp 11-14).

Industrial Archaeology

While Australian and American authors have used the term industrial archaeology without contention, in Britain its use has been far less innocuous. In 1990 Marilyn Palmer identified a need in Britain to establish if industrial archaeology was best treated as a thematic or period

discipline (Palmer 1990, pp 275-6). A thematic discipline was conceptualised as an archaeological study from any period which investigated previous industry (Palmer 1990, p 275). A period based discipline was concerned with understanding the rapid technological, economic and social changes which occurred throughout Britain in the last three hundred years, commonly known as the industrial revolution (Palmer 1990, p 275) (for a detailed discussion of the semantics of the term industrial revolution see Buchannan 1974). Palmer (1990) suggested that as all of the periods of history leading up to the industrial revolution were established in the literature and represented by professional bodies, a gap existed, which industrial archaeology as a period discipline could fill (p 276). In Australia and the United States this gap did not exist, therefore industrial archaeology has been treated as a thematic study within historical archaeology.

In more recent years industrial archaeology in Britain has come to be much like the historical archaeology of the colonial world. It can be defined in the same way in which Charles Orser and Brian Fagan (1995) have defined historical archaeology; by method, period and theme. The use of a combination of archaeological and historical material is central to the method employed by industrial archaeologists (Palmer 1990, p 277). The period and theme of industrial archaeology are closely related as they are both defined with reference to the industrial revolution. The period of study is confined to the last three hundred years (Palmer and Neaverson 1998, p 1, Buchannan 1972, p 19) while the theme is broadly similar to that of historical archaeology; as Palmer states:

> In Great Britain, industry in its broadest sense has been the dynamic force which has shaped human development and changed the landscape over the past two centuries. (Palmer 1990, p 276)

Therefore, in Britain the study of industrialisation is essentially the study of the development of the modern world with reference to a specific spatial context, while in Australia it is the study of industry within the historical or colonial period.

History, Cultural Heritage Management and Descriptive Approaches to Historical and Industrial Archaeology

The relationship between history and historical archaeology has been discussed by a number of prominent historical and industrial archaeologists. The main contention amongst the archaeological community is that historical and industrial archaeologies are able to provide something which history alone cannot. Historical and industrial archaeology give a voice to minorities and other groups who may not be represented or are misrepresented in historical documents. It is also possible to gain additional insights into economic, industrial or social processes which may have been overlooked or deliberately ignored by contemporary observers. (Connah 2003; Deetz 1988; Orser & Fagan 1995; Palmer 1990; Palmer & Neaverson 1998).

Historical and industrial archaeology is able to play a meaningful role in understanding the life-ways of past peoples and the societies of which they were a part; however, it has not always been successful in doing so. In Australia there have been criticisms of an apparent preoccupation with creating artefact typologies and a tendency towards descriptive rather than interpretive approaches to archaeology (Connah 1983, Megaw 1984). In Britain a lack of artefact typologies and comparative material has actually contributed to the prevalence of descriptive approaches (Palmer & Neaverson 1998, pp 3-4).

More recently, Connah (2003) has suggested that Australian historical archaeology has lacked clearly defined research questions and has identified a number of possible reasons for this. Central to his argument is the disparity between the quantity of university initiated and cultural heritage initiated archaeology (Connah 2003, pp 147-8). Connah suggests that the majority of published historical archaeology is written by consultant archaeologists who are not asking the

right kinds of questions (Connah 2003, p 147). Historical archaeology in Australia has been focussing on localised historical questions and not addressing the bigger picture issues, such as:

> …Environmental change, migration studies, cultural adaptation, technology transfer, product marketing, urbanization, industrialization, frontier theory, [and] world systems theory…(Connah 2003, p 149)

According to Connah this has resulted in historical archaeology's failure, to gain widespread acceptance amongst practitioners of other related disciplines such as prehistory and history (Connah 2003, p 149). However these criticisms may be a reflection of Connah's own processual approach to archaeology rather than an inherent flaw in the research of others. Other prominent Historical archaeologists have deliberately set aside processual approaches to archaeology in favour of "…an interpretive approach that paid close attention to local context" (Yentsch 1994, p xxii).

In Britain, much of the early work in industrial archaeology had very little in the way of a theoretical or explanatory framework and sought to describe the events leading up to a sites construction, those that occurred during its use and its abandonment, but not why these things where happening (Palmer & Neaverson 1998, p 3). As Johnson (1996) states, "Most work in this area has concentrated on the archaeological elucidation of the development of the technologies involved rather than the social and cultural parameters" (p 12). Palmer suggests that this occurred at least in part due to industrial archaeology's origins in cultural heritage management:

> Industrial archaeology, … grew from the need to *record* and *preserve* standing structures threatened with demolition rather than an inherent desire to understand more about the historical period of monuments. (Palmer 1990, p 275)

In addition, industrial archaeology in Britain has "…lacked a broader research agenda and has rarely tried to contribute to wider historical debates…" such as "…the origins and effects of industrialisation" (Palmer & Neaverson 1998, p 3).

An assessment of the material published in the British *Industrial Archaeology Review* over the past two years, suggests the ability of industrial archaeology to extract and disseminate past social and economic process is still being overlooked. The degree to which different authors attempt to elucidate social meaning varies greatly, ranging from almost entirely descriptive papers such as Johnson's *Friedrich Edouard Hoffmann and the Invention of Continuous Kiln Technology: The archaeology of the Hoffmann Kiln and 19th – century industrial development* (Parts 1 & 2) (Johnson 2002a; Johnson 2002b) to Taylor's paper *Structuration Revisited: A Test Case for an Industrial Archaeology Methodology for Far North Queensland* (Taylor 2003), where local social and economic developments are placed within the framework of developing world systems. To be fair many of the papers published make some attempt to draw conclusions regarding the social and economic effect of changing technologies or landscapes, and it is the extent to which they do this which is of concern.

A Framework of Inference: an interpretive approach to Historical and Industrial Archaeology

Lawrence (1998), Palmer and Neaverson (1998) have recognised the value of utilising a framework of inference for the interpretation of archaeological material. In regard to the AWSANZ project Susan Lawrence expresses this idea thus:

> This framework is one based on an ethnography of place, that is, the exploration of cultural processes through the thick description of places in their historical context (Mayne and Lawrence 1998). Such an approach requires a materialist perspective that meshes documents and artefacts into an integrated

> historical record which then interrogates this record with sensitivity to local horizons and cultural landscapes other than our own. (Lawrence 1998, p 113)

A particularly excellent example of such an approach is Shackel's book *Culture Change and the New Technology; An Archaeology of the Early American Industrial Era* (Shackel 1996). Within the book Shackel (1996) explores various aspects of social and economic change within the armoury town of Harpers Ferry. Shackel (1996) uses a range of evidence including primary and secondary historical documents, paying particular attention to the reaction of different social classes to increasing mechanisation and changing labour conditions in the armoury. The interpretation of the archaeological material is made with reference to this historical framework. Using this methodology Shackel (1996) has been able to investigate hidden social processes which were not made explicit through historical evidence alone. This approach has created a more comprehensive interpretation of how different social groups in Harpers Ferry reacted to changing, social and economic circumstance.

This is the theoretical approach which has been applied to this study. A variety of different sources of data have been used to inform the interpretation of the Sleaford Bay tryworks. Comparative archaeological material has been used to place the Fishery Bay tryworks within the wider technological context. This allows the significance of the materials and methods of construction at Sleaford Bay to be considered. The effect of economic forces on the construction of the Fishery Bay tryworks has been investigated through primary and secondary historical documents. This research has focussed on the relationship between world economic systems, and colonial shore based whaling as well as the local social and economic context. It is suggested that each of these sources of data are essential to the interpretation of the Sleaford Bay tryworks. When viewed together, it is possible to gain a fully informed understanding of the social, economic and practical forces which led to the construction of a brick built tryworks at Sleaford Bay.

3

Commercial Shore Based Whaling: A Historical Context

The opportunistic exploitation of stranded whales by humans has almost certainly occurred in all of the regions of the world where the two species co-habitated. This opportunistic exploitation is quite separate from the hunting of whales. Archaeological evidence indicates that the hunting of whales has been practiced around the Bering Strait for the last two millennia (Hacquebord 1990, p 11). Around the North Sea a combination of archaeological assemblages containing whale bones and rock carvings depicting whales within hunting scenes has led to the suggestion of a Stone Age antiquity for the hunting of whales in Europe (Hacquebord 1990, p 11). References to whaling are known from Greek and Roman literature, and accounts from the 9th century describe the activities of Norsemen herding whales into small fjords along the coast of Norway, trapping and killing them (Hacquebord 1990, p 11).

The hunting of whales is itself quite different to commercial shore based whaling, which is widely held to have first been practiced by the Basque people of northern Spain and southern France (Davis, L. et al., 1997 p 31; Jackson G. 1978, p 3; Hacquebord 1990, p 11; Francis 1991, p 19). This difference is one of technique, and scale. The first reference to Basque whaling occurred in the middle of the 11th century; the whales were pursued from the coast in small swift rowing boats, harpooned and then dragged back to shore for processing (Hacquebord 1990, p 11; Francis 1991, p 20). It is believed that the Basque's utilised most of the whale carcass. The baleen plates from the mouth of the whale were used in the manufacture of a variety of items, the flesh was eaten, and the blubber of the whale was reduced to oil (Hacquebord 1990, p 11). The reduction of blubber to oil is one of the defining characteristics of commercial whaling. Throughout the middle ages the Basques were supplying a growing market for whale oil in Western Europe (Hacquebord 1990 p 11; Francis pp 21-22). The preference of the Basques for slow moving females and calves combined with the scale at which they were whaling is believed to have had catastrophic effects on the right whale population of their traditional hunting ground, the Bay of Biscay (Hacquebord 1990 p 11-12). This pattern of over exploitation of right whale stocks was repeated in many areas of the world and is believed to have caused the collapse of the Australian shore whaling industry.

Demand for Whale Bone and Oil: World Economic Systems and Industrialisation

The development of world economic systems has been linked to the exploration and subsequent colonisation of most of the world by western Europeans. There were many different catalysts to western colonisation; they included freedom from religious persecution, opening of new trade routes, exploitation of new resources and the relocation of criminals. While the extent of western colonisation and its effects have varied, every region of the world has been affected to some extent. A detailed discussion of the development of world economic systems is beyond the scope of this study; however, the place of whaling will be explored within this context.

Central to the economic analysis of whaling is the relationship between supply and demand and its effect on whaling operations. The products associated with shore based whaling are whale oil and bone. Whale oil is distinct from spermaceti and sperm oil which were extracted from sperm whales and formed the major products of pelagic whaling. Whale oil was extracted from the blubber of baleen whales through a process known as trying out. This involved cooking specially prepared pieces of blubber in a large copper or cast iron trypot. Whale bone also required a degree of processing; the jaw of the whale was cut from the head and slit into sections, which were then scraped clean and allowed to dry. While the demand for whale oil and bone has been shown to fluctuate, the general trend was one of rapid expansion followed by stabilisation and then decline (Davis et al. 1997, pp 16 – 17). This expansion began at the beginning of the eighteenth century and has been linked to increasing industrialisation and urbanisation (Davis et al. 1997, pp 342, 637; Jackson 1978, pp 55 – 56).

Whale oil was the primary product of the shore whaling industry. Its uses included, lubrication for heavy machinery and fuel for lamps, and it was used in the manufacture of coarse woollen cloth, leather, soap, paints and varnishes (Davis et al. 1997, p 30; Jackson 1978, pp 55–6). The increasing mechanisation of industry and transport, coupled with growing urban populations, increased the demand for all of these products, particularly lubricants and lamp oil (Davis et al. 1997, pp 30, 367; Jackson 1978, pp 55–6). While the development of new fuels for lighting, particularly coal gas did have a negative effect on the demand for whale oil, it was the development of the petroleum industry in the 1860s which had the most dramatic effect (Davis et al. 1997, p 352, 362-3; Jackson 1978, p 122). Petroleum products quickly replaced whale oil as the fuel for the illumination market while composite whale and petroleum products were used as lubricants for a short period (Davis et al 1997, 362-3). Improvements to the refinement process of crude oil eventually led to a complete abandonment of whale oil as a lubricant (Davis et al 1997, 362-3). Due to its strong but flexible quality whale bone was in demand throughout the entire nineteenth century (Davis et al 1997, p 30). It was used in the manufacture of women's clothing and in industrial machinery (Davis *et al* 1997, p 367; Jackson 1978, p 56-7). Whale bone was eventually replaced by sprung steel and plastics (Davis et al 1997 p 30).

Whaling at Sleaford Bay: Dates, Profits and Losses

South Australia was a free settlement which was established largely due to the efforts of a cooperative of entrepreneurs known as the South Australia Company. The South Australia Company had many interests including, banking, wool and wheat production, and mining, all of which were expected to absorb capital for the first few years of the colony (Hoskings 1973, chp 1, p 4). Based on accounts of whaling in other Australian colonies the South Australia Company hoped that its whaling ventures would provide a quick return (Hoskings 1973, chp 1, p 1-2). They invested in five vessels of various sizes equipped for pelagic whaling as well as additional equipment for shore whaling (Hoskings 1973, chp 1, p 5-6). Between 1837 and 1840 the South

Australia Company operated three shore based whaling stations at Encounter Bay, Thistle Island and Sleaford Bay with mixed results. The first historical reference to whaling at Sleaford Bay was made in 1837, when *The South Australian Gazette and Colonial Register*, 1837, Nov. 11 states that:

> The Siren went from Port Adelaide a few days ago to Sleaford Bay, near Port Lincoln to take in a cargo of oil from the station there. (*The South Australian Gazette and Colonial Register*, 1837, Nov. 11, p. 1, col. 2)

A "station" may have been operating at this time; however, there is no reference to costs/profits, who owns the station, or which port the cargo of oil is destined for. There also is no mention of who is working at the site or if it was more than a transitory exploitation of the bay. It has been suggested that this early period of whaling may have been a Hobart or Launceston based operation (Staniforth 1998, p 60; Bradbury et al. 1997, p 35). As the South Australia Company established its first station at Encounter Bay in 1837, and there are many accounts of their activities, it is almost certain that it was not an officially recognised whaling station. There are no newspaper accounts of whaling at Sleaford Bay in 1838, and there is no mention of the station in the correspondence between Mr David McLaren, the manager of the South Australia Company's whaling operations, and the directors of the company. In 1838 the South Australia Company did establish a new station at Thistle Island, located off of the coast of the Eyre Peninsular (Hosking 1973, chp 1, p 24).

In 1839 the South Australia Company went into partnership with the Hack brothers who had also operated a station at Encounter Bay in 1838 (Hosking 1973, chp 1, p 22). The new company was called the United Fishing Company (UFC), and the day to day management of the joint operations was carried out by Captain Hart (Hosking 1973, chp 1, p 34). During the previous season Captain Hart had proven himself to be competent acting in this role for the Hack Brothers at Encounter Bay. In 1839, based on favourable reports from MacFarlane the headsman at Thistle Island, a new station was established at Sleaford Bay (Hosking 1973, chp 1, p 36). In April Captain Hay sailed to Sleaford Bay with the headsmen, crew and supplies for that station, Captain Hart was due to join them in May to supervise the preparations but did not arrive until June (Hosking 1973, p 36). The season was a particularly poor one for the western stations; by the end of June; no whales had been sighted at Thistle Island and only 55 tuns of oil were taken at Sleaford Bay (Hosking 1973, chp 1, p37).

1840 was the last year in which the South Australia Company participated in Whaling (Hosking 1973, chp 1, p 45). Catches were high in this year, and costs were lower. The station at Thistle Island was abandoned, and the total number of boats operated by the UFC was reduced from 19 in 1839 to 11 in 1840 (Hoskings 1973, chp 1, p 48). At Sleaford Bay 4 boats took roughly 110 tuns of oil, which resulted in a profit for the operations there.

In 1841 Hack and Co. continued to operate at Encounter Bay and Sleaford Bay. The takings at Sleaford Bay were lower in this year, as there were fewer whales than in previous years and the shore station was forced to compete with a visiting ship from Sydney (*South Australian Register*, 1842, January 1, p 3). The catch with three boats was only 30 tuns of oil and 1 ½ tuns of bone, with a value of 710 pounds while the expenses came to 997 pounds, which resulted in a loss of 285 pounds (*South Australian Register*, 1842, January 1, p 3).

In 1842 J.B. Hack and Henry Watson left their share of the UFC to Captain Hart and John Hagen who abandoned operations at Sleaford Bay (Hoskings 1973, chp 1, p 4). Unlike the Encounter Bay and Thistle Island whaling stations there are no historical accounts of when or who built the Sleaford Bay tryworks.

"The Mob": A Social History of Whaling and Whalers at Sleaford Bay

In the past it has been suggested that the social aspects of shore whaling have been largely overlooked within Australian historical archaeology (Lawrence 1998, pp 111-112). Susan Lawrence (1998) has suggested that social structures within whaling stations and the use of material culture to reinforce and delineate these structures is an area which requires further research (p 111). In regard to New Zealand, Nigel Prickett (1983) has researched social processes such as culture contact and Maori involvement in whaling through historical data. Prickett has also suggested that the understanding of these processes will be enhanced by investigations of the material manifestation of this interaction (1983, p 60-2). The lack of small finds excavated at the Sleaford Bay tryworks site makes it difficult to examine social process through archaeological material, therefore historical evidence alone has been used.

Historical accounts of colonial shore based whaling in Australia and New Zealand are littered with descriptions of the drunken and disorderly behaviour of whalers (Morton 1982, p 247). This behaviour is associated with the prevalence of rum in shore whaling activities. Morton states that:

> Rum was used as a reward for killing whales, as a stimulant when towing, as a cure for boredom if there were no whales, and even, although this is hard to believe given the reports of its quality, for pleasure. (Morton 1982, p 247)

In this regard Sleaford Bay and the other South Australia Company whaling stations were no exception, with rum invariably featuring on lists of provisioning. Mr McLaren the manager of the South Australia Company's whaling operations was consistently critical of the whalers; he complained that it was the inability of the company to recruit sober labour which had led to its failings (Hosking 1973, chp 1, p 16 - 17). His opinion is made quite clear by his description of the whalers and headsmen sent to Sleaford Bay in 1839 as "The Mob". David McLaren was not alone in his criticism of the crews at Sleaford Bay, in 1840 the Hart Committee found that:

> …with the extension of operations at Sleaford Bay, some inexperienced headsmen were hired, and employed at the new station. They proved "insufficient", and "caused such dissatisfaction that more than half the men deserted. (Hosking 1973, chp. 1, p 44)

Desertion was not restricted to Sleaford Bay, in the previous year problems with rotten beef and stale biscuits are believed to have led to a part of the crew abandoning the Thistle Island station (Hosking 1973, chp 1, p 26).

Not all accounts of South Australian whalers were critical, at Encounter Bay Simpson Newland recalled their value to the other settlers in the region (Hosking 1973, chp. 3, p 3). While after visiting Sleaford Bay in 1839, J.B Harvey a government official at port Lincoln commented:

> At the western extremity of Sleaford Bay, where the whaling station is planted, there is some good garden ground, and here I saw melons, cabbages, potatoes and various other vegetables in tolerable perfection; there is also a spring of excellent water at this settlement. (Somerville Collection, Vol. D, pp 31-2)

In 1840 David McLaren again expressed doubts about the crew at Sleaford Bay again; however, Captain Hart was confident of success. 1840 was the most successful year at Sleaford Bay.

In 1839 when the United Fishing Company began whaling at Sleaford Bay the nearest town was Port Lincoln which at this time was barely established as a settlement (Bradbury et al. p 34). Travel overland would have been difficult and time consuming while the use of the boats would probably have been restricted particularly during the whaling season. Social interaction at the station would have been restricted to fellow whalers, local Indigenous people and ships visiting

the bay. The nature of the work, which involved short periods of concentrated, dangerous and unpleasant activity followed by long periods of inaction, would have led to intense boredom. Furthermore, the weather at Sleaford Bay during the whaling season would have contributed significantly to the whaler's discomfort. There is little in the historical literature which suggests that these issues were of concern to the managers of the South Australian Company. However, they did not go entirely unnoticed, as one contemporary observer at the Encounter Bay station stated, "There is no employment more hazardous, more laborious, more disgusting, than whaling" (Leigh, 1839, p 169-170). It has been suggested that the difficult conditions which shore whalers endured may provide some explanation for their behaviour (Morton 1982, p 247).

It was not just the incompetence of the whalers which worried David McLaren, he was acutely aware of his own inability to manage the whaling operations of the South Australia Company. In a correspondence to the directors of the company McLaren states, "I feel more deeply than I can express, a sense of my incapability to direct these operations" (McLaren to Wheeler, 1 Jan 1838 SA Co. Loose Letters 1838). In 1837 the ineptitude of the Managers of the South Australia Company was demonstrated by their overpayment of the whalers. Historically whalers were paid based on a lay system. Rather than receiving a wage they received a share of the profits or a "lay." The size of the share received was based on their position within the crew. In 1837, the South Australia Company combined the catch of two gangs and calculated the pay for each crew member based on the total haul, rather than dividing the total by two (Hosking 1973, chp 1, p 17). This resulted in the payments costing more than the profits. In 1838 over expenditure on supplies and mismanagement of the shipment of oil to London caused the operations to record a loss (Hoskings 1973, chp 1, p 30-1). Disheartened by the failures of the previous two years David McLaren was no longer supportive of the whaling operations and following another poor result in 1839. The Directors of the company instructed McLaren to abandon the operations. The letters instructing McLaren to abandon them arrived too late, as preparations for the 1840 season had already begun (Hoskings 1973, chp 1, p 37, 45).

It is clear from historical accounts that the managers of the South Australia Company, considered their employees to be less than reliable. As drinking, violent behaviour and desertions were not restricted to Sleaford Bay, or even the South Australia Company, it seems likely that their criticisms were based in truth. However, the effect of this behaviour on operations is difficult to gage. Problems outside of the whaler's control, such as, the absence of whales from the bays, poor rationing and competition from foreign ships would also have affected the productivity of the stations. The ineptitude of the managers themselves was rarely considered to be a contributing factor, but it has been shown to have had a direct effect on the success of the whaling operations. Regardless of which was actually the case, it is clear that David McLaren believed that the whalers were an unreliable work force and that he was incapable of controlling them. By 1839, the year in which the Sleaford Bay whaling station was established, David McLaren and the South Australia Company were so dissatisfied with their whaling operations that plans were already being made to disband them.

4

Variability in Trywork Construction: An Archaeological Perspective

This chapter will review the archaeological evidence of one aspect of the industrial process associated with commercial, whaling known as trying out. In particular, it will review the methods and materials used to construct tryworks between the 16th and 19th Centuries. Trying out is the process of extracting whale oil from small pieces of blubber, which were removed from the whale and prepared through a process, known as flensing. The most basic and necessary function of the tryworks was to provide a stable platform for the large copper or iron trypots within which the oil was rendered. In addition, the walls of the tryworks are believed to have controlled the flow of air around the pots and furnace fires, which would have helped to regulate the temperature of the tryworks. Controlling the temperature may have been a necessary feature as overheating could damage the oil, while too little heat would slow down the process of rendering significantly. While the basic principles of trying out are widely known, the extent to which tryworks technology has changed over time or within different locations has not been investigated.

North America, Bermuda and Greenland

The Basques at Red Bay, Labrador

While it is commonly accepted that the Basque's were whaling on an industrial scale within the Bay of Biscay (Hacquebord 1990, Francis 1991), there have been no archaeological investigations (known to the author) of this earliest phase of shore based whaling. The earliest archaeological evidence of shore based whaling as part of an oil producing industry comes from Red Bay, Labrador where Tuck and Grenier (1989) excavated a number of 16th century tryworks built by Basque Whalers (Figure 3). The tryworks were built of stone, were enclosed on four sides and had between one and six fireboxes all facing the shoreline. "The fireboxes themselves were between 1.2 and 1.5 meters in diameter and, the entire stone structure may be as long as ten meters" (Tuck and Grenier 1989, p 40). There is no evidence to suggest that brick was used in the construction of the tryworks at Red Bay despite the tendency of the stone to fracture under the heat of the fires. Layers of broken roofing tile and scatters of iron nails suggest that the structures excavated at Red Bay had roofs built from imported tiles. One of the excavated tryworks was found to have clearly defined post holes up to 30cm in diameter. The structure was more than nine meters long by eight meters wide and had a central row of posts suggesting that the roof was peaked (Tuck and Grenier 1989).

Figure 3. The Excavated Lower Courses of a Stone Built Tryworks, Red Bay, Labrador (Tuck and Grenier 1989, p 39)

Dutch built tryworks at Spitsbergen (Greenland)

An historical and archaeological investigation of the 17th century Dutch whaling stations in the Spitsbergen archipelago has revealed evidence of three different periods of settlement and two different methods of constructing tryworks (Hacquebord, 1987). Two furnaces relating to the first period of Dutch whaling on the Smeerenburg spit were identified, and recorded. Hacquebord states that:

> These furnaces were small, round structures each capable of heating one cauldron. Circles of brick cemented with boulder clay not only supported a copper cauldron, but also formed a firebox for it with a fire hole placed on the side facing the sea. The diameter of the firebox was approximately one meter and no traces of a chimney were found. (Hacquebord 1987, p 23)

Using a combination of artefact analysis and historical documentation, a period of between 1614 and 1623 has been suggested for the construction and use of these furnaces (Hacquebord 1987).

The furnaces associated with the second and third period of whaling are particularly suited to the arctic conditions of Spitsburgen and are considered to be quite sophisticated in comparison to other tryworks (Hacquebord 1987, p 25). The tryworks consisted of an outer wall built from stone "…which was primarily designed to hold a scaffold built from timber" (Hacquebord 1987, p 25). Within the outer wall "…at a distance of about 30 cm…" another wall which was "…made from bricks and cemented with boulder clay…" (Hacquebord 1987, p 25). A stoke hole was built into the front of the tryworks, and another hole built in the opposite wall was designed to ensure that hot air would be drawn through. Louwrens Hacquebord (1987) suggests that "…the chimney was most probably placed above the fireplace high in the brick wall and without a direct connection with the fire…" This meant, that "…the hot air and smoke had to circulate around the cauldron before it could escape through it" (p 25). It is believed that this design would have created an even heat and may have been adapted from the ceramic industry (Hacquebord 1987, p 25). Using the same method of combining archaeological and historical data Hacquebord (1987) suggests a date range of between 1640 and 1660 for the third period of whaling.

Shore based tryworks in Bermuda

Smith's Island tryworks in Bermuda is believed to be "…the best and most complete tryworks on land anywhere in the world" (Paling 2003, p 75) and may have been constructed as early as 1759. The exterior is built of stone and is 5.75 metres in length, 2.46 metres in width and 1.14 meters in height. The interior was constructed of imported brick and bonded with locally produced limestone mortar. Each furnace had a pentagonal corridor which measured 36 centimetres wide, 32 centimetres high and two meters long. The corridors led to a slightly wider, square chamber which held the try pots. "The diameter of each try-pot measured roughly 87 centimetres, 80 centimetres, 90 centimetres and 82 centimetres" (Paling 2003, p 77). The irregular size of the trypots, a feature necessary for rendering sugar cane to molasses, has led Paling to the suggestion that the Smith's Island tryworks may have replicated "…the design and function of Caribbean sugar tryworks" (Paling 2003, p 78).

At another site in Bermuda known as Whale Island, Ely's Harbour, Paling surveyed two large features cut directly into limestone bedrock (Figure 4). One of the features is suggested to have been a cooling vat, while the other is apparently a huge furnace, with a stoke hole cut into its base. The features are likened to "Diderot's Spermaceti Furnace" and it is suggested that the furnace on Whale Island held trypots similar to those of Island Bay, New Zealand (Paling 2003, p 84). While this is possible it should be noted that there was no observed evidence of burning, and no confirmed accumulations of whale bone nearby (Paling 2003, p 87), casting doubt on the assertion that it was a tryworks.

Figure 4. The Front of the Smith's Island tryworks, Bermuda (Paling 2003, p 74)

Shore based tryworks in Ballast Point, California

Commercial shore based whaling began at Ballast Point in 1857; the first station was established by the Packard brothers who where of Portuguese decent from New England (May 2001, p 4). The Packard brothers were experienced whalers who successfully operated a number of whaling stations along the Californian coast (May 2001, p 8). While a number of other whaling companies came and went the Packard brothers only ceased operations at Ballast point after the government seized the land in order to establish Fort Rosecrans (May 2001, p 7). A number of different archaeological features where excavated at Ballast Point, including the stone foundation of the tryworks (May 2001, p 7) (Figure 5). The foundation appears to be built out of large beach cobbles and would have supported "…a pair of trypots, surrounded by bricks" (May 2001, p 7).

Figure 5. Excavation of the Tryworks Foundation at Ballast Point (May 2001, p 6)

Shore Based Tryworks in Australia

Tasmania

Kostoglou's (1995b) extensive survey of Tasmanian whaling sites revealed a large number of trypot 'nests'. While most trypot nests are "…merely amorphus piles of stone…" occasionally "…one is located intact…" (Kostoglou 1995a, p 26). The trypot nest at Whalers Cove, Maria Island (Figure 6) is suggested to be a representative example of construction methods in Tasmania. It consists of "…a U shaped stone wall measuring approximately 3 x 2 meters" (Kostoglou 1995a, p 26). At Imlay's Southport Station the tryworks consisted of "a dry stacked stone exterior protecting a central core of bricks arranged in a herringbone fashion" (Kostoglou 1995a, p 26). Nash (1998) has stated that "…some care appears to have been taken with the construction of the trypot nests at most sites" (p 26) in Tasmania.

Figure 6. Unexcavated, Stone Trypot Nest, Maria Island (Nash 1998, p 26)

Kelly and Lucas' whaling station at Adventure Bay (Figure 7) is an example of a Tasmanian whaling station where brick has been used extensively as a building material. Two brick fireplaces, within a stone built, two roomed building were excavated as well as a tryworks which was partially built out of brick (Lawrence 2002). The excavated tryworks consisted of:

> …the lower levels of a brick core encased in a masonry shell. The core contained two adjacent hearths, each with its own stoke hole and flue, separated by a brick plinth. The 250-gallon cauldrons in which the oil was rendered would have been encased in more brickwork above these hearths. (Lawrence 2002, p 8)

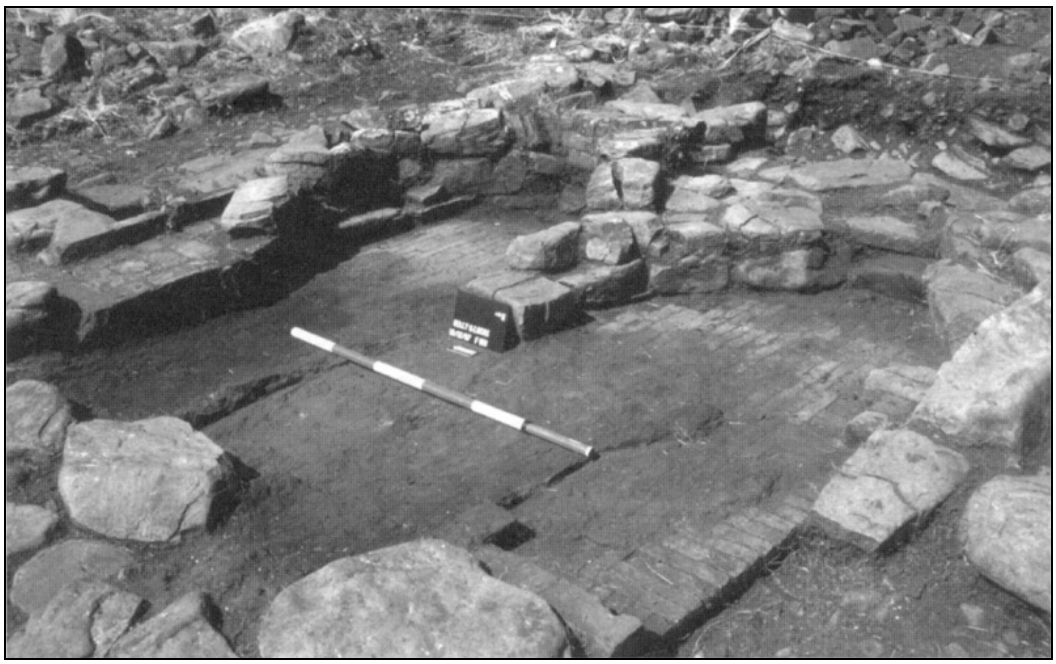

Figure 7. Excavated Brick and Stone Tryworks, Adventure Bay (Lawrence 2002, p 8)

Both the two roomed building and the tryworks appear to have been exceptional structures in terms of Tasmanian whaling. One possible reason for the extensive use of brick at Adventure Bay could have been the location of the site close to Hobart, which would have facilitated the regular distribution of supplies to the site (Lawrence 2002).

New South Wales

There have been several combined historical and archaeological research projects documenting the activities of a number of 19th century shore based whaling stations throughout the Two Fold Bay and Ben Boyd National parks (Hewitt, 2003, Gojak 1998, Bickford et al. 1988). While Hewitt (2003) has made a strong case for the existence of a tryworks at Bittangabee Bay, only one structurally identifiable tryworks has been found in the Twofold Bay area (Figure 8). This tryworks is located at Kiah Inlet and shows evidence of two phases of construction. Bickford et al. (1988) suggest that the first phase of construction (Level C) consisted of:

> …a single row of blackened bricks laid as headers, with [a] timber plank in the same line to the east. These bricks are wider and thinner than those of level A. Their size indicates an early date. (Bickford *et al* 1988, p 48)

This phase of construction is associated with the activities of Otaheiti Bill, who established a tryworks somewhere near the Kiah Inlet during the 1840's (Bickford *et al* 1988, p 43). Little can be established about the structure other than it was at least partially built from brick.

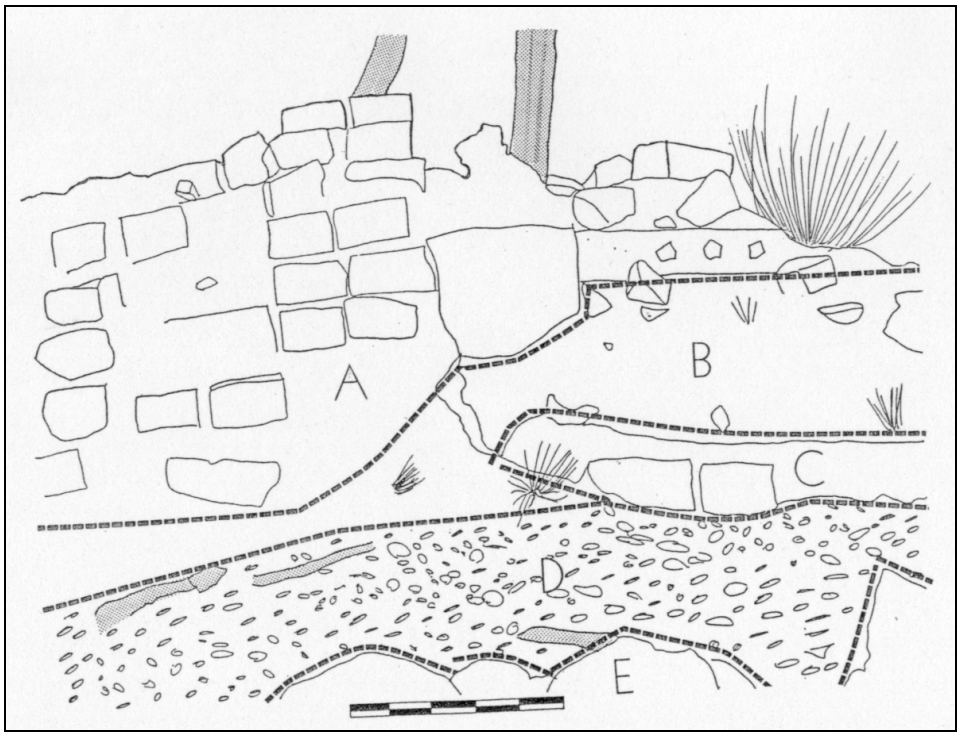

Figure 8. Profile Drawing of Davidson's Tryworks Bittangabee Bay (Bickford et al. 1988, p 42)

The second phase of construction is associated with the activities of Alexander Davidson and dates to the 1860's (Bickford *et al* 1988, p 43). The tryworks were built from Boydtown bricks which were probably taken from derelict buildings in the abandoned town (Bickford et al. 1988, p 43). The walls of the tryworks were at least seven courses high, and in plan view they form three sides of a square (Bickford et al. 1988, p 43). The southern wall of the tryworks has most probably been eroded away (Bickford et al 1988, p 43). The bricks are most blackened towards

the southern end suggesting that the fire hole was located in the eroded southern wall (Bickford et al. 1988, p 43). As the bricks came from the abandoned Boyd Town they would almost certainly have been as cost effective and probably less labour intensive than locally procured stone. An additional advantage of using bricks would have been the relative ease with which an unskilled person could produce a stable structure.

Western Australia

The Bathers Bay whaling station located at Fremantle Harbour was established in 1837 by the Fremantle Whaling Company and continued operating into the 1860s (McIlroy 1986). Another whaling station known as the Perth Fishery, located nearby on Carnac Island was also established in 1837. Gibbs (1998) suggests that while these two stations were relatively small operations with no more than three or four boats at each station "…both companies had drastically over capitalized on buildings, jetties and other infrastructure…" (p 37). In terms of financial returns 1837 was a poor season. Gibbs (1998) has attributed this to crew inexperience and mismanagement. As a result the Perth Fishery was declared bankrupt and the operations of the Bathers Bay station were reduced (Gibbs 1998).

At Bathers Bay the physical evidence of this mismanagement was revealed in the 1984 excavations conducted by the Museum of Western Australia. The Bathers Bay tryworks was a relatively elaborate example; it was constructed from two different types of brick and consisted of three hearths (Figure 9). These were roughly 4.5 meters wide combined, with a single central chimney. The bricks used consisted of red, locally produced brick and yellow brick, which may have been a heat resistant variety imported from the eastern states or internationally. The brick was mortared with a yellow lime mortar, which was almost definitely produced from the local yellow limestone (McIlroy 1986).

Figure 9. Excavated, brick built tryworks, Bathers Bay (McIlroy 1986, p 47)

In addition to the Bathers Bay station Gibbs (1995) has located five additional Western Australian tryworks, two on the west coast and three on the south coast. Gibbs has identified trends in the materials used in the construction of tryworks along different sections of the Western Australian coastline. "All of the south coast tryworks only used the local granite..." while "At Castle Rock and Malus Island the local granite was also used, but with some brick quoining and edges" (Gibbs 1995, p 180). According to Gibbs, granite may either have superior thermal qualities in comparison to brick, or it may simply have been used as a cost saving measure. In relation to the Fremantle area of the west coast, Gibbs (1995) suggests that brick had to be used, as granite was not readily available and the local limestone was "…likely to reduce to powder under sustained heat…" (Gibbs 1995, p 183).

Victoria

The history of whaling in Victoria is at this stage less well documented than the other states of Australia where whaling occurred. Lennon (1998) discusses the activities of whaling and sealing parties at Wilsons Promontory, from a historic and archaeological perspective. The earliest historical accounts of whaling in Victoria date to the 1830s. There are two contradictory accounts which mention the activities of a Tasmanian Whaler, Captain Wishart. Details of the early whaling stations are scarce, and it is not until the pastoral industry starts to become established in the 1840s that more detailed and reliable accounts of whaling are made. The historical data indicates that whaling in Victoria during the 1840s was being undertaken by merchants based in Launceston rather than the better known operations out of Hobart. Archaeological evidence for whaling is similarly scarce, with evidence of a shore based tryworks occurring at one site within Refuge Cove. Lennon (1998) describes a square shaped granite structure at surveyed at Refuge Cove and suggests that it "…may have been the base of a tryworks…" (p 66).

South Australia

As was stated previously, the Sleaford Bay tryworks is one of two tryworks excavated in South Australia. The trial Bay whaling station operated for a single year in 1845 by Messers Hagen and Hart producing only a small yield of 25 tuns (Kostaglou and McCarthy 1991, p 14). The tryworks was excavated in 1998 by Heritage SA and Flinders University and since the excavation there has been no written report. The structural evidence found at the site was limited, consisting of three in situ red bricks, brick and stone rubble and localised burning (Figure 10).

New Zealand

Through an historical and archaeological survey, Prickett (1983) identified a number of different whaling sites on Kapiti Island New Zealand. This study was intended to investigate the nature of the relationship between whaler and Maori; therefore, the two tryworks that were identified have not been described in detail. In regard to the station at Tokomapuna, Prickett states, "A large mound of boulders immediately behind this beach marks the site of the former try-works" (Prickett 1983, p 59) (Figure 11). As the tryworks was not excavated the structural details remain unknown; however, surface evidence (described by Prickett 1983) suggests that the main building material was stone. At Te Kahuoterangi the tryworks is located close to the beach and is built from finished stone held together with a clay mortar. The structure is roughly one metre high and two metres wide and is believed to have held a pair of trypots (Prickett 1983, p 46).

In the summer of 1989-90 Prickett conducted another survey of whaling sites, this time at Hawkes Bay where 14 stations were identified (Prickett 1998). Only two of these stations had identifiable tryworks, the first was at Taylors Bay (Figure 12) where a "…brick and stone tryworks foundation is eroding out at the back of the beach" (Prickett 1998, p 52). The second

was the site of Te Hoe which was relatively well preserved and included "…seven hut fireplaces, a try-works foundation with stone flue, slipway, Maori living terraces and other features" (Prickett 1998, p 52).

Figure 10. Trial Bay Tryworks, 1998 excavation, facing North, (Photo by Cassandra Phillipou)

Figure 11. Unexcavated Tryworks Te Kahuoterangi, New Zealand, (Prickett 1983, p 48)

Figure 12. Eroding Tryworks Foundation, Taylors Bay (Prickett 1998, p 52)

Chris Jacomb (1998) reported on the shore whaling sites of the Banks peninsular, locating a number of whaling stations identified by historical research. The sites identified by Jacomb (1998) were all operating within the years1836 to 1849, making them more or less contemporary with operations at Sleaford Bay. At Little Port Cooper, and Peraki the archaeological evidence visible on the surface was difficult to interpret; however, Jacomb (1998) suggests that at Little Port Cooper an area of heat affected rock may represent the tryworks (Jacomb 1998, p 68). Similarly, at Peraki another area of fire cracked rocks located immediately behind the beach was believed to be the location of the tryworks (Jacomb, 1998, p 70). At Ikoraki whaling station Jacomb identified the remains of a tryworks which included "…the charcoal stained fire bowls, an iron support, presumably for the pots and the rusted remains of riveted iron tanks to either side" (Jacomb, 1998, p 71). At Oashore Jacomb (1998) suggests that "…an area of burnt stones, small fragments of burnt whale bone and rusted iron…" coincide roughly with the location of the tryworks on an 1849 survey map (Jacomb 1998 p 72). The best structural evidence of the Oashore tryworks comes from a photograph (Figure 13) taken in 1924 showing two trypots one of them still located within the stone built tryworks (Jacomb 1998, p 72).

Jacomb (1998) describes a number of different terraced areas at Island Bay, one of which "…has a rectangular area of fire-cracked rocks, many still in their original position…" (Jacomb 1998, p 73). This terrace is identified as the remains of the stone built tryworks shown in Figure 14.

In 1990 Campbell (1993a) conducted an historical and archaeological survey of whaling stations on the south coast of the south island of New Zealand. The survey identified fourteen different locations two of which were found to have tryworks platforms. The Waikouaiti station was established in "…1837 by Messrs. Long, Wright and Richards, and was purchased at auction a year later by Johnny Jones…" (Campbell 1993a, p 135). The location of the tryworks is known and the threat of erosion has also been noted. Campbell mentions a historic photograph of a tryworks at the site which suggests that it may relate to a later period of operation, in the 1870's.

Figure 13. Photograph of Oashore Tryworks, Taken by W.A. Taylor, 1924 (Jacomb 1998, p 72)

Figure 14. Island Bay Tryworks, Photograph from the Weekly Press, 15 December, 1900 (Jacomb 1998, p 74)

Joseph Weller established a particularly successful whaling station at Otakou in 1831 which operated for nine years and produced roughly 1500 tons of oil in that time. In 1990 the Wellers Rock tryworks was identified as being under threat of erosion and was excavated and recorded by Matthew Campbell in 1991. The results of the excavation were presented in his Masters thesis which is presently unavailable to this author. A profile drawing published in Campbell (1993b) indicates that there was very little of the tryworks structure remaining *in situ* (Figure 15). The article from which the drawing has been taken was presenting the results of chemical testing of charcoal residues and did not discuss the structural evidence in detail.

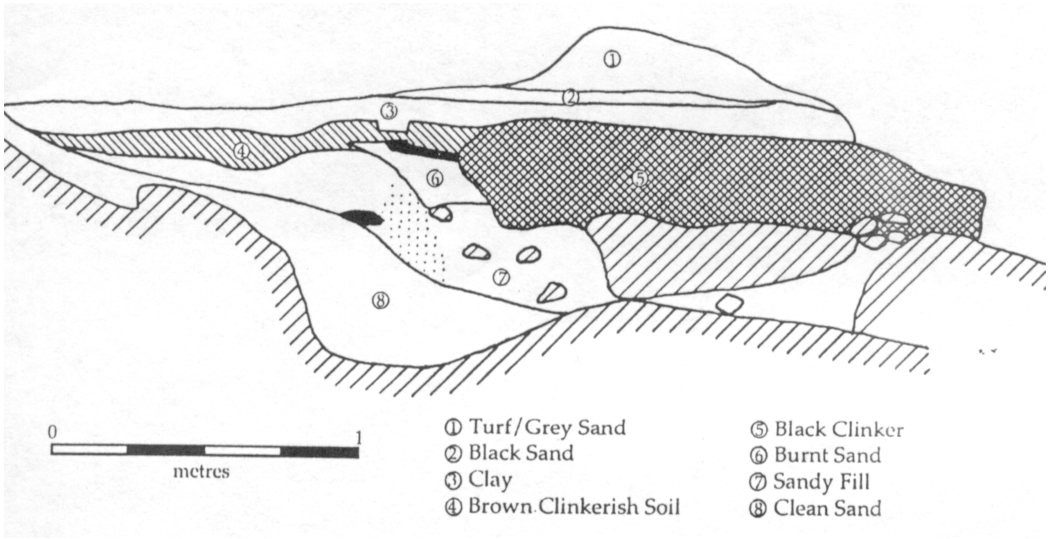

Figure 15. Profile Drawing of Wellers Rock Tryworks (Campbell 1993b)

Tryworks: A Persistent Technology

It is apparent that variation in the structural design of tryworks has occurred. This variation has been shown to occur over time within single locations as well as spatially between contemporary sites. The variation that did occur seems to have been of a minor nature, and functionally all tryworks had the same basic purpose. This was to support the trypots and to allow a constant heat to be maintained during rendering. The way in which this was achieved also appears to have remained unchanged, with a stone or brick built floor and walls supporting the pots and controlling the flow of air to the furnace fire.

In contrast to the structural design variation in the materials used in the construction of shore based tryworks has been much more marked. Unsurprisingly, locally procured stone appears to have been the most commonly used building material, as it would have required no capital to acquire. Furthermore, as many whaling stations were established in isolated locations without formal quays, transporting and unloading a cargo of bricks would have required a considerable amount of effort. Therefore, the use of stone may also represent an economy of effort. The use of building materials other than stone, such as brick can usually be explained within the local context. For example, the use of brick at Bathers Bay has been linked to the unsuitability of the local stone for furnace construction, while at Adventure Bay it has been linked to the location of the station close to Hobart.

Therefore while variation in the design of shore based tryworks did occur, it is suggested that it was usually quite minor and essentially remained unchanged for over three hundred years. As this stasis in technological development occurred during the industrial revolution, a period which was characterised by rapid technological change and innovation, it is suggested that tryworks should be conceptualised as a persistent technology.

5

The Sleaford Bay Tryworks: An Archaeological Investigation

The following chapter presents the aims, method, results and conclusions of a number of different forms of archaeological inquiry. While each of the individual sections has its own specific aims the general aim of this chapter is to gain a comprehensive understanding of the materials and methods used in the construction of the Sleaford Bay tryworks.

Previous Archaeological Work at Sleaford Bay

The first archaeological survey of the area identified the site as the Sleaford Bay "Station Complex" (Kostoglou and McCarthy 1991). Two functionally separate areas were identified: a habitation area located in the dunes behind the beach (Site A) and an industrial area including a tryworks and flensing platform located on the eastern side of the Bay (Site B) (Kostoglou & McCarthy 1991, p 17). A whip well was found close to the habitation area; however, its relationship to the site is not immediately obvious (Kostoglou & McCarthy 1991, p 17). Two fresh water streams were located near Site A; one flows year round from an aquifer while the other is a seasonal stream.

In 199, more detailed surveys of the structures at Sleaford Bay were carried out by Flinders University students (Bradbury et al. 1997). The results of the survey include detailed line drawings of seven structures located in the dune belt between the beach and the limestone cliffs (Bradbury et al. 1997 pp 58 - 66). These structures were mostly built from local limestone with some red brick being used, possibly in doorways (Bradbury et al. 1997, p 70). Given their small size it is probable that the structures may have been fireplaces or cellars attached to larger wooden structures (Bradbury et al. 1997, p 69). Detailed line drawings of the unexcavated tryworks, in plan and profile were also produced (Bradbury et al. 1997, pp 67 - 68). A baseline offset survey was later used to establish the extent of erosion along the seaward side of the tryworks between 1997 and 2001.

The 2001 Excavation of the Sleaford Bay Tryworks

The aims of the excavation

In September 2001, another team of archaeology students from Flinders University, under the direction of Dr Mark Staniforth, went to Sleaford Bay to determine the stability of the tryworks

platform. The team was accompanied by Heritage South Australia (SA) archaeologist, Terry Arnott. The location of the site on the coast prompted fears that it could be in danger of erosion. The main priorities for Heritage SA was to access the impact of erosion on the site between 1997 and 2001 and to take any necessary action to ensure that the tryworks remained intact. There was also an interest, shared by Heritage SA and Dr Staniforth, regarding the methods of construction of the tryworks. By excavating the site the structural details and the overlying stratigraphy could be recorded.

Excavation methodology

The Totalstation was set up on the top of the cliff above the site and triangulated using a survey mark on the eastern side of the bay and peg 1 from the 1997 survey. Peg 2 from the 1997 baseline could not be found, but it was re-established using the total station. The location of the tryworks site was measured at 0562799 East, 6136458 North plus or minus 5.6 meters using a Garmin hand held GPS. After an initial baseline off-set survey of the western, seaward side of the site, it became clear that the ocean had affected it. Approximately 0.5 metres had been eroded along the western edge of the site since the 1997 survey (Figure 16). It was then decided that the site should be excavated and recorded before it was damaged further.

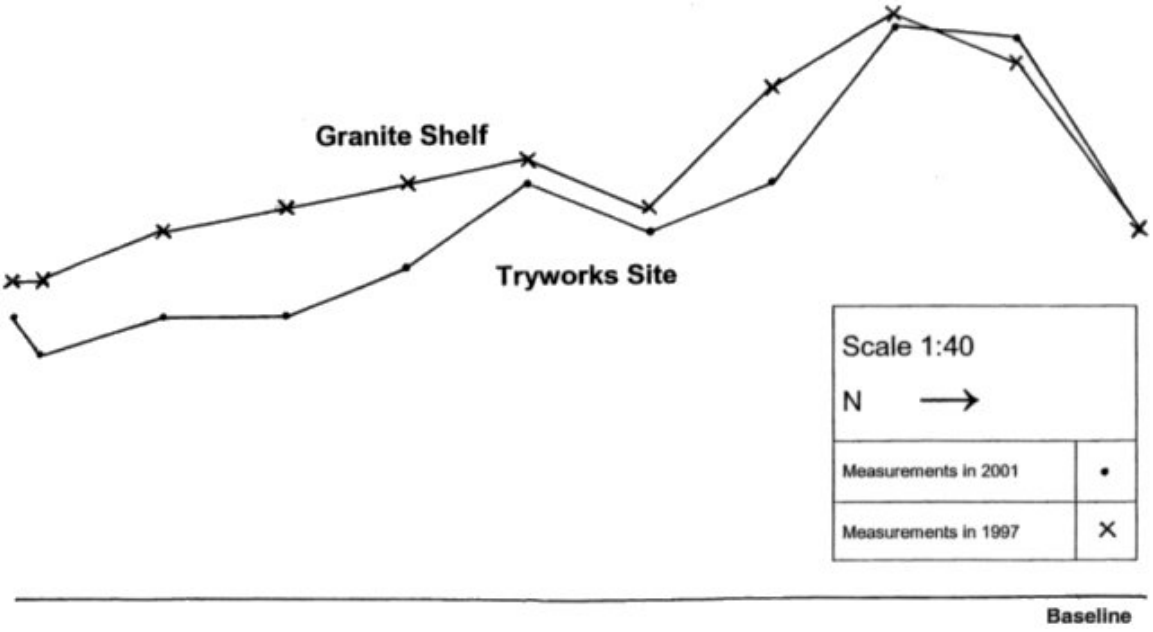

Figure 16. Plan of Site Loss Between 1997 and 2001 (Drawn by Charlotte North)

The team excavated and recorded the site over five days between the 23rd and 28th of September. A 3x2 meter trench was strung out within a 5x4 meter area using measuring tapes and Pythagoras' theory. The trench dimensions were subsequently surveyed using the total station. The trench was excavated in 5 cm spits which have been called contexts one to four, context one being the uppermost. Brick fragments which were not part of the tryworks structure were removed and assigned a context number. The number given to the brick was the context in which it came free. The spoil from every context was screened through 5mm mesh.

The first structural elements of the tryworks were uncovered during the excavation of context two. These were the lower courses of a brick pier. The bricks were laid end to end from east to west. During the excavation of context three it became apparent that the tryworks extended beyond the 3x2 meter trench (trench 1). Therefore, the trench was extended by 0.5 meters to the east (trench A) and 0.5 meters to the south (trench B). Context four was excavated down to the

floor of the tryworks which was on a slight incline sloping towards the ocean. Trench A and trench B were excavated down to the bottom of context four but did not uncover the edge of the tryworks. Therefore, two more trenches were added to try and determine the size of the tryworks. Trench C (0.5 x 0.5 meters) was excavated along the eastern edge of trench A, and trench D (1.0 x 1.0 meters) along the south eastern corner of trench B. These trenches successfully uncovered the southern and eastern edges of the tryworks. The northern edge of the tryworks remained unexcavated as there was a large limestone boulder restricting excavation in this area. Soil samples from the southern end of trench 1, context three and an samples of an ashy substance which was directly overlying parts of the tryworks floor were taken. A sample of a white gritty material found between the bricks was also recovered. Photographs were taken throughout the excavation using colour print and slide film. A plan of the trench was drawn after the excavation of context four, using a 1m by 1m drawing frame. As each student was only required to draw a 1m section and the excavation was occurring under time constraints, a 0.5 by 1m section of the trench was left unplanned.

After the excavation, measures were taken to minimise future damage to the tryworks. The soil was sieved before covering the site, then shade cloth was laid down and finally the rest of the soil and rocks from the spoil heaps were added. A sea wall was constructed from sandbags filled with concrete and reinforced with ¼ inch metal rods. The wall was built along the western side of the site in an attempt to protect it from erosion.

Results

Contexts one to four were essentially a single feature consisting of locally occurring sandy soil and a large number of brick fragments. The brick fragments most probably came from the piers of the tryworks which may have been pulled down to retrieve the valuable iron trypots. This feature directly overlies the floor of the tryworks (Figure 17).

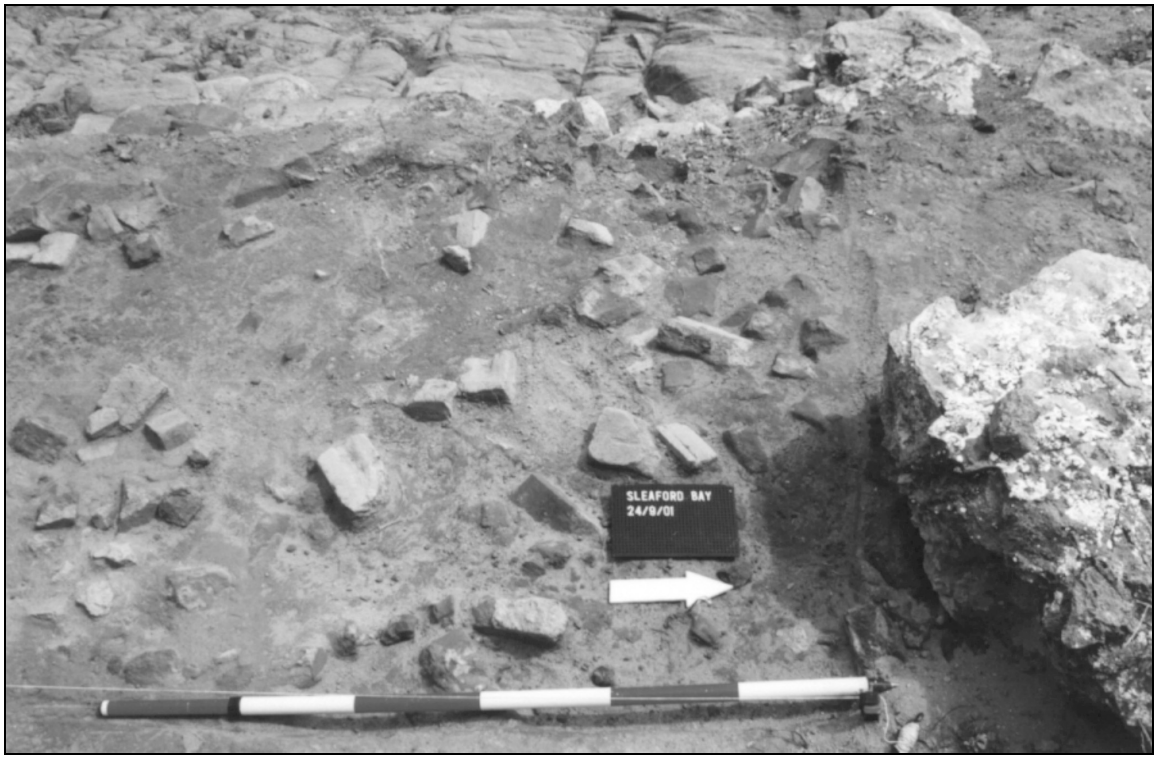

Figure 17. Context One, Northern end of trench 1, facing West, Sleaford Bay 2001 excavation (Photo by Stephen Keightley)

Several different materials were used in the construction of the tryworks. The floor of the tryworks was built from red brick, laid end to end, over a foundation constructed from large pieces of the local granite. This built floor was an extension of the naturally occurring bedrock, which was used as the floor along parts of the eastern side of the tryworks. A second type of brick with a frog was used to construct the central pier of the tryworks. The first course of the pier was laid end to end running from the western edge or front of the tryworks and was six bricks wide. The second course of bricks was laid perpendicular to the first and was two bricks wide. Roughly sixty centimetres to the south of the central pier there was a second projection of bricks laid side to side running from east to west. As it was so close to the central pier it is unlikely that this projection was the southern pier of the tryworks. Rather, given its location towards the back of the tryworks it may have been part of the back wall or flue. Three large burnt areas formed by the tryworks fires which would have sat on either side of the trypots. This burning has affected parts of the brick piers, the brick floor and the upper most parts of the stone foundation.

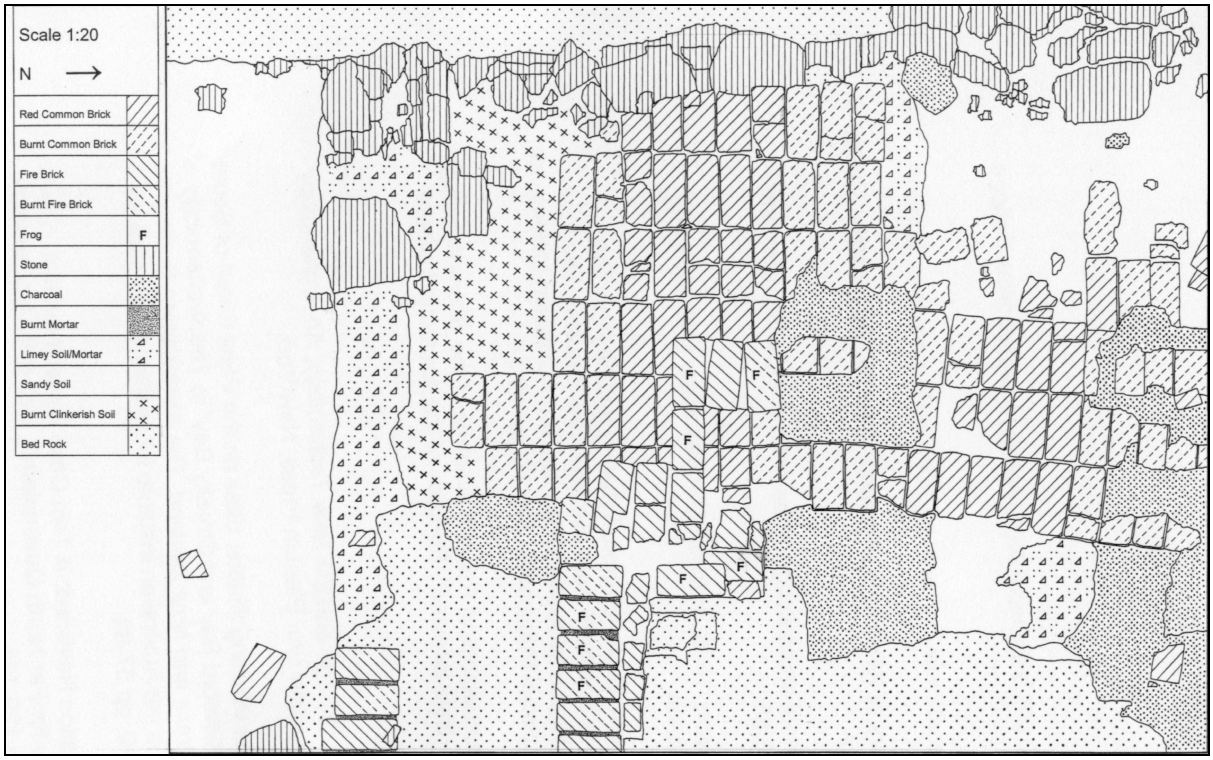

Figure 18. Plan drawing of tryworks, Sleaford Bay 2001 excavation, Trench 1, Trench A and Trench B, Context 4 (Drawn by David Sweeting, Emma Cook, Nicolas Grguric, Stephen Keightley Charlotte North and Adam Paterson, Final Drawing by Adam Paterson, October 28, 2004)

The profile along the western, seaward side of the site indicates that context four was directly overlying burnt sections of the stone foundation at the northern and southern ends of the site (Figures 19 and 20). As context four was not burnt it is suggested that bricks were removed from these areas of the tryworks floor post use. The irregularity of the brickwork along the southern edge of the tryworks floor and the presence of brick imprints in this area supports this suggestion.

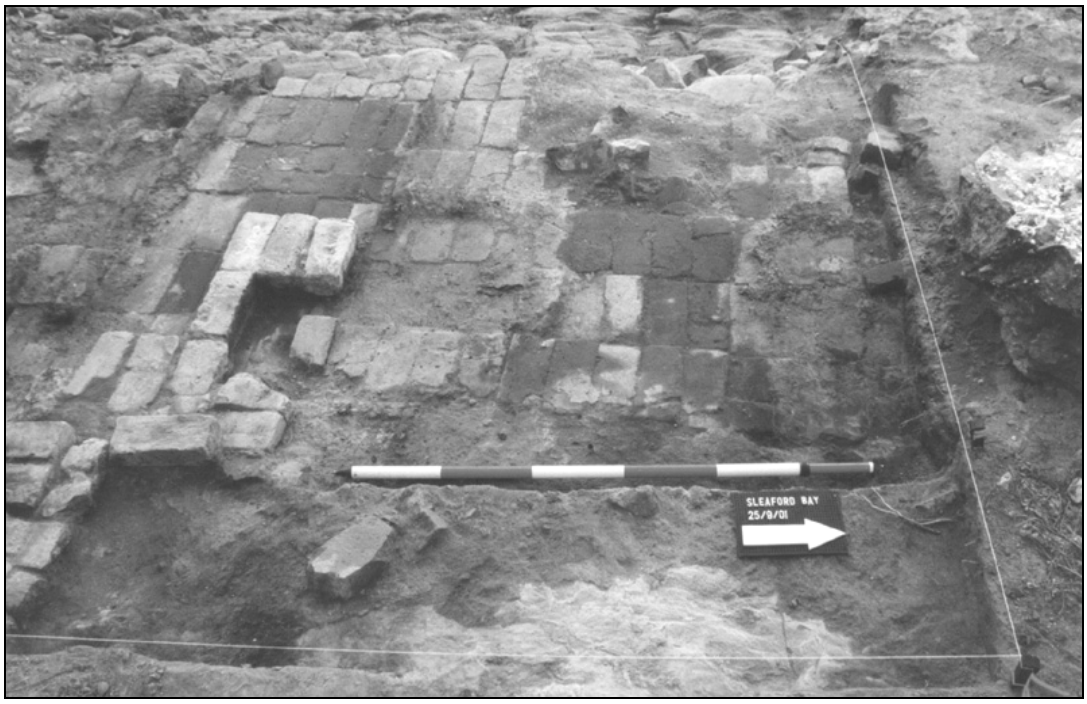

Figure 19. Tryworks Floor (Context 4) and Context 2, Northern End of Trench 1, and Trench A, Facing West, Sleaford Bay 2001 Excavation (Photo by Charlotte North)

Figure 20. Tryworks Foundation, Southern End of Trench 1, Facing East, Sleaford Bay 2001 Excavation (Photo by Luke Benbow)

In May 2004 Dr Mark Staniforth re-visited the site to access the stability of the seawall (Figure 21) and tryworks platform and found that the seawall had so far been effective in stabilising the site.

Figure 21. The Seawall, Facing East, Sleaford Bay 2001 Excavation (Photo by Mark Staniforth)

Three years after the excavation the sea wall is still intact and the active erosion of the tryworks has been halted. The details of the tryworks structure and the overlying stratigraphy have been recorded and are presented in detail within this study.

Follow The Yellow Brick Road: A Statistical Analysis of 455 Brick Fragments from the Sleaford Bay tryworks

Viewed simplistically, statistics is the collection and analysis of data in order to answer questions or test hypotheses to which the data are related (Weinberg S. and K. Goldberg 1990 p 1). In regard to archaeological studies, Clive Orton (1980) suggested that the data which is collected often does not directly test the hypothesis to which it is related; therefore, it is necessary to link the hypothesis to the data (p 19-20). This is achieved by describing the aspect of the hypothesis which relates most closely to the data in mathematical terms, allowing a comparison between the statistical data and the original hypothesis (Orton 1980, p 20). Best practice in archaeological research requires that as much detail as possible is recorded during excavation and artefact analysis even if it is not directly related to the initial hypotheses; occasionally this results in new questions being raised by the data. This is the process (illustrated in Figure 22), which has been applied in the following statistical analysis.

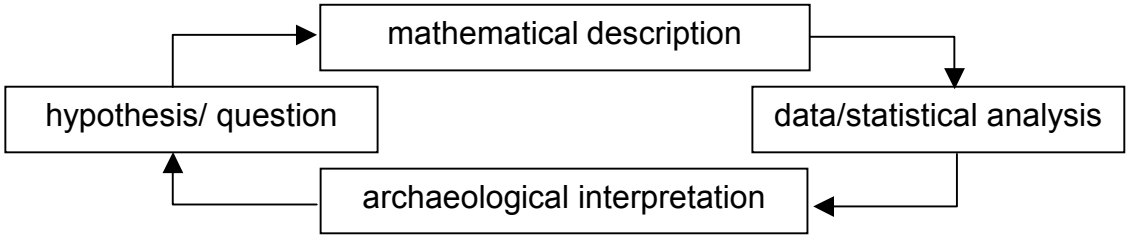

Figure 22. The statistical cycle (adapted from Orton 1980, p 20)

Aims and method

The aims of the statistical analysis of the brick fragments were:

1. To make a comprehensive and consistent record of the excavated brick fragments.
2. To determine if there were markings or other, possibly diagnostic features on the bricks.
3. To gain an understanding of how cultural and natural site formation processes may have effected the assemblage.
4. To demonstrate that there was an actual difference between the two brick types, which were identified during the excavation, and to quantify what these differences were.

A database was developed containing a number of different fields allowing the details of the brick fragments to be recorded. While the database was developed over time, those fields which have been revised or added to the database have been recorded for every brick fragment. The following is a description of the different fields used in the final database.

Brick ID number: This is an arbitrary number assigned to each brick fragment, allowing easy identification.

Context: The context in which the brick fragment was found, see section 7.2 for a detailed description of the contexts excavated

Trench: The trench in which the brick fragment was found, see section 7.2 for a detailed description of the different trench areas

Special brick #: An arbitrary number assigned by the excavator to any brick which they felt had special features worth noting, such as lettering or thumb prints

Markings:

Frog: A frog is a deliberate impression running down the centre of the upper face of a brick. Frogs act as a receptacle for mortar which increases the structural soundness of a built wall, y = a frog is observed, n = no frog.

Thumb prints: Many historic bricks have thumb prints pressed into their surface. This is associated with handling of wet bricks before firing, y = a thumb print is observed, n = no thumb print.

Lettering: Stamping bricks with the name or initials of the brickworks is a common feature of historical bricks, y = lettering is observed, n = no lettering.

Details: The letters observed are recorded here, if the letters depicted could not be made out then a "?" mark is entered.

Dimensions: The length, width and depth of all of the brick fragments have been recorded to the nearest millimetre, using a clear plastic ruler. An asterisk denotes a measurement of a manufactured dimension of the brick fragment. If there are no identifiable and opposite faces present, the length is the longest dimension of the fragment. The width is the longest measurement in the same plane as, but perpendicular to the length. The depth is the longest measurement perpendicular to the length and width measurements. If identifiable and opposite faces are present then the orientation of the unidentifiable dimensions are determined by those of the identified dimension.

Frag: This field has been used to denote if the artefact is a complete brick or is a fragment of a brick, y = yes, it is a fragment and n = no, it is a complete brick.

Weight: The weight of each brick fragment, measured to the nearest hundredth of a gram using an electronic scale.

Fabric:

Colour: The colour of each brick has been described with reference to the Munsel colour chart, indicating the notations for hue, value, chroma and the colour name. If there is more than one colour observed within a single brick then that which occurs most often is described here.

Second colour: If there is more than one colour observed then the second most profuse colour is described here.

Third colour: If there are more than two colours observed then the third colour is described here.

Describing the colour in this way documents the variation of colour within each brick. This variation is believed to have occurred for several reasons, discussed below in the Heat Effected/Unevenly Fired field.

Grainsize: This field describes the size of the majority of individual grains of lithic material which make up the fabric of each brick. The grainsize has been described as fin*e* = a grainsize of between 1 - 3 millimetres, or as very fine = a diameter of 1 millimetre or less (Figure 23).

Sorting: This field describes the degree of sorting which can be observed in the fabric of the bricks (Figure 24). If the fabric is well sorted then grains of lithic material which fall outside of the described grainsize occur infrequently; they are equal to or less than 2%. The fabric is described as poorly sorted when the grains of lithic material which are larger than the described grainsize make up more than 2%. This system of description is an adapted version of a geological method for describing sedimentary rocks. It has been designed to allow the description of a limited number of fabric types found within the archaeological assemblage.

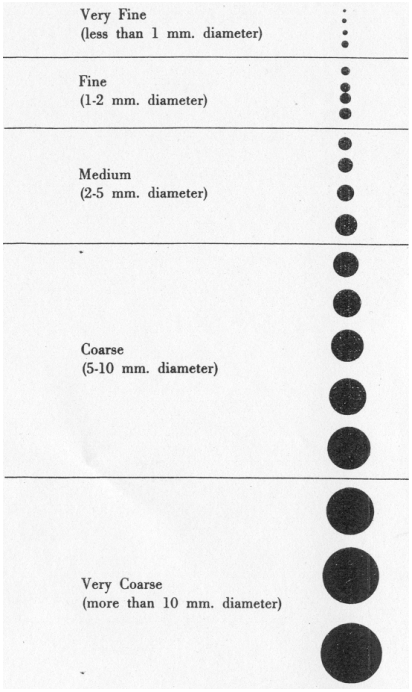

Figure 23. Grainsize Chart
(Munsell Colour, 1998, p 5)

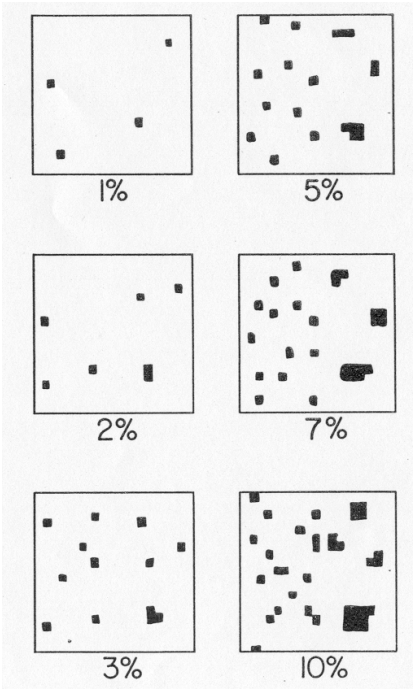

Figure 24. Degree of Sorting
(Munsell Colour, 1998 p 9)

Inclusions: For the purposes of this study inclusions are pieces of lithic or other materials which are 5mm across in one or more dimensions.

Air bubbles: This field describes if there are air bubbles within the brick fabric, n = no, there are no bubbles, y = yes, there are bubbles.

Method of Manufacture:

Mould marks: The moulds used in the manufacture of handmade bricks often left regular lines or markings on the brick surfaces.

Hack marks: Hand made bricks often have random markings, or hack marks on the surface of the brick.

Fold marks: This field records the presence of a characteristic pattern of folds on the surface of the brick which form as the clay is dragged down the surface of the mould.

Sandy surface texture: The surface of hand made bricks often have evidence of the sand used to line the moulds.

Burnt: This field indicates if any portion of the brick has been directly burnt, which typically leaves a black sooty residue on the brick surface, n = no, the brick has not been burnt, y = yes, the brick has been burnt (Figure 25).

Figure 25. Burnt Common Brick Fragment (Left) and Burnt Fire Brick Fragment (Right) (Photos by Matt Schlitz)

Heat effected/unevenly fired: Variation in the colour of the brick fragments can be interpreted in two ways; it may have occurred due to inconsistencies during the manufacturing of the brick or as a result of exposure to the furnace fire. This field records if the brick fragment has been affected by either of these processes but does not differentiate between them, therefore it is not discussed in the results presented below.

Weathering: This field indicates if there is any evidence of the brick being weathered, ranging from pitting on the brick surface to heavy weathering.

Lime burnt onto the outside: This field describes if there is a thin light green, glossy substance on the surface of the brick, n = no, there is no thin green layer, y = yes there is a thin green layer. It is believed that this thin green glossy layer is lime mortar which due to the heat of the tryworks fire has been fused to the surface of the bricks. This suggestion is based on the use of lime as a glaze in pottery production (Hodges 1989, p 44, 49) (Figure 26).

Figure 26. Common Brick Fragment with Lime Fused Onto its Outside Surface (Photos by Matt Schlitz)

Brick type: This field was used to differentiate between the two brick types in the assemblage. The names given to the two types are firebrick and common brick. This distinction was based on observations of a number of different elements of the brick fabric particularly the colour of the bricks and physical differences in the fabric of the two brick types. The common brick fabric was found to be friable in comparison to the vitrified fabric of the firebricks. The name firebrick has been applied somewhat arbitrarily; however the validity of its usage is demonstrated by the statistical analysis presented below. When the brick type could not be identified n/a was entered.

Figure 27. Common Brick (Left) and Firebrick (Right) (Photos by Matt Schlitz)

Statistical methods

The following statistical methods were applied to the common and firebrick sections.

The data was sorted with reference to specific responses in all of the fields except for the trench number, and colour fields. This allowed the number of brick fragments for each specific response to be calculated and expressed as a percentage. Chi squared tests were used to determine the probability that differences between the two brick types occurred by chance. This value is expressed as a percentage and is also known as the level of significance. The standard accepted level of significance is five per cent or below. Chi squared tests were chosen as they are useful when comparing unquantifiable data sets, such as yes/no answers. The Chi squared calculations were done using *Microsoft Excel*.

The measurement of the manufactured depth of each brick type was sorted and the frequency with which each value occurred was calculated. At this point it became clear that there were two

peaks in the manufactured depth measurements of the common brick group one at around 62 mm and another at 52 mm (Appendix 1). While it was acknowledged that the size of hand made bricks did vary within a single batch, a depth of 52 mm was outside of the usual size range for bricks of this period (Bell 1998, p 23). Therefore this patterning was investigated by splitting the common database into two sections, a small and a large group. This was done arbitrarily with all measurements of 57 mm or greater being included in the large group, 57mm was chosen as it was the mid point between peaks. The data was then sorted with reference to specific responses in all of the fields except for the trench number and colour fields. The number of brick fragments for each response was calculated and expressed as a percentage. Chi squared tests were used to determine the level of significance of any differences between the two groups.

The weights of all of the brick fragments from each type were sorted by value and the frequency with which they occurred was calculated. As there were a large number of unique weight measurements within each type, it was necessary to group the data by applying an arbitrary range of 0.2kg increments. These values have been tabulated and are presented graphically in the results (Appendix 1). The average weight of both brick types was calculated and a two-tailed t-test was used to calculate the level of significance of the difference between the two types. Two tailed t-tests are useful when comparing quantifiable data sets when the expected difference between the data sets is unknown. The t-test calculations were done using *Microsoft Excel*.

Results

Sixty-four of the firebrick fragments were found to have frogs, thirty of these had lettering stamped into them. The letters which were identified were I. B. W. It is suggested that the I is the first initial of the manufacturer, while the B.W. stands for Brick Works. Between 1837 and 1842 there were no brick manufacturers in Adelaide whose name began with the letter I which suggests that they were not locally produced. At this stage little more can be said about their origin other than given the nature of colonial trade and the whaling industry in the 1830s and 1840s they could have been shipped as ballast from just about anywhere. None of the common bricks had frogs or lettering.

The fragmentation by weight graphs (Appendix 1) indicate that there is a greater spread of weights recorded for the common brick fragments than the firebrick fragments. However while both graphs are negatively skewed the common brick graph is more skewed indicating that on average there were more common brick fragments in the smaller weight ranges when compared to the firebrick fragments. This suggests that the common brick fragments were more fragmented than the firebricks. A comparison of the average weights of the firebrick and common brick fragments supports this suggestion. The average weight of the firebrick fragments was found to be 0.16 kg heavier than the common brick fragments, indicating that the firebricks were more durable and less prone to fracturing than the common bricks.

The data recorded in the burnt and lime burnt onto the outside fields is indicative of nearness to the furnace fire. Only 33 per cent of the common bricks were burnt compared to 43 per cent of the firebricks. The significance level of this difference was six per cent, one per cent above the arbitrarily defined accepted level of significance. Similarly, only 7 per cent of the common bricks were found to have lime burnt onto the outside compared to 21 per cent of the firebricks. The level of significance of this difference was less than 1 per cent. When considered together these two data sets suggest that the firebricks were more affected by the furnace fire.

The patterning in the manufactured depth of the common bricks suggests that there may have been two separate brick types within the common group. Further investigations of the difference between size groups were inconclusive. This was due to the nature of the data as well as the

results of the analysis. Differences between the two size groups which were found to be significant such as the presence of mould lines could be explained by inconsistencies in the manufacturing process rather than any real or intentional differences.

A final point which should be made is that only 5 bricks with complete length, depth and width measurements were found within contexts one to four during the 2001 excavation. When this is combined with the evidence of bricks being removed from the floor it seems likely that complete bricks were also taken from the walls and piers of the tryworks.

A number of diagnostic features of varying significance have been identified including mould lines, hack marks and fold lines as well as the lettering stamped into the frogs of the firebricks. The two brick types identified during the excavation have been shown to differ on a number of grounds. The fire bricks were frogged, were more durable and were more affected by the furnace fire. It is suggested on these grounds that the terminology firebrick is appropriate as they were not only more suitable to this role but they were actually being used in this capacity.

Mortar Analysis

The following is an abridged version of a comprehensive report (Appendix 2) of the analysis of the mortar sample recovered from the site by Richard Smith and this author using a method developed by Pam and Richard Smith (Smith & Smith 2004).

Aim and method

The aim of the analysis was to determine the composition of the mortar and to compare the sand filler to the locally occurring sand to establish if they were from the same environment.

Essentially the method involves dissolving the lime portion of the mortar in dilute hydrochloric acid and observing the rate of effervescence at one minute, five minutes, one hour and twenty-four hours. After twenty-four hours the residues are observed microscopically. This methodology allows the presence of lime, Portland cement, sand and other fillers to be determined. It also allows for observations regarding the morphology of the sand and fillers to be made. The sand residues were then compared to those of the local environment taken from context 3 of trench 1, to determine if they were from a similar source environment.

Results

The mortar was found to be lime mortar with no Portland cement. The residue was found to be poorly sorted and highly angular river sand with some accreted inclusions. The locally occurring sands were small, well rounded and well sorted which is indicative of a beach environment.

Conclusion

The difference in the morphology of the mortar residues and the local sands suggests that the sand used in the mortar was deliberately brought to the site for the construction of the tryworks. River sand is commonly known to have the best properties for use in mortar and other cements therefore its selective use seems to indicate that a sound knowledge of building methods was implemented.

6

Discussion

During the 18th and 19th centuries the increasing mechanisation of industry and an associated increase in urbanisation in Western Europe increased the demand for whaling products, particularly oil. It was this demand which led to the establishment of the Australian and New Zealand colonial shore based whaling industry. As the Sleaford Bay whaling station was a part of this colonial industry, it follows that the developing world economic systems of which the trade in whale oil was a part were instrumental in its establishment. The economic plans of the South Australia Company were largely based around long term investments such as banking, grazing and wheat production; however, they saw whaling as an opportunity to make quick profits and cover initial costs in their other investments.

It is clear from historical accounts that there was considerable social tension between the whalers and the managers of the South Australia Companies whaling stations. The whaling operations of the South Australia Company faced many difficulties, including, opposition from foreign and other Australian colonial whaling vessels, and an absence of whales from the bays of South Australia. The ineptitude of the managers of the South Australia Company's whaling operations had a direct effect on the success of the stations during 1837 and 1838. The tendency of the whalers towards drunkenness, violence and desertions were perceived by the managers to have had a considerable effect on the success of the operations. By 1839, the year that the Sleaford Bay whaling station was established, David McLaren the Manager of the South Australia Company's whaling operations and the directors of the company were ready to withdraw from whaling altogether.

The structural design of tryworks has been shown to remain relatively unchanged between the 1550s and the later 19th century. While local variations in the materials used to construct the tryworks did occur, these have usually been explained with reference to the local environment or economic context. The level of structural sophistication required to build a functional tryworks was actually quite basic, and although a number of relatively elaborate examples are known, all tryworks performed the same basic function which was to hold the trypots and to control the heat of the furnace fire.

The Sleaford Bay tryworks was well built; its continued survival in such an exposed location is evidence of its structural soundness. The substantial foundation, well laid brick floor and deliberate selection of river sand for use in the mortar, suggests that the builders had a sound understanding of construction techniques. The use of the more durable firebricks in the construction of the piers is a further indication of the knowledge and planning which was invested in the tryworks. A large number of brick fragments in the overlying stratigraphy

suggests that the original structure would have been much more extensive. Based on comparative evidence from other tryworks the piers were probably about one to one and a half metres high. Unlike the other brick built tryworks discussed in chapter 6, the use of brick at Sleaford Bay is difficult to explain in terms of an availability of resources. As there was an easily accessible supply of granite at Sleaford Bay, brick was not necessary for the construction of a tryworks. The transportation of brick as ballast would have been relatively inexpensive; however, in 1839 Sleaford Bay was not close to an existing port and the effort required to unload and transport them from the beach to the industrial site would have been great. The question which the archaeological evidence draws us to is, why expend so much energy unnecessarily?

The historical evidence suggests that by 1839 the managers and directors of the South Australia Company were less than enthusiastic about the future of their whaling operations. Therefore, it is unlikely that they would have supported the construction of a tryworks of such exceptional quality based on the expectation of greater success in future years. While Captain Hart was more optimistic about the potential of the Sleaford Bay whaling station he is reputed to have had a sound understanding of the whaling industry and presumably of the practical requirements of a functional tryworks. Therefore as practical and economic forces did not predictate the use of such an elaborate design it seems reasonable to suggest that it may have served an additional social purpose.

Perhaps the answer lies in the nature of whaling and the relationship between the whalers and the station managers. Desertions, drunkenness, and violence were a major concern for the managers of the South Australia Company. All of these behavioural traits have been related to the idleness experienced by whalers during the long periods between whale sightings. By employing the whalers in the construction of the tryworks, it would have kept them busy and away from their rum. Furthermore, it would have required a high level of cooperation which was a necessary feature of successful whale boat crews. Therefore, it is suggested that the construction of the Sleaford Bay tryworks was an effort in relieving the social problems associated with whaling.

7

Conclusion

The Secondary Research questions have been answered in the following ways:

> Has tryworks technology changed over time, and, if so, how has it changed or remained the same?

Based on the evidence discussed in chapter six, tryworks have been shown to be a persistent technology, or in other words their function and the way in which they achieved this did not change over time. While the basic function and design of tryworks remained unchanged the materials used varied considerably. This variation has often been related to the local environment, particularly the availability of resources such as suitable stone for furnace construction or an easily accessible supply of bricks.

> What were the materials and methods used to construct the Sleaford Bay tryworks?

Local Granite was used to construct the extensive foundation, red common bricks were used to construct the floor of the tryworks and a harder more durable yellow fire brick was used in the construction of the piers and back wall of the tryworks. Lime mortar containing river sand which was brought to the site from another location was used to bond the brick work.

> How is the Sleaford Bay tryworks different or similar to other known shore based tryworks?

Compared to the majority of the tryworks discussed in chapter six, the Sleaford Bay tryworks was structurally one of the more elaborate examples, considerable planning and effort were expended in its construction. The use of brick in the construction of shore based tryworks was not common, and unlike the other brick built shore based tryworks discussed in the literature its use at Sleaford Bay did not make sense in terms of an availability of resources.

The primary research question has been answered in the following way:

> What are the social, economic and practical forces which led to the construction of a brick built tryworks at Sleaford Bay, South Australia, 1837-1841?

The demand for whale oil was the major economic force which led to the construction of the Sleaford Bay tryworks but did not directly influence the design or materials used. As the use of brick was not a necessary feature of a functionally viable tryworks and an easily accessible source of suitable building material was present at the site, there were no identifiable practical forces which would have led to its use. Rather, it is suggested that the extensive use of brick in

the construction of the Sleaford Bay tryworks is a physical manifestation of social tensions between the whalers and the managers of the station. Specifically it was an attempt by the managers to exert control over the whalers and limit the effect of those aspects of whaler behaviour which were perceived to be detrimental to the success of the whaling stations.

Limitations and Future Directions

As the density of the different brick types was not known the comparison of fragmentation by weight may been flawed. While it seems unlikely that the findings of the analysis would change significantly if the density was known, it does create some doubt. Therefore, it is suggested that further analysis of the strength of the brick fabric should be undertaken. The suggested methodology is unconfined compressive testing of a selected sample of bricks (Zsembery, S. 1991 p 8-10). This methodology will allow the conclusions made within this thesis regarding the difference in the strength of the two brick types to be tested and quantified.

The observed differences in the manufactured depth of the common brick type could not be confirmed or disproved through a statistical analysis of the data. It may be possible through the preparation of thin sections to identify if there are differences in the minerals present in the clays of both groups (Hodges 1998, p 199-200).

While it has been suggested that between the 1550s and late 1800s tryworks were a persistent technology, it is acknowledged that the data which has been discussed in Chapter 6 does have limitations. Many of the examples presented above have not been excavated; therefore, the details of the materials and methods used in their construction could not be discussed. In addition it has not been possible to include archaeological data from the very earliest phase of commercial shore based whaling in the Bay of Biscay, and, as a result, technological development which occurred during this period remains unexplored. Finally, due to limited space and time it was not possible to explore the causes of the persistence in tryworks technology; however, it would certainly be a useful direction for future research.

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Apendix 1:
Statistical Analysis

Table 1. Comparison of Common Bricks and Firebricks

Field	Common		Firebrick		Significance
	# Bricks	% of Type	# Bricks	% of Type	
Complete Length Measurement	5.00	1.42	0.00	0.00	
Complete Width Measuerement	92.00	26.14	67.00	68.37	
Complete Depth Measurement	215.00	61.80	88.00	89.80	
Thumb Print	11.00	3.13	1.00	1.02	0.2527278
Frog	0.00	0.00	64.00	65.31	0.0000000
Lettering	0.00	0.00	30.00	30.61	
Complete Brick	7.00	1.99	0.00	0.00	0.1594265
Inclusions	37.00	10.51	78.00	79.59	0.0000000
Burnt	115.00	32.67	42.00	42.86	0.0613056
Heat Affected/Unevenly Fired	191.00	54.26	82.00	83.67	
Weathering	311.00	88.35	40.00	40.82	0.0000000
Lime Burnt Onto Outside	26.00	7.39	21.00	21.43	0.0000582
Hack Marks	47.00	13.35	6.00	6.12	0.0495597
Fold Marks	3.00	0.85	43.00	43.88	0.0000000
Mould Marks	75.00	21.31	6.00	6.12	0.0005393
Sandy Texture	15.00	4.26	0.00	0.00	0.0376638
Air Bubbles	342.00	97.16	98.00	100.00	
Well Sorted	350.00	99.43	90.00	91.84	
Very Fine	350.00	99.43	98.00	100.00	
Context 1	96.00	27.27	44.00	44.90	
Context 2	82.00	23.30	14.00	14.29	
Context 3	101.00	28.69	23.00	23.47	
Context 4	28.00	7.95	5.00	5.10	
No Context Recorded	45.00	12.78	12.00	12.24	
Total # Bricks by Type	352.00		98.00		

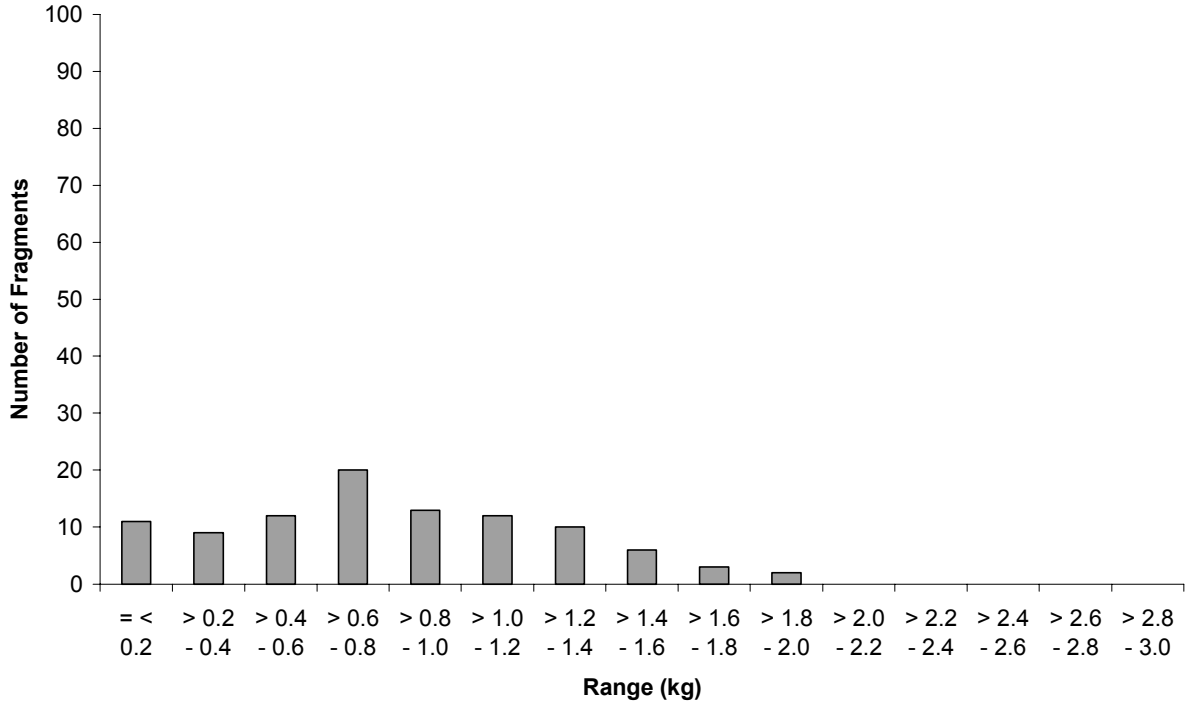

Figure 28. Firebrick, Fragmentation by Weight Profile

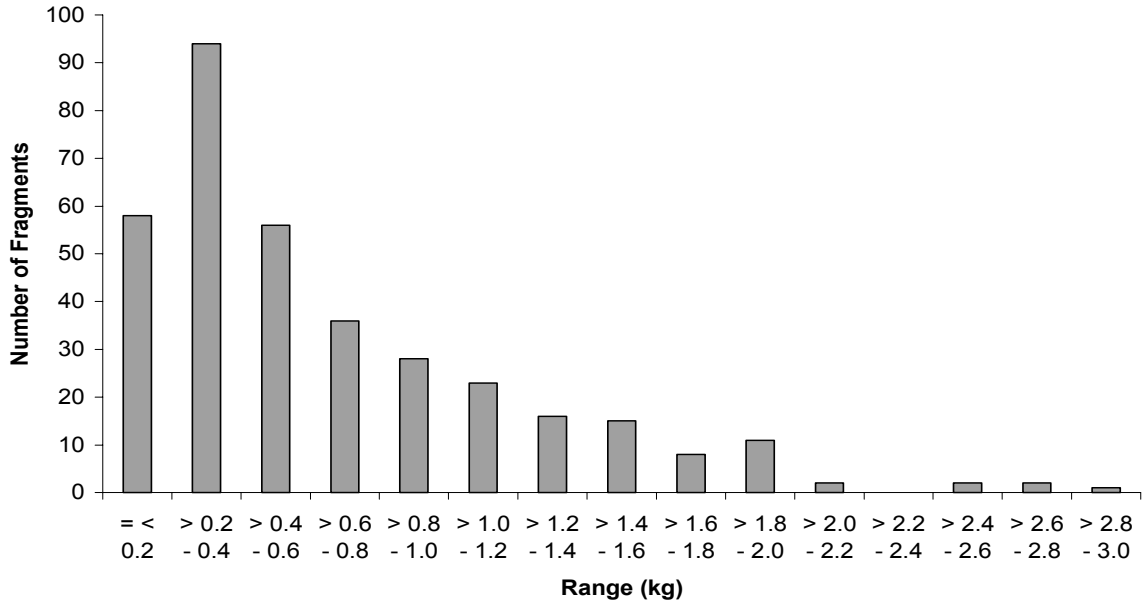

Figure 29. Common Brick, Fragmentation by Weight Profile

Table 2. Average Weight of the Common and Firebrick Fragments

Common brick		Firebrick		t test probability 2 tail unequal variance
# bricks	Ave weight (Kg)	# bricks	Ave weight (Kg)	
352	0.66	98	0.82	0.004

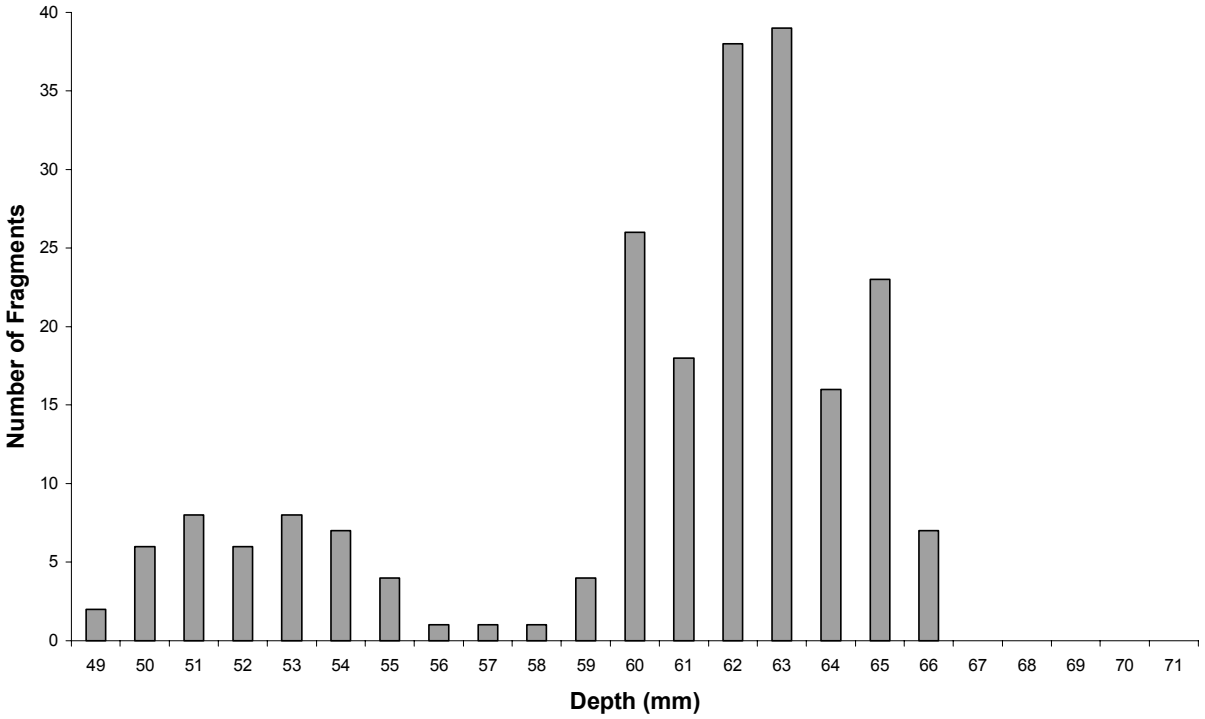

Figure 30. Common Brick Manufactured Depth Profile

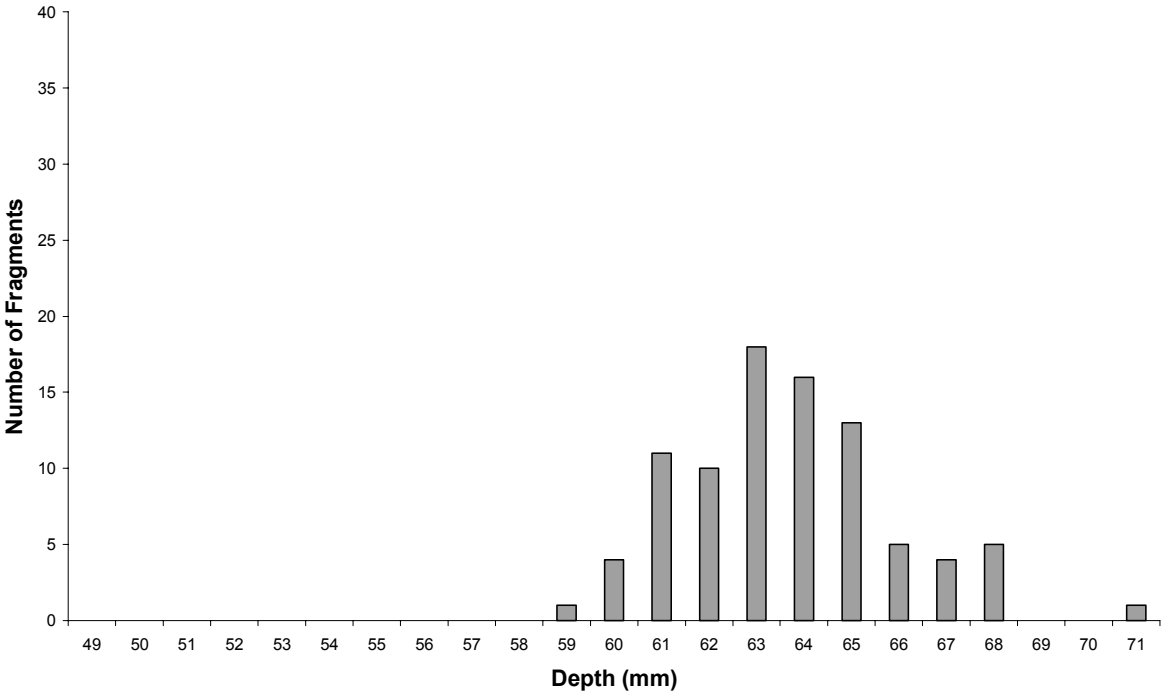

Figure 31. Firebrick Manufactured Depth Profile

Table 3. Comparison of Small and Large Common Bricks

Field	Small Common Bricks		Large Common Bricks		Significance
	# Bricks	% by Size	# Bricks	% by Size	
Complete Length Measurement	0	0	5	2.89	
Complete Width Measuerement	17	40.48	148	85.55	
Complete Depth Measurement	42	100	173	100	
Complete Brick	0	0	7	4.05	
Burnt	23	54.76	66	38.15	0.0499207
Heat Affected/Unevenly Fired	34	80.95	102	58.96	0.0080028
Lime Burnt Onto Outside	4	9.52	15	8.67	0.8612630
Weathering	40	95.24	138	79.77	0.0171971
Thumb Print	0	0	10	5.78	0.1105619
Hack Marks	12	28.57	30	17.34	0.0996201
Fold Marks	2	4.76	1	0.58	
Mould Marks	0	0	63	36.42	0.0000033
Inclusions	1	2.38	26	15.03	0.0264975
Sandy Texture	2	4.76	5	2.89	0.5398117
Air Bubbles	39	92.85	169	97.69	
Well Sorted	41	97.62	173	100	
Very Fine	42	100	172	99.42	
Context 1	16	38.1	26	15.03	
Context 2	9	21.43	42	24.28	
Context 3	10	23.81	61	35.26	
Context 4	2	4.76	18	10.4	
No Context Recorded	5	11.9	26	15.03	
Total # Bricks by Size	42		173		

Appendix 2:
Complete Mortar Analysis Report

Aim

The aim of the analysis was to determine the composition of the mortar recovered from the tryworks platform. The method stated below allows the presence of lime, Portland cement, sand and other fillers to be determined. It also allows for observations regarding the morphology of the sand or fillers to be made.

Method

The mortar recovered from the site was analysed by Richard Smith and this author using a method developed by Pam and Richard Smith as a means to identify different building periods in historic buildings (Smith & Smith 2004).

Approximately 5 grams of the mortar sample was immersed in 50ml of 10% (w/w) hydrochloric acid (HCl). Its reaction was monitored and the rate of effervescence and disintegration was described at 1 minute, 5 minutes, 60 minutes and finally after 24 hours. The residual granular material was washed four times by decantation with water before draining and allowing to dry in air at room temperature over 2 days. The information recorded at the intervals forms the data set which allows the categorisation of the mortar into lime mortar without Portland cement or lime mortar with Portland cement. Further important distinctions are made on the basis of size, variability in size and morphology of the grains in the building sands employed. After drying, the sand grains are transferred to a petri dish and are observed microscopically. Using a binocular Olympus microscope at 20X magnification fitted with a 0.05 mm graticule the sample was assessed for morphology (rounded and smooth grains versus angular crystalline grains and evenness of size versus substantial variability). Average grain size and variability was measured using the graticule on a sample of 50 grains randomly selected and randomly oriented. (Miln Walker & Assoc Pty, 2004 p 1-2)

A soil sample taken from context three at the southern end of the trench was also observed microscopically to allow for a comparison between the morphology of the grains. Due to the presence of an accreting substance the grainsize was not measured.

Results

Prior to testing the mortar was described as having a soft texture, and was white to off white in colour. The effects of the testing are presented in Table 4. Unaided observation of the residue

indicated that it consisted of grains of sandy appearance with occasional dark grains dispersed throughout.

Table 4. Disintegration rates and effervescence

Comment 1 1 minute	Comment 2 5 minutes	Comment 3 1 hour	Comment 4 24 hours	Description at 24 hours
Vigorous effervesence	100% disintegrated with small black inclusions			

Microscopic interpretation of residues

The grains were angular in appearance and were mostly clear to white in colour. There were also grains of a dark redish brown colour dispersed throughout. ccasional “conglomerate” particles made up of many fine grains were also observed. A substrate of very fine grains was observed but not measured. The mean grainsize was 4.786 graticule units or roughly one quarter of a millimetre, and the standard deviation was found to be 2.066152, suggesting that there was high variability in grainsize.

Microscopic observation of soil sample from context 3 Sleaford Bay tryworks

The grains are very small and rounded with little variation in grainsize. This is indicative of a beach environment. The grains were often bonded by some sort of accreting material the composition of which has not been determined. Given the light colour of the material and the immediate proximity of the limestone cliff it is likely that it contains some lime.

Conclusion

The mortar was found to be lime mortar with no Portland cement. The sand used in the mortar was highly angular river sand with some accreted inclusions. The grains from the soil sample were found to differ considerably from those of the mortar sample.

Appendix 3:
An Investigation of Possible Methods for Analysis of Tryworks Charcoal Residues

The charcoal samples were collected directly off of brick number 299. It was intended that the species of whale tryed out at Sleaford Bay would be determined from these samples. It was believed that this may have been possible as pieces of whale blubber from which the oil had already been extracted (known as 'fritts') were commonly used fuel for the tryworks fire. After consulting the literature it was found that there has been only one unsuccessful attempt to do so (Campbell 1993b). The method used by Campbell was to extract fatty acids from the tryworks ash using both, hexane and toluene, the extracts where then analysed using gas chromatography and mass spectroscopy (Campbell 1993b). The results where compared to library samples, and they compared favourably; however, based on the chemical analysis it was not possible to determine if the fatty acids originated from the whales tryed out at the site (Campbell 1993b). Therefore this method was excluded as a means of determining the species of whale tryed out at Sleaford Bay. Correspondence with Associate Professor C. Scott Baker of the School of Biological Science, University of Auckland and Dr Peter Spencer of the School of Biological Science and Biotechnology, Murdoch University established that as the sample was much burnt. It is highly unlikely DNA analysis will be possible. As a result DNA analysis has also been excluded as a possible technique and the tryworks ash remains untested.