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Sourcing Brickmaking Salting and Chemicals at Prestongrange

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PRESTOUNGRANGE UNIVERSITY PRESS
http://www.prestoungrange.org

FOREWORD

This series of books has been specifically developed to provided an authoritative briefing to all who seek to enjoy the Industrial Heritage Museum at the old Prestongrange Colliery site. They are complemented by learning guides for educational leaders. All are available on the Internet at http://www.prestoungrange.org the Baron Court's website.

They have been sponsored by the Baron Court of Prestoungrange which my family and I re-established when I was granted access to the feudal barony in 1998. But the credit for the scholarship involved and their timeous appearance is entirely attributable to the skill with which Annette MacTavish and Jane Bonnar of the Industrial Heritage Museum service found the excellent authors involved and managed the series through from conception to benefit in use with educational groups.

The Baron Court is delighted to be able to work with the Industrial Heritage Museum in this way. We thank the authors one and all for a job well done. It is one more practical contribution to the Museum's role in helping its visitors to lead their lives today and tomorrow with a better understanding of the lives of those who went before us all. For better and for worse, we stand on their shoulders as we view and enjoy our lives today, and as we in turn craft the world of tomorrow for our children. As we are enabled through this series to learn about the first millennium of the barony of Prestoungrange we can clearly see what sacrifices were made by those who worked, and how the fortunes of those who ruled rose and fell. Today's cast of characters may differ, and the specifics of working and ruling have surely changed, but the issues remain the same.

I mentioned above the benefit-in-use of this series. The Baron Court is adamant that it shall not be 'one more resource' that lies little used on the shelves. A comprehensive programme of onsite activities and feedback reports by users has been designed by Annette MacTavish and Jane Bonnar and is available at our website http://www.prestoungrange.org – and be sure to note the archaic use of the 'u' in the baronial name.

But we do also confidently expect that this series will arouse the interest of many who are not directly involved in

educational or indeed museum services. Those who live locally and previously worked at Prestongrange, or had relatives and ancestors there (as I did in my maternal grandfather William Park who worked in the colliery), will surely find the information both fascinating and rewarding to read. It is very much for them also to benefit – and we hope they will.

Dr Gordon Prestoungrange
Baron of Prestoungrange
July 1st 2000

David Anderson

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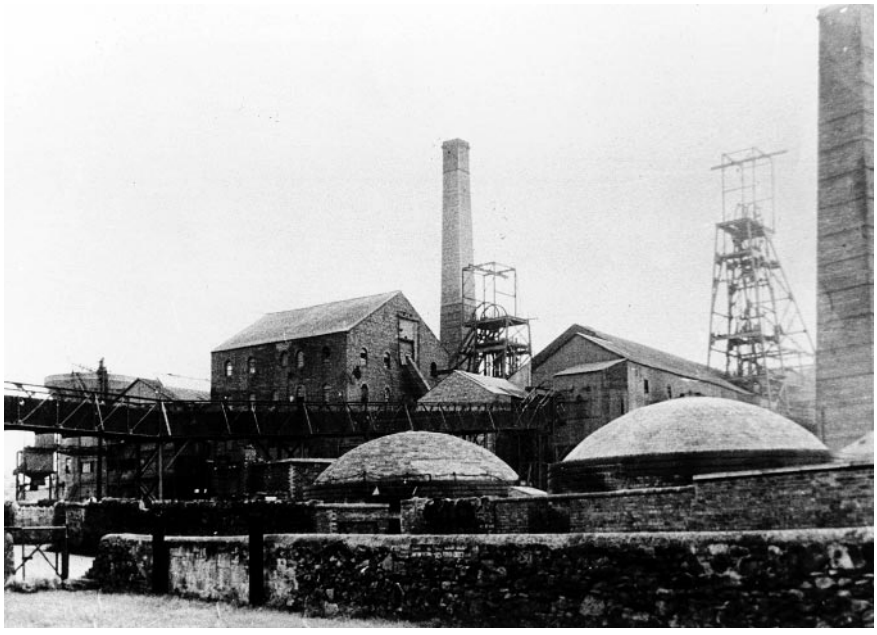

Colliery and Beehive Brick Kilns, Prestongrange Colliery
Scottish Mining Museum Trust

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INTRODUCTION

THE **REFRACTORY** (bricks, tiles, pottery and glass) and **chemical** industries (salt, acids, soaps and bulk chemicals) of Prestongrange and Prestonpans Parish are of great antiquity. They are inextricably linked, both amongst themselves and to the production of coal in the immediate vicinity and the availability of good water, both salt and fresh: in effect, an early integrated industrial complex. However, additional speciality materials had to sourced from outwith the UK. There are thus geographical and geological components to be considered in any assessment of their history and development. I understand pottery will be treated in a full paper by itself and so will only mention the subject where it impinges upon brick and tile making.

The industries under discussion can be considered to have a known history of at least eight centuries, although it would be natural to extrapolate certain aspects further back in time: thus salt, coal, and clayworking are likely to have been of importance at an even earlier period. Over the course of these eight centuries, the industries have employed substantial proportions of the local inhabitants in conditions which range (to the contemporary eye) from the barbaric to simply appalling. In general, primary producers (the actual workers) seldom enjoyed any rights over their produce, their lives being dictated by landowners and entrepreneurs. However, it is becoming clear that certain groups of workers, with special skills or expertise, might have been able to 'dictate' their terms, at least at some times. Some of the landowners and entrepreneurs were national figures, with significance beyond the confines of the immediate locality. Others were in advance of their time and initiated remarkable projects at the forefront of industrial development. All the industries under consideration are extinct in the Prestonpans and Prestongrange locality. Some survived into the twentieth century, but insurmountable economic, technological and cultural trends combined to lead to progressive closures. There is much that is beyond the scope of this brief; however, in attempting to draw together the story of these industries, pointers may be suggested for other researchers, who may desire to 'fill in the gaps'.

Treatment

Each theme will be developed on a chronological basis, tracking development across the years and highlighting key (or known) individuals or 'types' and characteristic products, methods or consequences of the industries. Key sites have been identified wherever possible and again, individuals are linked to places. The several themes are cross-linked wherever appropriate. Each theme is introduced to set its context and a conclusion attempts to summarise the impact of the industry locally, regionally, nationally, and further afield (if important).

Headgear at Prestongrange Colliery
Scottish Mining Museum Trust

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SALT

MOST ACCOUNTS of Prestongrange rightly begin with salt. However, they place the start of this industry with the proprietorship of Newbattle Abbey; this probably ignores a significantly longer association with the neighbourhood.

Chemistry and Technology

Brine is a complex solution of positive and negative solvated ions, generally about 3.5% of the whole by weight. By increasing the concentration of these ions, simply achieved by evaporation of the water, they will precipitate at different rates. First come relatively insoluble sulphates, mostly calcium sulphate in the dihydrate form: Gypsum. This often caused problems for unskilled salters – encrusted gypsum in the pan caused hot spots and hence both corrosion and uneven boiling, both increasing inefficiency. Then after further boiling comes sodium chloride, common salt, which comprises over 70% of the ionic content of brine. Precipitation by boiling yields 'sea salt' in 95–98% purity. 'Sunday salt', which crystallised in large plates when the pans were allowed to cool on the Sabbath, is of higher purity and was therefore prized, but needed to be ground before use. The impurities in sea salt, or Scotch salt, meant that imported 'Bay salt', first from Bourgneuf Bay in France and later from the Iberian Peninsula, was often preferred for the table. More will be said on the quality of salt. The remaining liquor in the pan contained hydroscopic calcium and magnesium chlorides and sodium and magnesium sulphates. These 'bitters'(alternatively 'bittern') hardly ever crystallised under normal conditions, although sodium sulphate sometimes precipitated on cold nights (when the pan fires were out). To early panners the bitters were a useless by-product, often thrown away, sometimes used as animal feed, sometimes used as a washing solution for window glass. During the seventeenth century chemists began to isolate the constituents of the bitters: the identification of Glauber's Salt, sodium sulphate heptahydrate, in 1624 has been taken to be the beginning of the chemical revolution of common salting: bottled in solution as Oil of Salt Liniment it

was one of the last products of the Scottish Salt Company in the twentieth century.

The amount of sodium sulphate could be increased by the action of sulphuric acid (see on) on common salt, when it is formed with the evolution of hydrochloric acid gas (it was also formed when low quality sulphurous coal was used to fuel the pans: the sulphur oxides formed by burning the coal react with brine and white encrustations of sodium sulphate grew round the pan rim). The action of sulphuric acid on the bitters increased the proportion of magnesium sulphate (Epsom salts), which then precipitated (also with the evolution of HCl gas). By the eighteenth century the range of salts refined at salt works with simple chemical processes had grown to include magnesium carbonate, magnesium chloride, magnesium oxide and others. By the nineteenth century salt was increasingly being used in the artificial formation of soda, which had supplanted natural alkalis in the soap and glass industries. In general, it can be said that diversification into the productive use of a once waste product helped to sustain the profitability of salting.

To win the salt, seawater had first to be collected and fed to the boiling pan. Often it rested in an intermediate 'bucket pot' above the tideline, where solids could settle (and a small amount of natural evaporation would take place). The pans were shallow and wide to maximise evaporation and heated from below by a dispersed bank of embers to evenly spread the heat. Once made of lead, iron plates were used for pans as soon as a practicable size of plate could be fabricated. In the sixteenth century there was a dearth of iron, which held back the industry – at this time there were as many as 38 pans in the immediate Prestonpans area. Limekilns Iron Works in Fife bore most of the demand for iron plates in the succeeding century. Empirical improvements appeared over the years, practical solutions to the mechanics of producing clean, dry sodium chloride. Alexander Hamilton's Salt Pans (Outlet designs, Edinburgh, c1980) describes some of these – creech cogs to collect the least soluble calcium sulphate, wells to drain the bitterns or concentrate of very soluble salts remaining when the sodium chloride precipitated, and the use of blood products to sequester organic matter, inadvertently drawn into the pans, so it could be drawn off. Further improvements included the introduction of 'Brander pans' by innovative saltmasters in the eighteenth century. Brander pans were fired from a furnace

(rather a raised firebed, an iron grille to support the fire, ashes falling through to be raked) instead of the simple ground level bed of embers under the traditional sole pans; they were also larger: both furnace and size meant they were more economical (at Grange Pans further up the Forth, Dr John Roebuck continued to experiment in the 1760s, producing a pan so large – it was 55 by 32 feet – that it required 10 men to tend it; it never really worked effectively and was only in operation for five years).

Imports of Cheshire rock-salt (via Liverpool) improved the purity of the final product and tripled the nominal output, allowing a draw every charge of the pan, but at the concomitant cost of buying what had been a 'free' raw material. The last real innovation was to mechanise the intake of brine, by means of force pumps driven by steam engines, saving on the labour of manually charging the pans (the economy won by installing pumps justified their capital expense). By the nineteenth century the fuel ratio of previous centuries, which had been somewhere between 6:1 and 8:1, was reduced to about 3:1; this was still much higher than that achieved by the Cheshire producers. The material produced even after all these changes was still of inferior quality, with a tendency to be deliquescent (absorbing atmospheric moisture), sometimes gray in colour, and sometimes bitter to the taste: all a consequence of impurities and the rate at which salting was forced. Experiments which slowed the process showed that fine quality could be achieved, but not at a competitive cost (although the last surviving panworks in Prestonpans, Mr Alexander's, produced salt of 'fine quality' by the mid-nineteenth century according to the New Statistical Account).

Outline History of Salt and Saltprestone

Salt extraction is one of humanities oldest technologies, with a rich northern European archaeological record. Hundreds of salt extraction sites have been recognised along coastlines and by brine springs, characterised by distinctive shallow ceramic pans. While many sites are reckoned to have been seasonal, familial operations, industrial scale sites have also been found. There is little doubt that this technology was adopted by the ancient peoples of the British Isles, both the Celtic peoples who occupied the Lothian area at the time of the Romans and their Anglian successors in the second half of the first millennium. Indeed, the Roman presence would provide a

stimulus for any salt extraction which then existed and the economy and organisational dictates of the Anglian kingdom would demand an input of salt.

It must be admitted that there is no direct evidence for any longer history, but it can be inferred from:

1. the presence of the Roman Inveresk Fort and the Celtic centres of Traprain and Edinburgh, all of which would demand commodities, and both cultures knew salt could be extracted from seawater;
2. Althammer House in Prestonpans, which recalls the name of one of the burgh's constituent villages and is an Anglian name, as is the first part of the oldest recorded name for Morison's Haven: 'Gilbert's Draucht' (where Gilbert is from the Old English Gislbe(o)rht; Black, Surnames of Scotland). Both suggest a considerable Anglian presence. Salt working might be expected to be a seasonal activity within the Anglians predominantly agricultural economy and
3. the charters to Newbattle Abbey can be read as the monastery succeeding to an already established estate; it was after all intended as a donation whereby the revenue accrued to the Abbey (and the goodwill of the Abbey accrued to the spiritual well-being of the De Quincys, the donors). For a translation see David Spence, Early Charters Relating to Coalmining, Transactions of East Lothian Antiquarian and Field Naturalists, 1984; and
4. the simple fact of the density of settlement and agriculture in the area creating a steady demand for salt.

Having mentioned the Abbey charters it must be noted that the Cistercians were no strangers to industrial developments, the improvement of their estates being a central imperative of their economy and culture. Newbattle was working saltpans on an industrial scale further up the Forth before Prestongrange was donated. Although there is no mention of coal mining in the first of the De Quincy charters, the specific mention of 'carbonneris' in the second suggests the inheritance of facilities which were already established. This is a key point: coal was being worked when the Abbey acquired the land and, although they were certainly involved in development of mining, there must have been a reason for the pits earlier existence. The De Quinceys, father and son, as the previous landowners may have had a hand in earlier developments.

The presence of the Abbey would certainly stimulate the large scale production of salt using comparatively cheap fuel (arable East Lothian was long cleared and had limited supplies of wood and peat, which were in demand for domestic use) and the brinier water of the Prestonpans shore. Better returns could be expected compared to their earlier operations. However, the basic operation of a pan was to remain unchanged for several centuries – even if the details of development remain obscure. Salting references are scarce in contemporary records but the religious houses and the crown secured possession of much of the industry and statutes were promulgated to protect the workers. At one time a Master of the Royal Saltworks existed; interestingly, the King's Pan Craig lies near Prestongrange, perhaps marking an early Royal saltworks. Occasional inferences might be drawn about the industry from other sources such as Treasury statements and Accounts, placenames and folk stories. The 'Salter's Way', the route from Newbattle Abbey to their lands and holdings around Prestongrange is an example of the latter. After the easy coal of the Great Seam outcrop near (the now) Bankton House had been exhausted the route reputedly saw a two-way trade of Eskside coal down and Pretonpans salt up. Salt appears in a list of regularly taxed goods at the burgh of Berwick in the period before 1303 and salt was reckoned to be one of the foremost exports of Scotland during the reign of James VI. There are more documentary sources surviving in the sixteenth century, when lay proprietors were a significant feature of the industry.

In the Prestonpans area the transition to lay ownership was almost universal. In the late fifteenth century Sir Nicholas Flemyn, chaplain at Seton Collegiate Church, was the occupier of a single pan at 'Saltprestone', and perhaps represents an intermediate stage as benefices were secularised and ownership transferred from Church to lay proprietors. Other saltworks were in the hands of burgesses (citizens of nearby burghs) and local 'indwellers' (a lower social ranking), c.f., the Achesons of Prestonpans. Most of the owners of the sixteenth century had single or double pan operations, essentially family operations or superintended by a Grieve: one such family can be traced in the Grant-Suttie Papers at the SRO. Thus, George Mott had charter of a saltpan from Mark Ker of Prestongrange in 1559. Many of these small-scale owners were to disappear as works were consolidated under the ownership of

landed proprietors. Next, a daughter of George Mott consolidated her sisters' shares, which they inherited in 1595, and sold on to Mark Achesone of Mylnehevin (Morison's Haven) in 1597 (GD1/402/28, et seq.). The Achesones were only one rung below the landed gentry and controlled the Abbey's old harbour. Some years later the pans passed from the Achesones (Sir Patrick of Clancairney) to Alexander Morisone of Prestongrange.

However, small scale undertakings remained the norm in the Prestonpans area (in later centuries an untypical position in the Scottish salt industry). Even most of the pans on Prestongrange Estate were in the hands of people of modest rank. For example in the early eighteenth century John Greig, indweller, and Richard Henderson, sailor. Others were merchants, both local and from Edinburgh. A total of eleven works around Prestonpans remained outside the hands of the landed proprietors in the early eighteenth century. However, their output has been estimated as only 2,000 bushels each per pan p.a. when the Scottish average was 4,500. The remaining works were on a considerably larger scale, c.f. the 40 pans owned and operated by the Winton Estates at Cockenzie and their individual outputs were higher.

The golden age of the Scottish salt industry lasted from the latter sixteenth century to the middle of the nineteenth. It has been the subject of a scholarly investigation by Christopher Whatley, who has assiduously assembled statistical and social information relating to the Salt Industry 1570–1850 (published by the Aberdeen University Press, 1987). Some of his key points include noting the low operational efficiency of everyday panning throughout most of the period (above), with occasional bursts of better performance when demand was up (e.g., the Napoleonic Wars) and towards the end of the period when efficiency was essential in the fight for survival against Cheshire rocksalt competition. Additionally, he makes it clear that the industry survived only because of the skill (and obstinacy) of the saltmasters in securing a virtual monopoly in the home market and manipulating and interpreting legislation to suit themselves. That this was done in the face of competition which destroyed a comparable industry on Tyneside, in the face of anti-competitive English legislation, and with a product which was notoriously poor, is remarkable. Scots salters could make high quality salt (see Sunday salt and slow evaporation, above) but the amount of time a

Scottish pan was down (for repair – beiting – or natural interruptions: storms damaging the pans and bucket pots or even weed clearing from the latter) meant that when pans worked they had to be driven hard, taking a draw every 24–28 hours. The scale of production is illustrated by figures compiled by Whatly. Thus, Forth Estuary saltworks produced 95% of Scotland's salt in 1716–17, of which Prestonpans parish (including Prestongrange) accounted for 29% (of that total; 67,400 bushels). At the end of the century the Forth's share had marginally declined to 88%, but the Prestonpans proportion within this had risen to 37.3% (107,500 bushels).

Whatly accounts for the landed interest, including the proprietors of Prestongrange, by considering both the gathering industrial revolution and the need of the estates for ready cash. Early industrial developments in Scotland were small scale, with the exception of the investments of the Board of Trustees in establishments such as bleachfields (inspired by Fletcher of Saltoun). Comparatively, saltworks once called for large investments – not just pans, but girnels, salters' housing, and reserves for unpredictable repairs. An estate could absorb these costs amongst their other operations. As the eighteenth century progressed and the industrial revolution took off, the capital stock tied in saltworks paled into insignificance. There was also a century long (slow) decline in demand and valuations decreased in real terms; quite markedly towards the last productive years of the industry. In the mid nineteenth century a working pan could be had for the annual rent of £50–60; only fifty years before pans could be let for several hundred pounds. In view of this decline, although it explains why estates absorbed pans as small scale operators succumbed to liquidity problems, another reason must be sought for the estates' interest in panning.

Most of the landowners in Prestonpans and its vicinity were coal proprietors: and the two industries were interlocked. Salt sales might make marginal mining operations profitable. Further, in the seventeenth and early eighteenth centuries income from salt could form a considerable part of an estate's cash income (Scotland was notoriously short of moveable capital and cash). At Prestongrange in 1716–17 (SRO CS 96/4520: Factor's Account Book of Prestongrange 1716–23), income from salt amounted to 63% of the non agricultural income, the rest being spread over coal, cloth, and bottles (the remnant product from Morison's glass-making enterprise). As

the agricultural income was predominantly in kind, cash from salt sales could go a long way towards plugging an estate's liquidity gap. So the Morisons of Prestongrange were at an advantage over their immediate inland neighbours. Their accumulated cash reserves were noted by Rev. Alexander 'Jupiter' Carlyle – William Morison was very rich, sufficiently so to fund a political career (although it all went in the bright lights of London and gambling dens). Other proprietors invested their salt revenues in improving and sinking coal pits, and subsidising their tied colliers when pits were inoperable (a frequent occurrence). The colliers, when unpaid and despite their unfree status, could be 'mutinous' and it was expensive to return absconders through law.

The saltmasters operated their industry to a background of distinctive legislation. By 1707, at the Union of Parliaments, a file of 361 pages of 'all statutes relating to salt' was drawn up. As well as quality, differential taxes, customs dues and other imposts meant that Scottish salt often competed against other supplies with 'one hand tied behind its back' in the eighteenth century export market. Lobbying, exercise of interest and political influence could turn the situation around in the home market and the landed proprietors were intimately connected with the Government of Scotland. Bay salt had been heavily taxed: in the 1650s a Colonel Aytkins and his colleagues, the tacksmen of the excise of Bay salt, were investigated for importation such that '*no other merchant finds a market*' (Records of the Conventions of Royal Burghs of Scotland, ed. JD Marwick, Edinburgh, 1866–90). An investigating committee was appointed and proposed an inhibiting tax of £12 Scots per boll. Thus, the saltmasters managed a virtual domestic monopoly throughout the eighteenth century, aided by times of dearth in other supplies for one reason or another. In 1687 it was observed that '*salt masters intend to make a monopoly*' prejudicial to Royal Burghs (Conv. of Burghs) and although the monopolists did not succeed then, the Convention was well aware it needed to be on guard against further attempts. One of the few uses to which imported salt could be legitimately put was to preserve fish, an exemption secured by another powerful lobby group. Despite public complaint, virtually all domestic salt had to come from Scottish pans. The saltmasters in the neighbourhood of Edinburgh also gained from the growth of the city; the salt wife walking to Edinburgh and hawking her wares through

the streets is a remembered figure. Steady sales there and to the immediate area were Prestonpans saltmasters' main market. By the Old Statistical Account (1796) there were 14 saltmasters and agents employing a similar number of assistants (persons employed in saltpans with their families totalled 47, giving between 10 and 15 able bodied adult male labourers). The statistical analysis of the account estimated a grand total of 205 workers in Scotland, the majority clustered on both sides of the Forth.

The salt proprietors grouped themselves into a Salt Association ('*the Proprietors of Salt Works on the Firth of Forth*' also known as '*the Society*') to co-ordinate action. As well as acting to restrict imports, they operated as a cartel regulating the output of domestic pans and 'fixing' domestic prices. Most small operators were ignored by the Society and even some of the landed proprietors felt no need to join (such as those with a nearby city market), but all benefited as the Society seldom had less than 55% of the industry in its own hands. Their strategy was simply to set an agreed output per pan to force up prices in their relatively secure domestic market. Quota breaking was enforced by fines, the confiscated salt sometimes being distributed amongst other producers but at other times dumped on export markets or the Icelandic fisheries. The Society remained strong until the last decade of the eighteenth century, having accomplished their objectives for about twenty years They managed a decline in output from over 300,000 bushels p.a. to around a quarter million while increasing prices from around 1/1d per bushel to 1/6d; as costs at a well managed pan were 9–10d this implies a profit of around 100% before the Society's tax of 2d a bushel. However, growing public disquiet at unfair pricing and a change in Government attitudes to taxes signalled changes. In Ayrshire, the Forth Society faced another threat: imported rocksalt. Their biggest challenge to the end of the eighteenth century had been keeping Cheshire competition out of Scotland. Now there were promoters who actively sought to supplant brine by refining rocksalt (and break the existing monopoly in their own interest). Despite plaintive appeals to Parliament and to patriotism, with a solemn undertaking to reduce domestic prices, the differential tax between English and Scottish salt was eroded in 1798, when the ratio was changed from 30% to 55%. Only the Napoleonic Wars now protected the industry, and other industrial users (e.g., chemists, bleachers and calico

printers) had gained as much economic clout as the Society; they all needed plentiful, cheap salt. Further, fisheries were being supported and developed by Government subsidies and their supporters argued against cumbersome official procedures involved in getting the salt they needed. With the arrival of peace in 1815, the writing was on the wall. In 1823 all duties were repealed; within two years, large legal shipments of rocksalt had arrived in Scotland and the industry was devastated. In the next generation, railway transport was just one more problem to overcome for the survivors.

The surviving nineteenth century salters, by now concentrated in Prestonpans, Joppa and Cockenzie, attempted to meet the competition by importing rock salt themselves. Added to brine it meant salt could be drawn on every boiling instead of the traditional 1 in 3. Pigot's Directory, 1825–6 tellingly records the survivors in that year:

Cockenzie:	Francis Cadell
Prestonpans:	Andrew Alexander
Cuthill:	William McLean
Cuthill:	Robert Laidlaw
West Pans:	Robert and George Gordon (Potters: a supply of glaze for their works?)
West Pans:	Nicol Watson
Joppa:	John Baxter & Company
Portobello:	Joseph Astley (Physical salts, a medicinal manufacturer)

By 1860 (Slater's Directory of Scotland) only the Cadells (now Hew Francis), Alexanders (now William), Joppa (now under Alexander Nisbet) and the pharmaceutical salter (now Robert and Thomas Smellie of the Wellington Chemical Works) were in business, but there was a slight resurgence a few years later (Slaters, 1867) with old works at Magdalen (Robert Irving) and Musselburgh Links (Alexander McKinley & Co), Pinkie Works (John Grieve; a coalmaster) reopened and joining the three other survivors. Perhaps the growth of brick and tile works was stimulating local production – vast amount of salt ware required as glazes, and quality wasn't a problem. However, any respite was short lived. By 1878 (Slater's) four works survived:

Cockenzie:	P&C Forman
Prestonpans:	William Alexander, John Sharpe, manager

Pinkie:	John Grieve
Joppa:	Alexander Nisbet & Son

Shortly afterwards, the Scottish Salt Company was formed, most surviving saltmasters becoming founding shareholders. When Peter McNeil came to write his History of Prestonpans (John Menzies, 1902), only William Alexander Meek was operating working pans, a twin unit. Under the Scottish Salt Company the surviving pans were able to carve out a niche. The quality of the salt was much improved, and in demand as coarse cooking salt. Oil of Salt and Saladine Ointments had their adherents and the Joppa pans diversified into pipeclay whiting (for doorsteps). The company survived for fifty years, coming through the Second World War only marginally reduced. However, although the demand for salt remained fairly steady, the company's other products were no longer selling. When the last Scottish salt pan closed in Prestonpans during 1959 (Cockenzie closed in 1939), no one could be found to repair it. At the same time, the supply of Cheshire rock-salt dried up (it was diverted to road spreading); an attempt was made to import salt, but it coincided with the pan failure and only one boiling was made.

After a few years spent packing English salt in Scottish Salt Company packets, the Company was wound up and the story of Scottish Salt came to an end.

3

CHEMICALS AND SOAP

Sulphuric Acid

IN THE MIDDLE of the eighteenth century a new industry began in Prestonpans. Two English scientists and entrepreneurs selected the area to develop a new process for making sulphuric acid (oil of vitriol). John Roebuck and Samuel Garbett are profiled in Appendix 1. The partners were already experienced in both commerce and technology: they raised the seed-money for their new plant from a gold recovery process in Garbett's home city of Birmingham, where they had also carried out the preliminary development work for the new plant. Their process revolutionised the production of the acid, slashing the price by a third and laying the foundations for an explosion in the heavy chemical industry. Their instinct for secrecy, commercial protection and patent avoidance led them to Prestonpans in 1749, where they set up the world's first successful large scale sulphuric acid manufactory. The presence in Edinburgh of one of Roebuck's old tutors, Professor Francis Home, who had experimented with sulphuric acid for linen bleaching and Lord Milton's (Andrew Fletcher of Saltoun) push for bleaching and linen making in Scotland through the Board of Manufactures were probably other considerations. Indeed, Roebuck and Garbett engineered an introduction to Milton through Rev. Alexander Carlyle of Inveresk; Carlyle quite took to Garbett, but he held a lesser opinion of Roebuck (see: the Autobiography of Dr. Alexander Carlyle of Inveresk, Foulis, London and Edinburgh, 1910). The market for bleaching agents on East Lothian's many commercial fields was considerable. Bleaching required first a mild alkali (extracted from wood or kelp ashes, acting to strip out oils and dirt), followed by acid treatment, the best of which was soured milk, although the treatment took 5 days. The old bleach, soured milk, could not be secured in sufficient quantity: in the 1730s Cockburn of Ormiston's bleachfields at Ormiston and Glenkinchey employed over 90 hands under John Christie and John Drummond; Fletcher's in 1746 was on a similar scale. In the eighteenth century owners of public bleachfields were granted an immunity of duties on 'whitening materials' (bleaches; Conv. of Burghs). The

intention was to boost the linen trade and the effect was to increase demand for bleaches, as well as soap and ashes (alkalis) needed by the trade. Once adopted, oil of vitriol was not only more plentiful and cheaper, but also took only five hours to do the same task as soured milk.

To some extent the Prestonpans chemical industry was also a natural spin-off from salting. Increasingly in the eighteenth century by-products had been found commercial uses and salt itself was becoming an important feedstock for other processes (covered in more detail with salt, above). By the eighteenth century, basic chemicals were needed in bulk at economical rates. Prestonpans provided a skilled workforce (experienced in the toxic and corrosive environment of the plant), ready supplies of fuel, easy transportation links and, perhaps above all, privacy and security and a nearby market. Security was enhanced by a high wall round their plant (the '*Secret Works*') – a fact which has passed into local legend (MacNeil, Prestonpans).

The secrecy was essential because the basis of Roebuck and Garbett's new process was simply to exchange fragile glass retorts for robust lead equivalents, although they may have refined the preparation and balance of their ingredients (a mixture of sulphur and saltpetre). Roebuck's first vessels had a 200 cubic foot capacity and held 4 inches of water with the reagent on lead pedestals, where it could burn; the combustion took a month (with replenishment of combustibles in the vessel), the process being that the sulphur, burning in air, yields sulphur dioxide; this combines with the nitre to yield sulphur trioxide and sodium nitrite. Solvated sulphur trioxide is sulphuric acid. The process is inefficient and yields amounts of highly toxic gases – a great problem not only for the workers in the plant, but also the local environment. By 1785 there were 100 chambers, some of them larger than the original designs.

Further evidence of the operation of the plant comes from a variety of sources. Between 1784 and 1786 a nearby competitor was Dr Francis Swediaur who petitioned for the erection of a salt-works at Port Seton (where he was already established; OSP 181:23) where he intended to make soda (sodium carbonate) by the application of sulphuric acid to salt. Fanjus St Fond, a visitor, left a record (Fanjus Sant Fond, 1799, Volume 1) of the corrosive nature of the atmosphere around Prestonpans, its effect on brass (which turned green in

hours), and the hellish conditions under which the workers laboured. He attributed it to the vapours from salting, but to our eye the acid works would be the natural culprit. He also provides testimony on '*the suffocating smell at a distance*' and '*the high wall concealed even chimneys*'. In a comment in a Local History (History of the Regality of Musselburgh, James Paterson) another plant, at Fisherrow, was seen to cause concern to local fishermen. They complained the effluent was wasting their musselbeds; mussels were essential for baiting their lines. Finally, Thomas Pennant (A Tour of Scotland, 1769) graphically captures the salters' (and by extension the acid workers') lot with his comment '*nothing ever exhibited such an idea of the infernal regions as the horrid furnace and the poor miserable naked wretches attending it*'.

Although the Works could produce sulphuric acid at a third of the historic cost, the secret was one which could be applied by anyone else, once out. Despite inducements and binding indentures their workforce was potentially the main source of leaks and it is believed that the secret was stolen by decamping workers who sold it to the highest several bidders they could find: soon all sulphuric acid was made in lead retorts. However, such was the demand for cheap acid that for a number of years the leaks were irrelevant and the profits enabled both partners to go on to greater enterprises with a third, the local man William Cadell: together they founded the Carron Iron Works, in 1759. The Prestongrange Works was left in the hands of Garbett's former apprentice (Carlyle, Autobiography) Peter Downey as manager in 1766. About then, Garbett bought out his partner Roebuck (who squandered large sums on adventures in coal mining and salt panning as well as the Works at Carron). The partners still had mind of their joint responsibilities as in 1772 they sought the protection of a patent (Old Session Papers 116:18) for their process.

After Roebuck had sold on, the enterprise traded as Samuel Garbett and Company. Like many such concerns, when the proprietor ran into trouble, in this case in-fighting between the directors and a 'boardroom coup' at Carron, sequestration was the result. Garbett and Company folded in 1772. Its future was secured, because in 1774, the Company traded as Glassford, Downey & Company: the new controlling partner was Henry Glassford of Dougalston, a Glasgow industrialist. Patrick Downey died around 1790, and a James Mackenzie, also of Glasgow appears as the Company's agent in that city up to

1807 and also between 1810–20; he was also associated with the Caledonian Pottery there. Then, in 1795, the pollution caused by the works was the subject of a legal action between a resident, Elizabeth Howieson, on one part and the new manager, John Gilmour, on the other part for Henry Glassford. These trying conditions were not helped by six competitors in Glasgow, a large plant at Burntisland and others in the immediate neighbourhood. All of them were experiencing difficult times because of further technological advances, mainly the developments under Tennant at St Rollox (below).

However, St Rollox was in the future and the Company was still trading at the time of the Old Statistical Account, 1796; the name was then the Prestonpans Vitriol Company and it supported 188 people, suggesting a staff of around 40–45 hands, a considerable number: in 1784 the Company's operation had been the largest acid works in Great Britain and had secured a great export market. Prestonpans Customs accounts from Downey's time, March 1768 to March 1769, record the export of 750 bottles of green glass and 84554 pounds of oil of vitriol. Applying figures given in the OSA, oil of vitriol fetched 3d per pound and was sold in 140lb bottles (supported in wicker baskets, which each cost three shillings). Therefore the exports above were valued just under £2200 – a great sum. The scale of the Works was probably still comparable in the 1790s, but the next decade was difficult and the Company disappears from the record until in the light of the evidence from sasines in the Haddingtonshire Register, Laird Fowler, the proprietor of the Prestonpans brewery and the successor to the Cadells in many of their enterprises (he also backed their pottery company) had secured the premises.

There has been a curious tendency for researchers to place 'the Secret Works' at a site on the west of Prestonpans, to the north of the High Street (See, for example, Patrick MacVeigh, Scottish East Coast Potteries). A sasine registered on 15 May 1879 (Index, Haddingtonshire) notes '*several connected tenements of land lying in a triangle in the Harlawhill of Prestonpans with the buildings thereon, on the south side of the High Street … on which lands the works of the Vitriol Company of Prestonpans and part of the accommodation of the late Brewery Company … were erected and situated*'. This site is contiguous with the present Preston Links shopping complex and supermarket (and in the east and south of the High Street – well away from MacVeigh's location; the

problem appears to be confusion with the site of Belfield's Pottery, which had been a saltworks and, for a period, a chemical works). In 1879 the site was in the hands of John Fowler and Company, as it had been for some years.

It is not clear when Fowler or his successor Hislop gained the Works, either as an operating concern or for its assets, although the evidence from Glasgow would suggest after 1820 (Scottish Pottery Historical Review 4, p73). At some point in the very early nineteenth century it was operating next to their Prestonpans Distillery Company on an adjacent part of the site and the land was mortgaged to provide funds for Brewery development. It would have faced increasingly difficult trading conditions. As early as 1785 Roebuck's protege James Watt was introduced to the properties of chlorine as a bleach; by 1788 his father-in-law James McGrigor was using it to bleach linen. Then in 1799 Charles Tennant of St Rollux patented a process for the bulk synthesis of chloride of lime. Within a few years, it was the bleach of choice, available at a fraction of sulphuric acid's price. In 1800 Tennant made 25 tons of bleach; by 1825 he was producing 1000 tons p.a. and the acid plants were disappearing. There is no mention of the Vitriol Company in Pigot's Directory of 1825–6 and any chemical making at Prestonpans continued solely as an adjunct to the surviving saltworks or the soapworks.

The Chemistry of Soapmaking

Soap is the alkali metal (sodium, potassium) salt of stearic acid. Stearic moities are found in nature combined in tallow, an ester of stearic acid and glycerol (alternatively, propantriol – a molecule with three alcohol moieties). Under conditions of alkaline hydrolysis the stearate is formed and the triol regenerated. This means, by boiling tallow with an alkali it can be split into its component parts. When the ionic content of the solution is changed – by loading it with salt – soap separates and floats to the top where it can be collected. Subsequent cleaning, drying and perfuming gives a solid which can be melted and moulded, or simply cut into blocks, or flaked. Different feedstocks, such as vegetable, nut or tree oils yield variants on the theme. Soap cleans by 'solubilising' dirt particles: it coats them in such a way that they are mobilised and can be rinsed out.

Soap was discovered long before the chemical explanation above. A scenario where animal fat drips onto hot embers on

an open cooking fire, followed by quenching of the fire, would leave a naturally formed soap deposit amongst the ashes. This means that soap would be discovered countless times in prehistory (if the ashes were used for scouring) before the connection with fat was noticed. For a long time it was a domestic industry: it did not become industrialised until the eighteenth century. The well known process was scaled up in the first manufactory, set up in 1703, and soap had joined the Industrial Revolution. It quickly attracted a prohibitive excise duty or tax which held back advances in production, but its main markets, the cloth finishing industries were growing equally as fast and demand continued to grow. As noted above, in the 1730s, bleachfields were common in Scotland. Many of them had, initially at least, their own soapmaking facility. Soap was essential for finishing the cloth and, like the case of bleaching agents, specialists soon took over the manufacture and supply of the commodity. By the end of the eighteenth century the larger soapmaking plants were capable of producing several million pounds per annum.

Soap Making at Prestonpans

In the middle of the eighteenth century, Thomas Paterson was established as a soap boiler in Prestonpans on a site to the West of the Brewery, on the North (seaward) side of the High Street. He had the advantage of an agricultural hinterland (supplies of tallow), nearby fuel (coal), alkali (potash could be made from kelp, which the previous century had been burnt for the glass industry (John Ray, 1662) and, of course, plentiful supplies of salt and a local market of both domestic and industrial users. Although the Prestonpans OSA is silent, the plant was there because it appears in Pigot's Directory of 1825–6 in the hands of Thomas and William Patterson. The latter features in a complimentary report in the New Statistical account where '*Mr Paterson's Soapworks*' were '*thriving*' and importing supplies of tallow from as far afield as Australia. By 1852 (Slater's) the soapworks was in the hands of a relative of the Patersons, James Mellis: after the 1860s the company name became James Mellis and Company, and remained so until closure.

It was always a small affair employing only a few hands, but some of these spent their whole working lives there. There was little necessity for technological improvement and it appears that some of the Victorian equipment may have been

used for many years in the twentieth century. Robert Scott in writing the Industrial History of Prestonpans for Mining Technology, 1980, covers the soapworks. There were three old iron boiling vats, about 10 feet high and 6 feet across, which had originally been heated by open fires; three more modern vats were cylindrical steel retorts of a similar size. In later years both sets were heated by steam pipes. The range of fats and oils imported by the company increased during the twentieth century and was not restricted to animal fats, but palm oil and other vegetable oils were used as appropriate feedstocks for different soaps and some detergents were also manufactured. The by-product glycerol, some of which was retained for moisturising soaps was occasionally otherwise in demand: during the First World War it was collected for processing into explosives.

The product range was at some times quite extensive. Fine perfumed soaps and toilets soaps, large blocks for flaking and clothes washing, soft soaps and leather soaps, detergents and others were all produced. An advertisement (Haddingtonshire Register and Almanac, John Hutchinson, Haddington) in 1918 lists soft soaps sold from the firkin (41/2 gallons) to 1lb tin, Speedwell Soap Powder sold from 7lb to penny packets, as well as toilet and bar soaps. Despite this, the factory was closed in the late nineteen fifties, a victim of the advertising power and the economies of scale of the giant chemical companies which still dominate production today.

4

GLASS

GLASS IS processed silica in combination with a variety of other materials, all of them commonly available now and in the past. Purification has always been a problem, but colouring glass to disguise unattractive hues was an early known skill (it was accomplished by deliberately allowing a contaminant of known effect into the melt). Hardness, melting point and optical characteristics are all aspects of glass which can be controlled to some degree, and most of these attributes had been arrived at empirically by medieval glassmakers long before scientific reasons were formulated. Glassworks require a skilled workforce, both for the making and the fabrication of glass objects and both sides of the trade have always been amongst the elite of the working classes. However, as late as the sixteenth century, there were few glassmakers in Britain, their products being regarded as a rich man's luxury. With the development of the country's first flint glassworks at London's Crutched Friars Lane in 1557 (David Bremner, Industries of Scotland, Adam and Chas. Black, Edinburgh, 1869), its use began to spread. In 1615, the application of coal as a fuel brought down costs and throughout the seventeenth century, further immigration of skilled hands raised the standards of the native industry: the Duke of Buckingham's Venetians at Lambeth were Britain's first mirror makers in 1675. An excise was briefly applied in 1695, and then again in 1745 (for a century). Although the first period caused problems for Scottish glassmakers, the production grew until, for a time, it was Scotland's third greatest export, by value.

Glassmaking in Britain is first mentioned (after the Roman period) in 674AD, when the Church at Wearmouth, near Durham, was employing workmen from abroad. This was a pattern which continued over the centuries, as mentioned above, and it was repeated in Scotland, where the origins of glassmaking were probably the initiative of Hay of Wemyss, who had a patent from James VI (Scottish Industrial History 7.1 1984 p34). Glass-wrights were working in Scotland in the early seventeenth century, their output of window glass being regulated by defining Act between 1624–26 (CRB). As early as 1662, there was production in the Prestonpans area. In August of that year, John Ray described (Hume Brown, Early Travellers

in Scotland, James Thin, 1973) his journey from North Berwick to Leith. He wrote '*By the way also we saw glasses made of kelp and sand mixed together, and calcined in an oven. The crucibles which contained the melted glass, they told us, were made of tobacco-pipe clay*' (kelp was still being collected in the early 1800s: Musselburgh Council Records). This suggests that the Morisons of Prestongrange had a glass making facility at least as early as that year, and probably earlier; certainly the local area afforded all the raw materials.

The next significant figure is William Morison of Prestongrange. 'Jupiter' Carlyle of Inveresk was intimately connected with the Morison family and has left several impressions of William. He writes (Alexander Carlyle: Anecdotes and Characters of Times, Oxford University Press, 1973) that Morison was MP for East Lothian in the first UK Parliament, standing against Fletcher of Saltoun; he had previously sat for Haddingtonshire in the Scots Parliament. He had had a considerable fortune, based on his family estate and the industries and farms developed on it but by 1732 the estate was sequestered by his creditors. Carlyle believed that this had been caused by Morison's involvement with a notorious gambler, Colonel Charteris. In another anecdote, in the course of development work at Morison's Haven Mill Morison had encountered a series of vaults underground, perhaps part of the 'fort' noted on early maps just to the west of the harbour, which were believed by the credulous Laird to be part of the 'infernal regions'.

Morison's beliefs notwithstanding, he pursued a vigorous policy on his estates. On the fifth of August 1697 he obtained an Act and ratification in favour of the Glass Manufactory at Morisons Haven from the Scots Parliament. This Act followed an earlier one in favour of the Leith Glassworks of George Mackenzie, Viscount Tarbat, who had had a similar Act on 8th October 1689 (Monica Clough, The Leith Glassworks, Scottish Industrial History, 5.1, 1982).

However, the acts differ in some detail. That to Tarbat extends a prohibition to competitors making green glass bottles, chemists and apothecaries glass ware; that to Morison suggests his works would enjoy '*the whole privileges, liberties and immunities granted by the former acts ... at any time bygone*', therefore perhaps superseding Tarbat's. Morison's stated product list included special glasses such as Mirrors, coach glasses, spectacles, watch glasses and window glasses

'*never heretofore manufactured within this Kingdom*', as well as common bottles and his application was supported by samples. The application further mentions the expenses in getting skilled workmen to make these new products, suggested the normal glassowners augmentation of local skills by paying for new from abroad. Morison and his partners would also have a fair idea that Tarbat had difficulties with marketing, transport and, not least, English competition so the terms of the act were written to expressly forbid anyone else making the new glasses for nine years and also prohibited importing these articles on pain of confiscation. It was perhaps these very imports, probably a consequence of the glass excise, that prompted this clause in Morison's Act.

Viscount Tarbat was the nearest direct competitor to Prestongrange and Morison. Tarbat had found trading conditions difficult, as mentioned above, and failed in the early eighteenth century (despite petitioning in 1701 for further protection from English exports). As the reverse export was impossible because of the legal position favouring English exporters he was in an invidious position. Morison seems to have weathered this period, and gained a niche for bottles (the finer products seeming having disappeared), or so at least the estate accounts of 1716–23 would indicate (above). Shortly afterwards, we find the glassworks site in the hands of one of the Prestonpans potters, and the site remained in that industry until most of the works were demolished to make way for the industrial railway lines of the colliery and brickworks of the later nineteenth century.

5

BRICKMAKING

Bricks, tiles and heavy ceramics

BRICKS ARE generally defined as prismatic rectangular units of burnt clay, however both standards and definitions have varied over time, changing as the industry evolved. Bricks have historically been made in a variety of ways. The earliest were hand moulded, brickmakers extracting and preparing their clay with little mechanical assistance. There was no appreciable technological advance until the nineteenth century when mechanisation permitted the use of a wider range of raw materials (such as fireclay, shales, and coaly shales (locally *blaes*)) and gave greater output (at lower cost) of more consistent quality. Often in Scotland, clays and shales have been worked as a by-product of the coal industry; this is particularly true of the industrial development of the Prestongrange Works. Thus, several of the coal seams comprising the East and Mid-Lothian coal basin are underlain by significant depths of fireclay and contain bands of, or are roofed with, blaes. The attractions of the latter arise from a proportion of combustible material integral to the blaes which can supplement fuel during firing. 'Self-firing' is a useful economy exploited from the late nineteenth century, when sophisticated kilns were developed to utilise this feature. Such was the demand for the resulting 'composition' or common bricks that Prestongrange Pit was by the years after Nationalisation (1947–1961) increasingly devoted to the supply of the adjacent brickworks.

Tiles are closely associated with brickmaking but in particular to improvements in farming after about 1800. When it is understood that the bulk of the many nineteenth century tile-works produced field drainage tiles (and not roofing pantiles) the latter connection is clear. East Lothian was at the forefront of land improvement, led by luminaries such Lord Belhaven of Biel, Cockburn of Ormiston and the Fletchers of Saltoun. Many other landowners, such as the Grant-Sutties of Prestongrange and Balgone were quick to follow their example. In the later nineteenth century drain-tile manufacture became an adjunct to heavy ceramics production, essentially comprising everything from roofing and floor tiles;

speciality bricks and furnace fittings; chimney cans and firebacks; a diverse range of garden wares such as edging, rustic furniture, bird baths and planters; water and gas pipes; drainage and sewerage traps; to sanitary wares such as sinks, cisterns, toilets, and the like. This market was developed at the Prestongrange Brick and Tile Works under a variety of owners until it closed.

Brickmaking

The Romans used clay to make bricks and tiles (both roof and drainage) and were probably responsible for the technology's introduction to the British Isles (see also Salt, above). The presence of a major Roman fort and viccus or civil settlement at nearby Inveresk suggest that native British inhabitants would be exposed to both the technology of brickmaking and salting, although no evidence exists to suggest that either process survived during the Dark Ages.

The spread of continental Monasticism in the medieval period saw a revolution in both technologies. Decorative tiles were produced to floor ecclesiastical structures, some being imported from the continent, but others certainly manufactured locally. The Franciscan Priory at Dunbar had a tiled floor, St Mary's Church in Haddington likewise. A good example of a tile kiln was excavated at North Berwick and examples of its tiles are to be found in the National and East Lothian Council Museum Service Collections. This kiln was almost certainly worked by an emigree European tiler, from stylistic similarities to European examples. From the extent of the tilework now discovered, other undiscovered kiln sites must have existed in the locality.

Brick became popular in Britain in the mid 1400s, in areas where there was abundant clay but little useful building stone. However, in Scotland there was an abundance of good building stone (and subsequently a powerful and organised (operative) masonic guildery (or lobby) hindered the development of brickmaking for construction). Here, roofs of significant buildings continued to be finished in stone slabs and slates and common dwellings used sod, heather and other natural materials, right throughout the late medieval period and into the industrial age. Gradually, there was a change. One Tobaccos Knowes (Tobias Knox?) received a patent for '*the making of bricks under several conditions*' prior to 1643 (Conv. of Burghs). Bricks were convenient and could be quite

cheap to produce. By 1784, brickmaking was of sufficient importance to attract an Excise duty of 2/6 per thousand bricks. Later duties were applied on the basis of size: in 1835 the common brick tax had increased to the rate of 5/10 per thousand. The same rate was applied universally in 1839, because the differential rate had 'obstructed the development of dwellings for the poorer class' (David Bremner, Industries of Scotland); the effect of the tax had certainly been to inhibit brick manufacture: in 1802, 714 million bricks were made annually; after abolition (1840), 1725 million.

After the Union of Parliament, Scotland's landowners and the main agricultural producers had to compete in a wider market. Several looked south to see the farming revolution underway there and imported new ideas. New villages were created as '*policies*' and parks grew around country seats. Lord Belhaven at Biel expounded upon the ideal stackyard and steading layout, specifying the housing conditions which the farm servants might enjoy. Cockburn of Ormiston experimented with long leases on his estate and encouraged his farmers to explore new methods in cultivation, rotation and the application of fertilisers. New technology meant that new land could be ploughed and with liming and draining could be made fertile. Old style field drains involved trenching and packing stones. Porous earthenware tiles and pipes did the same job much more simply and their production boomed. They could be made by hand from any suitable clay deposit and fired using available resources in a clamp or temporary kiln. There were excellent deposits of suitable clay at the surface all along the coast from Portobello right through to Prestonpans and there have been countless tileworks exploiting these resources.

Once, fireclay and blaes were worked simply to give room around the coals with which they were associated. Refractory materials such as fireclay have high resistance to high temperature and can be used to retain heat and line furnaces. It was not until the early 1830s that reserves of high quality fireclays were proved in Scotland: by 1900 they were being exploited by over sixty separate companies. Natural fireclays have 26–43% alumina; soda, potash and iron content all reduce the effective refractoriness; basic raw materials can be treated to increase their refractoriness (KW Sanderson, the Scottish Refractory Industry 1830–1980, 1990). The reserves around the Mid and East Lothian Coalfield were such that

even in the 1970s, the Lothian Region Structural Plan considered (but discounted) fireclay reserves and noted 1.5 million, workable tons of blaes in the Dolphinton-Wallyford area.

Brickmaking at Prestongrange and Prestonpans

At the time of the Old Statistical Account, there were two works in Prestonpans itself. One was near the Old Kirk (Edinburgh Advertiser, 1789: the Old Kirk tile works had its clay onsite, supplying nearby potteries as well) and employed six men at a shilling (5 pence) a day. In 1795 they fired 13 kilns of tiles at 10,000 tiles per load paying 3 shillings and 6 pence per 12 hundredweight of coal; they also made 107,000 bricks, probably in clamps because no kilns are mentioned. The other works lay further to the west (a site called Ravenscroft) on the seaside, digging its clay from a three acre site immediately adjacent. It was slightly smaller, because it fired 9 kilns of 9000 tiles; the work was carried on by 3 men at 7s each per week. At this period bricks fetched 17 shillings and 6 pence (with half a crown duty included) per thousand and a thousand tiles was £2 13 shillings (including 8 shillings duty); the tax had been introduced in 1784. An article in the Scottish Pottery Review, The Old Kirk Pottery (at) Prestonpans by Gerald Quail, assembles valuable information and detailed references to both brick and tile works. An expert tiler and his assistant could turn out 4–5 thousand daily (for a long time hand labour had the advantage of greater economy than machines). Drain pipes, however, were more economically made by machine (although Belfields of Prestonpans developed a line in glazed, hand thrown gas pipes in the 1840s). Bricks and tiles also may have been made at the pottery beside Morisons Haven at Prestongrange: there was certainly an appropriate source of clay, and later events suggest that it may have been applied to this purpose for some time. Customs Accounts for the port of Morisons Haven have been analysed and show that between 1742–1770, 29 entries towards the end of the period relate to the export of bricks. A total of 443,400 and 218,000 brickstones went out in this period (Scottish Pottery Historical Review, 4, p. 18).

In the last decade of the eighteenth century, Caddell, Anderson & Co. of the Old Kirk Pottery and Brickworks leased the smaller, Ravenscroft Works from the owner Alexander Banks, through his nieces the Misses Clapperton, as

well as continuing their own Works. Both are located on Forest's Map of Haddingtonshire, 1799. From the sasines relating to the Ravenscroft, it lay adjacent to Northfield Estate on the north side of the road (therefore by the seashore) with three acres of claypits, and so was within the bounds of the ancient Barony of Prestongrange. The works had been founded around 1770 and passed from an Edinburgh builder, Thomas Russell to the lessees above and subsequently their successors, the pottery company Anderson & Co. However, relations between the company and the landowner's agent Miss Clapperton were bad to begin with and deteriorated, leading to a series of actions at the Court of Session. The reasons for the dispute centre on a decline in tile demand which set in around 1805, after Anderson and Company had enjoyed several years of profitable operation. The tileworks came up for a renewed lease in 1813, which was secured by the holders now trading as David Thomson & Company. However, David Thomson had backed a salt manufacturer (and sulphur manufacturer) Mr Walker, in 1814. Walker's works lay even further west and it would appear that he had diversified from salt to other related chemicals, perhaps also including sulphuric acid. In 1817 Walker failed, Thomson's bond was called in, and the pottery's sleeping partner, Fowler of Prestonpans Brewery, intervened to prevent his interest (capital) disappearing. Both pottery and brick and tile works were advertised for sale, the latter clearly not in an operating condition as the claypits were under a crop of barley and grass. The advertisement suggests that the product range was pretty limited – only undifferentiated bricks and tiles are mentioned. It was sold for £240 to Hew Francis Cadell of Cockenzie.

Attention can now be shifted to Prestongrange where the pottery had come into the hands of the Gordons of Bankfoot. Once again, the Court of Session Papers are a valuable source: a prolonged dispute arose between the lessees, George and Robert Gordon, and the proprietor of Prestongrange, Sir George Grant-Suttie. The core of the dispute appears to have been clay dug from the nearby deposits on Grant-Suttie's estate (the site is still obvious today, on the edge of the Golf Course). The Gordons were also making industrial ceramics in contravention of their lease. The Gordons tenure at Morison's Haven is covered more fully in the Chapter on Potteries.

Having disposed of the Gordons, the Grant-Sutties began to

make bricks and tiles on their own account. The Works came under the estate factors, or managers, and appears to have been of a small scale. In 1837, it was under the control of George Leach, described as Clerk (he also served under Grant-Suttie's colliery manager Robert Moore, at Birsley; Pigot's Directory). The Grant-Suttie Papers in the SRO include a sequence of documents relating to the family's industrial undertakings after Mattias Dunn's Prestongrange Pit was sunk (the Beam Engine shaft); the documents relate to annual balances and the colliery and brickmaking operations in the period up to the formation of '*the English Company*' in the 1870s. The management of the Works changed hands several times; for example Slater's Directory notes James Myles, Brickworks Colliery manager, 1852. From 1841, the decennial censuses begin to flesh in the operation of the Works on a personal level, as employees can be identified living in premises leased from the estate at Morison's Haven and at Cuthill to the east.

To pick just one of the censuses, that of 1871 identifies several of the workers at Grant-Suttie's Brickworks, most residing at Morison's Haven. The brickmakers were William and James Anderson, from Stirling. The record of their families suggests that their association came via one of the neighbouring sites in Inveresk Parish (Levenhall or West Pans, perhaps) although they had been employed in the Prestonpans area for at least six years. The works were in the charge of Edward Yule, the estate's factor, land agent and colliery manager, who resided at Ravensheugh Cottage. Yule retained this position for a number of years. In 1873–4 he is recorded as Factor, residing at Ravensheugh (Valuation Roll); James Anderson was by then Tilework Manager. The Grant-Suttie operation was into its last years. Physical evidence from the site (the remains of the 1874 ventilation duct on Shaft No 2, sunk in that year) suggests that the output in this period did not include fireclay products: the duct is composed of hand moulded, red terracotta bricks.

The full industrial development of the Prestongrange site commenced in the early 1870s with the arrival in the Prestonpans area of Richard Kitto, a Cornishman (see Appendix 2). His main interest was mining – but not necessarily coal. He and his partners secured a lease of Prestongrange minerals and the existing infrastructure owned by the Grant-Sutties. This development is first marked in the 1874–5 Valuation Roll

when the Prestongrange Colliery Company is in possession of the colliery and workmen's houses at Cuthill. The most important feature of this year, however, is that Grant-Suttie retained the Brick and Tile Works in his own hands (via Yule and James Anderson). In the same year the Colliery Company was reformed as the Prestongrange Coal and Iron Company, with Kitto as Managing Director and several Middlesborough magnates on the Board, and took over the Brickworks. By 1878, the company could boast to be '*manufacturers of every description of Fireclay goods*'. After several years of successful trading the Company lost way and was wound up in 1880. Throughout this period it is clear that the Brick and Tile Works had formed part of the new company infrastructure and had been comprehensively developed (Slater's Directory, 1878): no longer simply a rural tileworks supplying material for the estate, but a major heavy ceramics plant utilising the underground reserves of fireclay to fabricate a wide range of products. A major increase in the labour force, both for the Colliery and the Brickworks, was accommodated in a new housing estate at Cuthill. However, the older part of the workforce seem to disappear: the Andersons disappear from the record when the Prestongrange Coal and Iron Company took over – possibly as early as the later part of 1874.

After the company failure, operations continued under a liquidator. There are a number of workmen identified in the 1881 census who must have continued in employment. Trades mentioned include fireclay and sewage piper makers and finishers, brickmakers, brickwork labourers and a foreman, Robert Fishlock (most of these lived in the company's housing estate at Cuthill and some had worked for the Grant-Sutties). The brickworks manager was James Campbell, residing at Morisons Haven Harbour House.

Out of the ashes rose the Prestongrange Coal and Firebrick Company, with more directed objectives. Coal was still exported to the Middlesborough ironmasters, but investment in fireclay was made more prominent, probably reflecting prevailing market conditions. The evidence of the site (mainly surviving bricks) and museum artefacts (East Lothian Museum Service Collections, National Museums of Scotland Collections) shows a large output of machine-made composite bricks, fireclay special bricks (hand-moulded) and a large variety of salt-glazed wares. The last consists of pipes, traps, chimney cans, sanitary wares, and decorative urns and garden pieces.

All of these materials were in great demand in Edinburgh and the local district. Indeed, advertisements suggest that fireclay products became the company's main product (Slater's Directory, 1893); depots were opened at Leith and Granton, as well as Morisons Haven. The Prestongrange site was managed for the company by Francis Rawling Luke (of Redburn House, to the immediate west of the site), in succession to his father GB Luke. Larger artefacts from this period might be distinguished by a glassy, green-blue interior slip-glaze, probably compounded from flint; many shards survive on the site and a few single objects (East Lothian Museums Service Collections and National Museums of Scotland Collections). A full page advertisement from this period (ELMS Collections) includes a woodcut showing that the brickworks had spread to occupy much of the area of the existing site. The large moulding halls are evident as are a variety of bottle and downdraught kilns and the railway is in place with spurs into the Brickworks. In the background of the view is the tall chimney of the Company's powerplant, a boilerhouse supplying steam to pumps and stationary engines.

Shortly after the entry in Slater's 1893 Directory, the Prestongrange Coal and Firebrick Company was also wound up, succumbing to outstanding liabilities in May 1893. Once again the site was operated in receivership by an Edinburgh CA, AAW Carter. The new owners were the Summerlee Coal and Iron Company who entered in 1895 and operated until Nationalisation in 1947. Summerlee invested heavily in infrastructure: the power station to generate electricity, a new workers housing estate, coal washers, new underground pumps, an extended railway network, and new kilns were erected. Summerlee is believed to have replaced 15 beehive style kilns with 9 round kilns for glazed pipes and they were responsible for large scale clearance of older properties on their land, mainly unoccupied and very old cottages and tenements lying on the seaward side of the road from Cuthill to Morison's Haven. Thus were probably lost the last remains of many of the Prestongrange saltpans (Haddingtonshire Courier,15/2/1914).

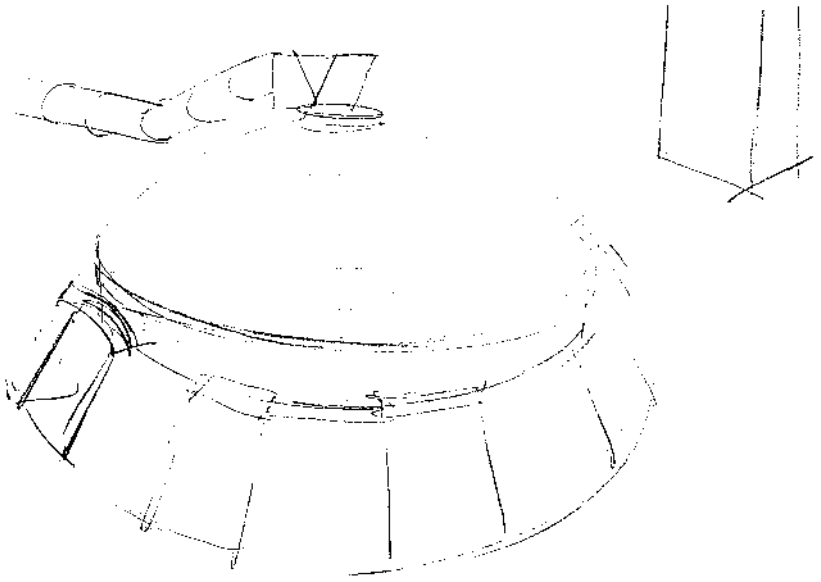
Slater's Directory of 1907 records John Haliday as manager of the site. He appears in several surviving photographs, standing confidently with his staff. He, like the other managers, resided close to the Works in the cottage at Ravensheugh; their occupancy of this house gave rise to the

local name for the road behind, which is still current: Manager's Brae. The earlier bottle kilns were replaced by the suite of domed downdraft kilns which survived (with continual repair and replacement) until site closure. In 1910 brickmaking was facilitated by the erection of a Hoffmann continuous kiln (Appendix 3), another feature which was operated until closure and stands today. About the time the kiln was built, Sumerlee published a catalogue under the 'Prestongrange Company' imprint, which illustrates and lists the entire product range (some 500 different articles). A large export trade was worked up with the Low Countries and Germany, although Morison's Haven was soon abandoned due to silting. The overseas trade came to an end at the outbreak of the Second World War, but the domestic market remained strong.

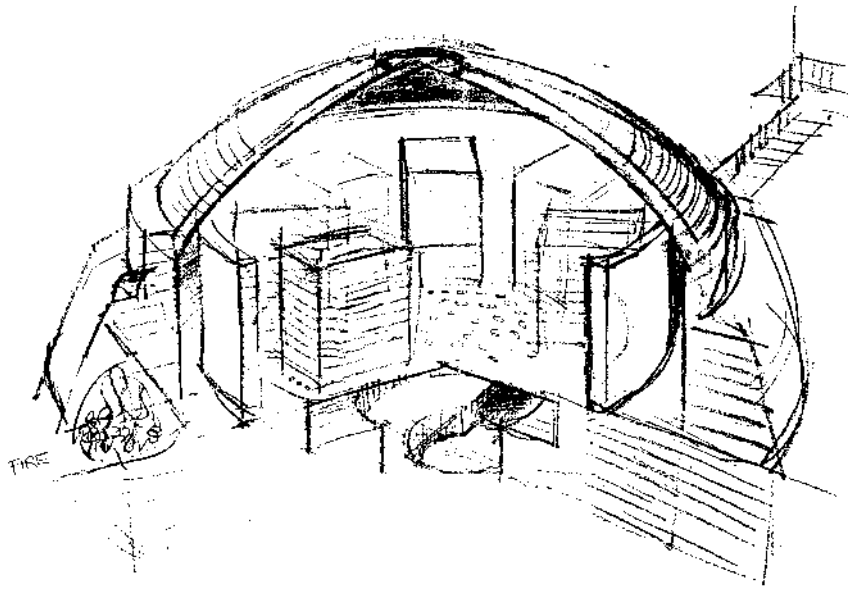
The workforce was high throughout the whole of Summerlee's tenure, often over a thousand hands, more than 200 of whom were associated with the Brickworks. The site employed 786 underground and 202 hands above in 1924, a high proportion of the latter working at the Brick and Tile Works; a significant proportion of the former supplying their raw materials (fireclay, blaes, coal) from the pit (Andrew S Cunningham, Mining in Mid and East Lothian, Thin and Orr, 1925). Even in the 1950s, the Third Statistical Account (1953) records that the Brick and Tile Works employed over 100 hands. By this period both it and the colliery had been nationalised (1947). The raw material still came from the adjacent colliery and was used for building bricks, pipes and chimney cans and special orders on demand. Most articles were machine made, but many continued to be hand moulded – a skilled task calling for experience. Several of the senior tradesmen spent their whole working life at the Brickworks: a number who started in 1914 were still there in the 1960s and one at least saw the plant through right to closure.

The last minerals were brought from the pit in 1961 as the Coal Board concentrated on the super pits of Bilston Glen and Monktonhall. The Brick and Tile Works passed to the newly formed Scottish Brick Corporation in 1969, with a declining workforce and infrastructure. It was operated for six more years, finally closing in 1975, a victim of transport costs because all raw materials and fuel had now to be brought onto the site. All the owners of the twentieth century have left their (literal) mark, in the frogging (recess) on the bricks which are

found around the local area: bold PRESTONGRANGE (Summerlee), NCB–PG (Coal Board), and SBC (the Corporation).



Drawing of Downdraft Kiln
East Lothian Council, David Spence Collection



Section of Downdraft Kiln
East Lothian Council, David Spence Collection

6

CONCLUSION

THE INDUSTRIES discussed above have all ended in the Prestongrange and Prestonpans area. They have left few substantial physical traces, although there is probably a wealth of archaeology at a number of local sites. All that remains are a few placenames, some walls, the surviving industrial buildings of the Prestongrange Industrial Heritage Museum and souvenirs, artefacts and products held in the community and at museums and archives.

But the industries were not transient affairs: even the shortest lived, the glassworks, lasted for around sixty years, nearly two full working lives, and salting has a documented history of eight centuries. In their time thousands of hands were employed. The local population was enriched by the immigration of skilled workers and later exported its own skilled hands (sometimes legitimately, sometimes not – the Secret Works). Some of the businesses were family affairs, some part of landed estates, some part of industrial conglomerates. Their products were used locally, nationally and internationally (counting England here, because for most of the period it was a foreign country) and were exported against frequent tax and excise barriers. Some of the industries enjoyed periods of monopoly in their home markets and at other periods went through phases of cut-throat competition. The owners might be local people, either landed or not, or from outside. Some were of national importance, such as Roebuck, who brings the best of the eighteenth century Scottish Enlightenment to Prestonpans, and others have passed as unremarked by surviving sources as the vast majority of the workers. Some made their home locally, such as Kitto of the 'English Company who died in Prestonpans, others were absentee landlords, like Henry Glassford, whose manager went to court for him.

For the most part people laboured in (to the modern eye) appalling conditions which would have significant effects on their health, but they had jobs which required a degree of skill (some more so than others), had a freedom of movement within the local economy (despite what the law might say) and a steady income at most times.

CONCLUSION

Only two of the industries – salt and glass – have been the subject of comprehensive academic study, and then only as part of the Scottish whole. There is scope, and the resources in many collections, to further investigate Prestongrange's many industries.

Pithead Baths, Canteen and Pipe Store on the shores of the Firth of Forth
Scottish Mining Museum Trust

7

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The three *Statistical Accounts (Old, 1796; New, 1845; and Third, 1953)* and *Martine's Reminiscences (of the Parishes of East Lothian),* republished by East Lothian Library Service, 1999) provide background studies of Prestonpans and Prestongrange of varying detail at approximately 50 year intervals. For the nineteenth century, *Pigot's Directory of Scotland (1825–6, 1837)* and *Slater's Commercial Directory of Scotland* (consulted various years 1852–1907) provided detail on industrial concerns at Prestonpans and Prestongrange and their nearby competitors. The series of volumes compiling the *Proceedings of the Convention of Royal Burghs* also provided useful information. Local publications such as Alexander Hamilton's *Salt Pans* (*Outlet Design,* c1980) and *The Pans Remembered* (East Lothian District Library, 1986) provide local anecdotes and folklore. Peter McNeill's three volumes, all of which have been republished by East Lothian Library service are of similar value; they are *Prestonpans and District*, its companion volume, *Tranent*, and a novelisation, *Blawearie*, which gets under the skin of the local inhabitants of two centuries past.

Also of use were articles in *Scottish Pottery Historical Review*, the Journal of the Scottish Pottery Society, where interest in the Prestonpans area extends beyond their core brief. CA Whatley has investigated the *Scottish Salt Industry, 1570–1850* (Aberdeen University Press, 1987) in depth and his book contains detailed references to source material; the same author's paper published in the *Transactions of the East Lothian Antiquarian and Field Naturalists Society (A Saltwork and the Community: The Case of Winton, 1716–1719, Transactions of the ELAFNS, 18, 1984*) provides a detailed exposition of the operation of eighteenth century saltpans nearby to Prestongrange. See also, *Scottish Salt-making in the Eighteenth Century: A Regional Survey,* Scottish Industrial History, 5, 1982. General industrial texts, such as the *Companion to the Industrial Revolution* by Clifford Lines (*Facts on File*, 1990) were also useful. East Lothian Museums Service Collections, in particular the *David Spence Bequest*,

provided additional information as did the resources of the East Lothian Library Service Local History Centre: in addition to *newspaper cuttings, study packs, parish information*, and scarce publications relating to East Lothian, the Centre holds complete runs of *Valuation Rolls of the Parish (and Burgh) of Prestonpans* (from 1855), the *Haddingtonshire/East Lothian Courier* (on microfilm) and the indexes to the *Register of Sasines for the Sherrifdom of Haddingtonshire*. Background on Roebuck, Garbett, Cadell and Morison came from a variety of sources, including Carlyle (referenced in the text) and RH Campbell's, *The Carron Company*, (Oliver and Boyd, 1961).

Early charters relating to Prestongrange are published in *Transactions of the ELAFNS*, (David Spence, volume 14, 1984), which series also contains material of local interest. The complete *Chartulary of Newbattle Abbey* was published by the Bannatyne Club in 1849 (*Registrum Sancta Maria de Neubotle*).

Other relevant sources

A work in progress, Gillian Harding's survey of early Scottish Glassmaking (Ph.D. Edinburgh University, to be published) will undoubtedly increase knowledge on the early history of the glassmaking industry at Prestongrange and vicinity.

The Scottish Record Office contains a wealth of material on the industries of Prestonpans and Prestongrange. To highlight just a few, there are records of the Scottish Salt Company (*SRO GD454/* and bundles therein) including daybooks, cash-books, letter books and accounts. There are eighteenth century tacks (rentals) of Prestongrange saltpans (*SRO GD24/17/642*) and details relating to the Colliers and Salters Bill of 1775 (*SRO GD18/1123; GD172/503*). There are even sketches by John Fowler Hislop, the brewer, who had antiquarian interests and deposited his papers therein (*SRO GD172/862*). There is also relevant material in the National Library of Scotland, Edinburgh University Library, the City of Edinburgh Central Library, and even the collections of Glasgow Libraries.

APPENDIX 1:
ROEBUCK, GARBETT AND CADELL

SHEFFIELD BORN **John Roebuck** (1718–94) was the son of a cutler and one of a large family. He attended Grammar School and Northampton Academy, before becoming a student at Edinburgh University during the period when Cullen, Home and Black revolutionised the science of chemistry and its application to industrial processes. He graduated in medicine in 1737 and undertook advanced studies at Leyden, graduating MD in 1743. He afterwards practised medicine in Birmingham and developed a side-line as a consulting chemist to industry, which brought him into contact with the entrepreneurial Samuel Garbett. Roebuck has been described as the 'ideas' man of the partnership. He seems to have taken enthusiastically to each new project that came along, sometimes with success but ultimately ending his productive career with a series of failures in the early 1770s.

With Garbett, he became expert in refining precious metals, setting up a plant in Steelhouse Lane which generated sufficient profits to float other ventures. The business faced a bottleneck in the supply of sulphuric acid (then known as oil of vitriol), essential in the refining process and also in demand as a metal cleaning agent. At Steelhouse Lane they developed a process which revolutionised production, as described in the main text. He was the partner who selected the site for their next venture, having identified a gap in Scotland's iron production facilities, he prospected diligently until he found the most suitable site, passing up on Musselburgh Links in so doing. At Carron he became interested in the work of James Watt, taking him under his wing (and into partnership), effecting introductions and commissioning one of Watt's engines for his mines. However, always interested in the next new thing, he raised capital from his various interests and ventured into ceramics, coal-mining and saltpanning, adventures which failed.

Samuel Garbett's (1717–1805) background is obscure. He was of a similar age to Roebuck, but his earlier circumstances would appear to have been modest and his education poor. He was working successfully in the Birmingham brass industry

when he met Roebuck, and was already his own master and comparatively wealthy. A man of modest tastes at home, contemporaries generally liked him and admired his steady business head, describing him as '*acute with great understanding*'. In partnership with Roebuck he seems to have maintained his erratic partner's discipline and focus: it was only when acting independently that Roebuck failed. However, Garbett suffered bankruptcy himself, with a fight for control of the Carron Works ending in failure and the further failure of partners back in Birmingham. He too ceased to figure from the early 1770s.

William Cadell of Cockenzie was a scion of a local merchant family which had originated in Haddington and was based at Cockenzie House, just along the coast from Prestonpans. He exercised considerable entrepreneurial skills in developing an extensive trade in general merchandise, based on his family's control of pits lying on the north east of Tranent, the gravity tramway to Cockenzie Harbour and his interests in what was the East of Scotland's most productive pottery in Prestonpans. He invested in many local concerns and was prepared to come in with Roebuck and Garbett in their ambitious plans for the Iron Works at Carron. He also controlled iron mills at nearby Cramond.

APPENDIX 2
THE ENGLISH COMPANIES

The Memorandum of Association of the *Prestongrange Coal and Iron Company* (locally remembered as *The English Company*, a name also applied to its successor) was filed on 30/9/1874 (BT2/584, Files of Dissolved Companies) and lists the principal shareholders at outset as:

Richard Luke Middleton Kitto		
Coalmaster	Prestongrange	1000 shares
Isaac Wilson		
Ironmaster	Middlesburgh (sic)	300 shares
Alexander Hogg Naysmyth		
Mining Engineer	Musselburgh	100 shares
Thomas Brentnall		
Merchant	Middlesburgh	1000 shares
Henry Brentnall		
Ironmaster	Middlesburgh	50 shares
Fred. Sam. Brentnall		
Ironmaster	Middlesburgh	50 shares
George Bainbridge		
Solicitor	Middlesburgh	100 shares

This group is dominated (2500 shares) by the proposed buyers of Prestongrange's raw materials, which were prospected to include ironstone (of which there are a number of seams at Prestongrange all of which were probably not economically viable then, let alone now). However, the high quality coals had a history of being suitable for iron founding and this was probably the principal interest of the Middlesborough ironmasters and their financiers. The company was consolidated from earlier agreements between RLM Kitto, T Brentnall, and the Cornish mining engineer, Matthew Loam on one part and the landowner Sir George Grant-Suttie on the other. The details of the earlier agreements specifically mention fireclay, along with coal, ironstone and limestone. Kitto,

APPENDIX 2

Brentnall and Loam's embryonic company was probably floated to raise the capital required to rehabilitate the pit and the engine works proposed by Loam. The opportunity was taken to secure the brick and pipe works at the same time – a good move considering the subsequent story of the site.

The company entered voluntary liquidation on 3 June 1880, when FW Carter, Edinburgh, was appointed liquidator. He seems to have ensured some continuity until the company was finally wound up on 14 February 1884. The principal problems appear to have been mineralogical – the iron and limestone was never worked and there were problems with coal output – and personal – Kitto, the Managing Director had cash flow difficulties (see GS) and later died, removing the company's guiding hand.

However, on 25 February 1882 a Certificate of Incorporation (BT2/1092) was filed for the *Prestongrange Coal and Firebrick Company*. The shareholders included members of the previous company (John Gjers, Middlesborough who had bought in, perhaps after Kitto's death) as well as new blood (for example, Robert Stephenson, Middlesborough, and CE Mills, a locally based mining engineer). The consortium had acted in advance of their incorporation by securing leases, property, equipment and stock for £45,000 at the public auction of the previous company's goods on 9 November 1881. The new company installed GB Luke as company secretary and site manager, a position inherited by his son, Francis R Luke. Advertisements from the latter's administration emphasise the ceramics production above coal. The Company survived until 1893, before it too went into receivership and the site was ultimately sold to the Summerlee Iron Company.

APPENDIX 3
THE HOFFMAN KILN

CIRCULAR PATTERN Hoffman kilns were introduced into Britain in 1858 by Friedrich Hoffman, a German engineer. The first were used for firing pottery and burning lime; their advantage was that they could be worked continuously, the burning zone rotating through a kiln's chambers in succession. The principle was adapted and improved within a very few years and the style proliferated across Britain, finding new applications in brickmaking, for which industry it became one of the most significant types. Oblong kilns became the standard pattern after 1870 and the chimneys were soon off-set to one side on a floor heated by ducts carrying flue gases. Hoffman kilns were particularly well suited to the firing of composition bricks made from blaes. The only criticism levelled at them was a lack of fine control, problems with staining and scorching from fuel contacting the bricks and lack of high temperatures (for more specialised products: solved at Prestongrange by the suite of eleven round down-draught kilns). Prestongrange got its first Hoffman in 1910, and the chimney still stands. It was replaced by another in 1937, built by Cleghorn of Newmains, which operated until the Works closed in the mid 1970s and is still standing.

Hoffman Kilns were worked by teams on piece-work: setters, working in advance of the fire, and the burnt team, clearing the fired bricks and redding the chambers. An expert, waged employee worked the kiln roof and controlled the operation. The setters built green brick stacks, positioning voids below the roof vents (through which coal would later be added) and constructing flues and channels amongst the bricks to ensure even burning. A temporary wall was constructed to terminate the filled chamber and the exterior gate was 'stuffed' or closed with bricks. Another chamber was then set, and so on. Behind the burning zone the burnt team, working in singlets and with leather hand protectors, unloaded hot bricks from the kiln. To get them, they first unblocked the gate; an inrush of air helped to keep them cool. In passing over the bricks the air was increasingly warmed as it was drawn to the burning zone. Some of the air was diverted along the spinal

conduits to heat the green bricks in advance of the burning zone. The remainder fed the fire and was discharged to the chimney, carrying away the volatiles released in the burning process. meanwhile the green bricks were heated until the chamber temperature was above the flashpoint of coal: when added, it spontaneously combusted. At this point, the combustion gases were diverted (underground) into the chimney flues, raising the temperature of the drying floor outside and predrying the green bricks stacked there. After a burning period which was judged empirically (cold iron in a vent was moistened when the bricks were still curing), no more coal was added and the bricks began to cool down. By this time the head of the fire would be several chambers further on.

Hoffman kilns required 12–14 chambers for regular operation on a continuous process. The Prestongrange kiln has 24, suggesting a higher load bearing capacity – or periods when the output could be doubled. Each chamber stacked 11,000 bricks, suggesting a potential annual output of between 3 and 6 million bricks.