THE KENTISH COPPERAS INDUSTRY

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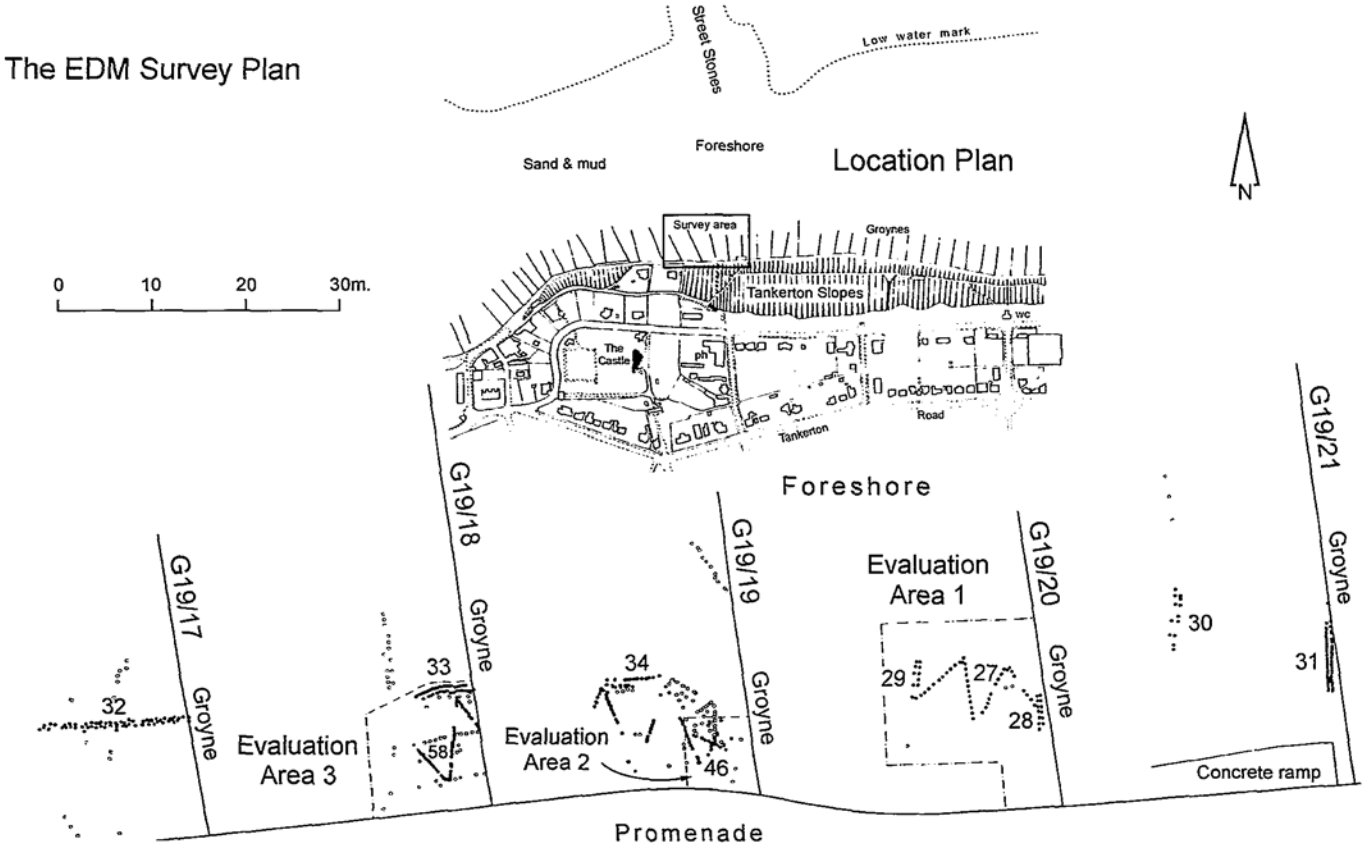
During monitoring of the Whitstable foreshore it was noticed that marine erosion in Tankerton Bay had exposed a complex of timber structures, including a group of posts arranged in a predominantly triangular pattern and set in yellow-orange poured mortar. These structures were known locally as copperas pits because they adjoin the Tankerton Slopes, shown on eighteenth- and nineteenth-century maps to be occupied by 'copperas houses' (for example, **Plate I**). In 1997, the Canterbury Archaeological Trust was commissioned by English Heritage to expose, record and ascertain the significance of the remains. A further programme of excavation, took place in 1998. An Electronic Distance Measuring (EDM) survey of all exposed timbers (**Map 1**) was also undertaken.

Documentary research identified a wide range of records for the early Kentish copperas industry, including descriptions of the production process and associated equipment. It was also discovered that several researchers have compiled notes on, or written detailed accounts of, various aspects of the industry,[1] although a comprehensive history of the English copperas industry had not been written. This omission reflects a general neglect of the chemical industry's role throughout the history of the Industrial Revolution.

The copperas industry revolved around the production of ferrous sulphate (copperas) from iron pyrites (iron disulphide). The pyrites occurs as 'copperas stones' or 'gold stones', washed out by marine erosion from London Clay. The industry therefore developed at many sites, most being on the Essex and north Kent coasts.

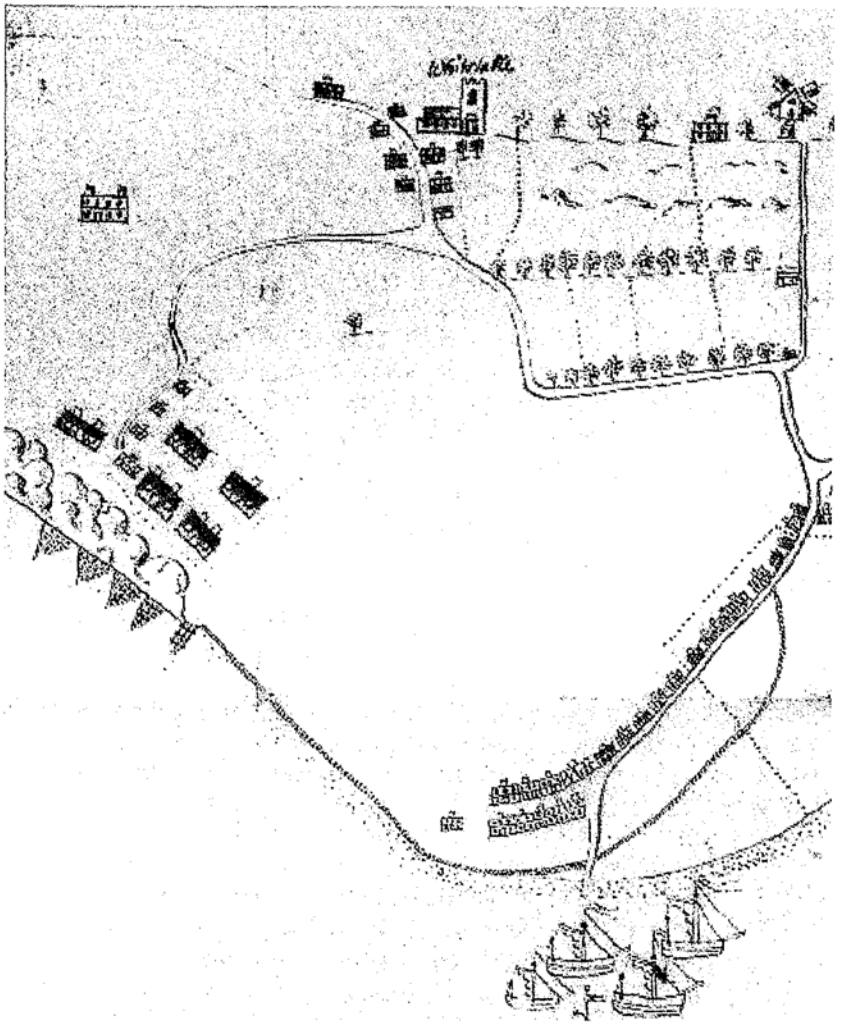
The uses of copperas

The principal use of copperas was as a textile dye mordant and saddening agent; and, in combination with oak galls, as a black dye.[2] Consequently, the industry was closely linked to the Kentish woollen industry, centred around Cranbrook in the Weald. A Cranbrook clothier's inventory dated 1567 mentions 'a c[wt] of copparasse and 5 li of allam, 20s'.[3]



Map 1 Tankerton copperas works: EDM survey with location plan.

PLATE I



Map of 1725 showing triangular complexes of wooden posts and associated buildings

Copperas was versatile and valuable. Common writing ink was made of copperas, galls, gum arabic and water. Some works such as those at Whitstable apparently used copperas solution to make ink without crystallising it. During the medieval period, copperas mixed with thornwood extract was used as scribe's ink (*incaustrum*, also *atramentum*) and to colour gold and in *repoussé* work. Copperas was widely used to colour leather goods black after tanning. Dyers used it to make Prussian Blue and, with lime, to improve the important dyestuff, indigo.

Nitric acid was derived from copperas used by gilders and brassfounders and, more importantly, to manufacture sulphuric and hydrochloric acids. Sulphuric acid was increasingly used from the mid seventeenth century to prepare coloured dyestuffs and England eventually developed a European reputation for this acid.[4] However, from the 1730s copperas was rapidly displaced as a source of sulphuric acid by technical advances elsewhere and by the late 1790s relatively little was used for this purpose.

Some iron pyrites was also used to produce sulphur, a strategic alternative to imported mineral sulphur. One sixteenth-century account[5] states that a third of the 'brimstone' used nationally went for the 'Tryminge and Dressinge of shippes and other vessels'. Sulphur was mostly imported at great cost from Sicily, which probably encouraged the search for a domestic supply. The account states that brimstone was 'Drawen out by force of the fyre of suche stones as here we psent to yr honrs wherof we fynd sufficient quantytie upon the Coastes of the Isle of Sheppey Whitstable and other Coasts therabouts'. A description of Sheppey by Lambarde in 1579 distinguishes between sulphur and copperas production.[6] A method of producing sulphur for gunpowder using iron pyrites was discovered by Christopher Saunders in 1570.[7] Here, a large pyramid of copperas stones on a platform of wood fuel was covered with earth and wet ashes, and then ignited to produce condensed deposits of sulphur. Saunders' discovery may explain the first-phase of gunpowder production at Faversham, established some time before 1573, when a Thomas Gyll is listed as a gunpowder maker.[8] It may also explain the location of the industry at Faversham, close to the pyrites beds of Queenborough and Whitstable.

Copperas was also used as sheep dip[9] and in the seventeenth century Dr Robert Plot attributed Sheppey's scarcity of rodents to the toxicity of copperas,[10] while an account of 1464 mentions '. . a cure for sore eyes using white coperose' (zinc sulphate).[11] The Royal Navy mistakenly used 'elixir' of vitriol to treat scurvy.[12] The medicinal use of copperas continued beyond the eighteenth century, when it was

used as a laxative. It later became the basis for many pharmaceutical products, especially Glauber's Sal Mirabile.

Origins and Development of the Industry

By the sixteenth century, woollen cloth production was the largest English manufacturing industry; in 1564-5 cloth and woollens comprised 80 per cent of English exports, mostly undyed cloth sold in Europe, often by foreign merchants. Under Elizabeth, English merchants were encouraged to explore new export markets for dyed cloth, which increased domestic demand for copperas. In 1562, a patent[13] was granted to a William Kendall of Launceston to find suitable ores for the manufacture of mordant in the Southern coastal counties but this, and other attempts to find domestic sources of pyrites seemingly came to nothing and expensive imports continued to damage the English economy. Fortunately Elizabeth I was able to attract 'certain foreign chymistes' and 'Dutch Mynerall men',[14] to England by granting 'patents which gave monopoly rights over both the production of the ore and its processing'. Thus, in 1579, Lambarde, describing Queenborough, stated that:

> Being in this Castle (in the year 1579) I found one Mathias Falconer, a Brabander, who did (in a furnace that he had erected) trie to drawe very good Brimstone and Copperas out of a certein stone that is gathered in great plenty upon the Shoure neare unto Minster on this Isle.[15]

Early interest in developing the Whitstable industry is recorded in a letter written in 1569 by Matthew Parker, Archbishop of Canterbury, to Sir William Cecil, stating that:

> This poor man cometh to me and signifieth that by the councel of a stranger whom he hath kept in his house, and by his own cost and industry, he hath found out the making of brimstone . ., and saith further that the stuff where he gathereth it on the shore of Whitstable is so fat, that it will yield so well that it will rise to a good comodity, and nothing so chargeable as hath been elsewhere proved to be.[16]

It is probable that the 'stranger' was one of the 'foreign chymistes' brought in by Elizabeth. A likely candidate is Cornelius Stevenson, a Brabanter who received the patent to produce copperas at Whitstable in 1565[17] but did not begin production at that time. Indeed, the first works were established in Dorset but these were quickly overshadowed by those in the South-East, nearer the London markets.[18] In Kent, major production sites were established at Deptford, Queen-

borough and at Whitstable (Tankerton). Apart from the Deptford and Blackwall works, many smaller works were established on the Thames (ships were the principal means of transport) and close to the capital (the chief market for their product), these works being mainly supplied with raw material from Dorset, Kent and Essex.

The industrial process required immense quantities of coal. The Queenborough works consumed about 300 tons annually up to the year 1640[19] and Whitstable received 5,000 chaldrons (about 13,250 tons) of coal yearly from Sunderland in the late eighteenth century.[20] It was previously thought that this went mostly to supply the Canterbury market, but most was probably destined for the Whitstable copperas works. The finished product was shipped out in barrels or casks. A typical cargo perhaps weighed between 8 tons (the amount carried by the *Content* to London in February 1688) and 11.5 tons (the average amount carried by the *Gift of Whitstable* and the *Thomas of Whitstable* in 1629).[21]

Contemporary descriptions of the Deptford, Whitstable and Queenborough works[22] show them to have been extensive but to employ relatively few people. However, larger numbers were employed in collecting the raw material; for example, in 1600 up to 20 people gathered 'copperas stones' in one tide at Whitstable.[23] We are also told of 'old iron, picked up by the poor people about our streets to sell to the coppperas makers'.[24] The transportation of both raw and refined material employed many more.

The English Civil War appears to have boosted the copperas/iron pyrites trade by increasing demand for dye (for uniforms), for pyrites (for pistols, fuses and gunpowder) and for the tanning and blacking of boots, saddles and harnesses. Once established, the domestic industry prospered and a century later (by the 1760s) England was the principal European copperas producer, making the industry a significant export earner. However, the southern industry gradually contracted during the eighteenth century and eventually collapsed in the early nineteenth.

The Queenborough copperas works represented a notable survivor. Copperas and brimstone were produced there in 1579 (Lambarde). The Queenborough Chemical and Copperas Works were acquired by the Stevens family in 1882 and by 1886 the company, re-named the Sheppy Glue and Chemical Works Ltd, was using sulphuric acid to manufacture organic and inorganic fertilisers, along with a wide range of other substances including bone glue, tallow and degelatised bone. In 1886 it began the manufacture of fertilisers using sulphuric acid produced from local pyrites. The company is still owned by the Stevens family and continues to produce fertilisers.

The Whitstable industry

The first history of the copperas industry in Whitstable was published in 1957,[25] although the industry in Kent had been mentioned by writers from the sixteenth to the early nineteenth centuries, examples being Lambarde (1579), Seymour (1776) and Hasted (1798).[26] The name Cornelius Stevenson first appears in the Whitstable lay subsidies in 1588, one year after his lease at Canford, Dorset, had run out[27] and it is probable that copperas production began in Whitstable around that time. However, it is also possible that, as in Essex, a rudimentary pyrites-based sulphur and copperas industry already existed. An undated State Paper issued earlier in Elizabeth's reign entitled 'Briefe Notes for the Makinge of Brimstone'[28] states the following in respect of 'the Coastes of the Isle of Sheppey Whitstable and other Coasts therabouts':

> The quantitye of Brimstone that may be made wicklie by the firnaces allreadie erected but not in full worke wilbe 2240 weight after this pporcon. The ffurnace is made to conteine XXtie potts, evrie one of seavenfote in Leynthe, evrie pott ... yeldeth his Brymstone foure tymes betwene daie and nighte...

Further evidence for early, local copperas production is supplied by the following account, dated 1572:

> ... the 17th daye of November in the 15 yere of the reygne of our soverigne ladye Elizabethe, one Crosse of merchunte man of London whyche he seyethe henowe by syghte, he went aborde of the said Lewes harder hys barke, lyeing atthe cryckes mouthe comyng in here to Faversham [some 10 miles to the southwest of Whitstable] and hys men delyveryd and shypped into hym the said Abraham Snothe hys hoye 4 fattes of cooperes..[29]

The copperas industry required considerable capital outlay due to the expensive equipment involved and the length of time before a return could be expected. Lack of capital may explain the earlier delay in initiating copperas production on a significant scale in Whitstable. However, Stevenson was named as a Trustee of the Whitstable Charities in 1589, suggesting he had profited from his Canford lease. He died in 1594 and his associate, Thomas Gauntlett, quickly married his widow and took over the running of the copperas works.

The Whitstable industry thrived and became the subject of fraud and deceit. Gauntlett soon became embroiled in legal suits as when he successfully filed a charge in 1600 against Arthur Bidolph, accusing him of assuming his name in order to obtain the lease to the

Whitstable pyrites beds.[30] In the same year, when Gauntlett transferred the works to Richard Shepham, his principal creditor, the deeds of conveyence contained the following:

> Inprimis the workhouse and coolinge house with a cesterne in the same workhouse and to bennes to drie the coppres. Item a furnes of leade with 13en barres of iron that the same furnes standeth uppon and iron plates that lie betwene the bottome of the furnes and the greate barres with the two iron grates that the fire is made on with the foundacion that the furnes standeth on. Item two coolers of leade for the coppres to congeale in, that standeth in the coolinge house. Item three beddes or raucks of goulde stones or sulphure stones to make coppres, that lie in a feilde wherein the workhouse now standeth, with 18 greate butts that stande in the the grounde to receyve the liquer from the goulde stones.[31]

Two of the earlier copperas works were situated on the coastal flats, now foreshore, north of the Tankerton Slopes, one being established around 1588, the other around 1610, both being lost to marine encroachment within 50 years. A document dated to between 1759 and 1765 shows that eventually six more were established on, above or near the Tankerton Slopes.[32] Buildings termed 'Copperas Houses', apparently ten in number, are shown schematically on a chart of 1770 (**Plate II**). Hasted states that six 'copperas houses' were in existence in 1798. However, a map of 1835 shows only one building in the area, and a contemporary description states:

> Near the sea shore, the manufacture of copperas ...was formerly carried on to a considerable extent; but; for some years, the works have been abandoned, and nothing is now remaining but a few ruinous buildings.[33]

The collapse of the Whitstable copperas industry, as elsewhere, occurred gradually throughout the mid to late eighteenth and early nineteenth centuries partly as a result of a decline in the south-eastern woollen and tanning industries. An additional factor in the decline of the Whitstable industry was marine encroachment, which turned the dry-land sites of the earlier works into tidal foreshore. Later works were sited less conveniently further up the Tankerton Slopes, with pyrites being hauled up the Slopes for processing, and copperas being transported back down to ships anchored off shore.

Charles Pearson, the last principal owner, acquired three of the Whitstable copperas works in 1780 and subsequently bought the remainder, having already acquired the copperas works in Deptford and the Walton works in Essex along with extensive copperas-

PLATE II

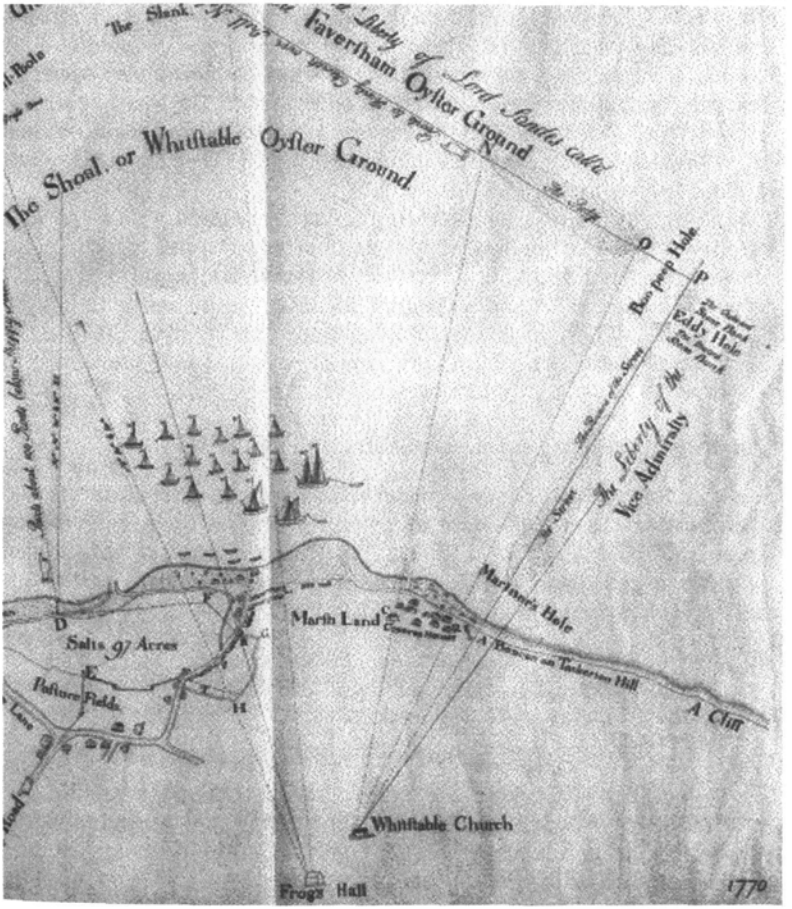


Chart dated 1770 showing increased number of 'copperas houses' (wording indistinct)

gathering rights.[34] Thus, for the first time the Whitstable industry passed into single ownership with Thomas Porter of Canterbury, possesser of the valuable skill of 'burning' (fusing) lead, appointed manager.[35]

By 1820, Charles Pearson Junior had taken charge of affairs at

Whitstable. He invested unwisely in several other ventures and was a minor investor in the Canterbury to Whitstable Railway (the Crab and Winkle Line), built in 1830 to a design by George Stevenson. This venture did not make money and the market for southern copperas, Pearsons' economic base, continued to contract. He was eventually (in 1836) constrained to sell the copperas works to his cousin, Wynne Ellis, having been declared bankrupt in 1835. Ellis chose not re-establish copperas production.[36]

Although the local manufacturing industries ended with Pearson's withdrawal, the collection of pyrites continued along the shore for many years. In 1853, Ann Woodcock of Herne Bay was drowned 'in quest of copperas'[37] and probably as late as the early twentieth century, the Whitstable fishermen '. . made idle by the gales used to supplement their income by gathering it [pyrites] and sending it to Germany to be used to make brown dye'.[38]

The archaeological evidence at Whitstable (**Figs 1-3**)

A 10m long section of a well-preserved plank-and-post structure and two abutting clay strips were exposed in Evaluation Area 3 during excavation [56/67, 57/59, Fig. 3]. The planks and posts were joined by mortise-and-tenon work and conformed in appearance with Colwall's description of a copperas bed:

> ... they make Beds ... about an hundred feet long, fifteen feet broad at the top, and twelve feet deep, shelving all the way to the bottom. They ram the Bed very well, first with strong Clay, and then with the rubbish of Chalk

These features were therefore interpreted as part of a repaired or rebuilt copperas bed associated with one of the two copperas works lost to marine encroachment before 1639. A plank-and-post structure of similar build and alignment was exposed in Area 2 [43, 44, 45, Fig. 2]. This was considered to be part of the same bed, suggesting that the bed was over 141ft long. This structure was identical in appearance and orientation with two smaller structures [52 and 54, Fig. 3] exposed in Area 3 and interpreted as earlier examples of copperas beds, again associated with a copperas works lost to marine encroach- ment.

Also exposed was a linear spread of chalk rubble and limestone blocks [35, 39, Fig. 2] immediately north of the bed in Area 2. An iron bar was embedded in the chalk's surface and the north-west edge of the linear spread abutted a row of 12 upright timbers [40]. This row was probably contemporary with another row of upright timbers [36], which intersected it, the contained area being flint-cobbled [37],

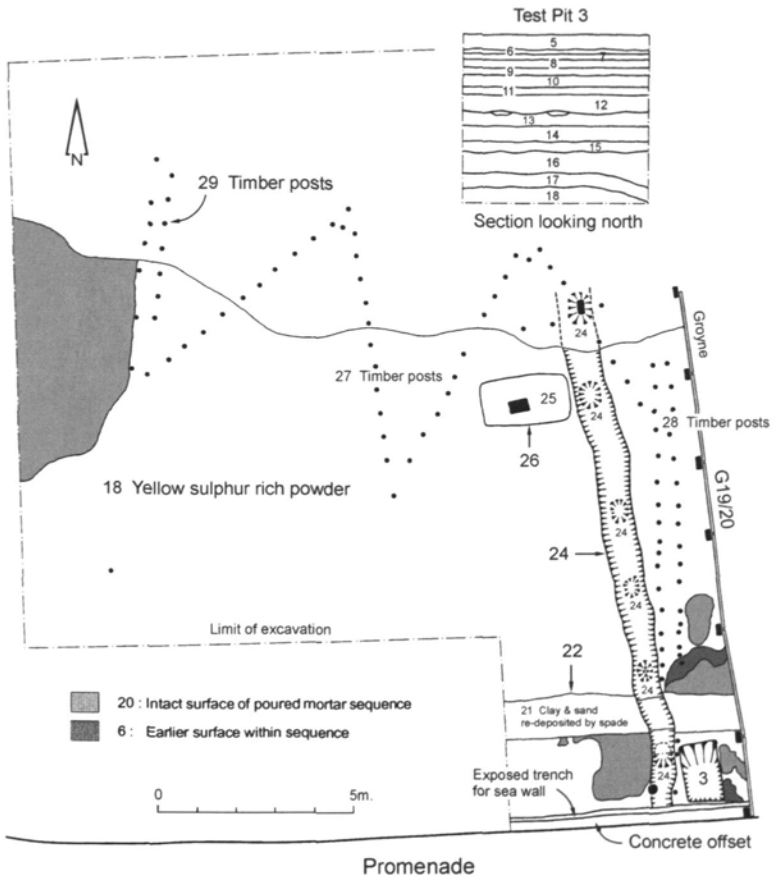


Fig. 1 Tankerton copperas works: plan of excavations in Area 1.

stained red-brown [38] and covered with brick fragments and iron nails. This was consistent with Colwall's description of the Deptford boiler as having '. . *crosswise ... ordinary flat Iron Barrs*' overlying 'sides . . made up with Brick-work'. The presence of nails (and perhaps the iron bar) was consistent with Fiennes' observation that, during the boiling process, 'they do add old iron and nailes to the Copperass Stones'. The red-brown staining was interpreted as waste residue from the copperas production process.

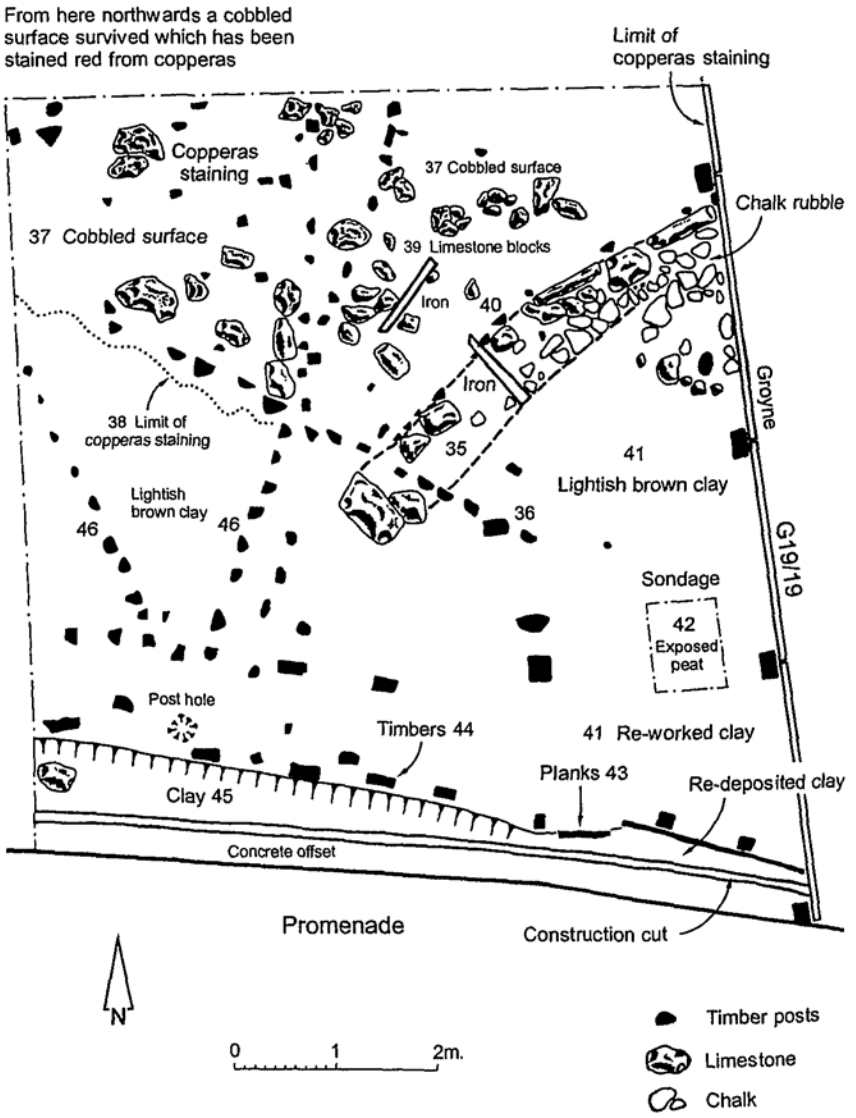


Fig. 2 Tankerton copperas works: plan of excavations in Area 2.

Copperas bed(s) [56/57 and 59/67, Fig. 3] appeared to be contemporary with an extensive, predominantly triangular complex of wooden posts [27, 28, 29, 46, 58, Figs 1-3] set behind an outer wall

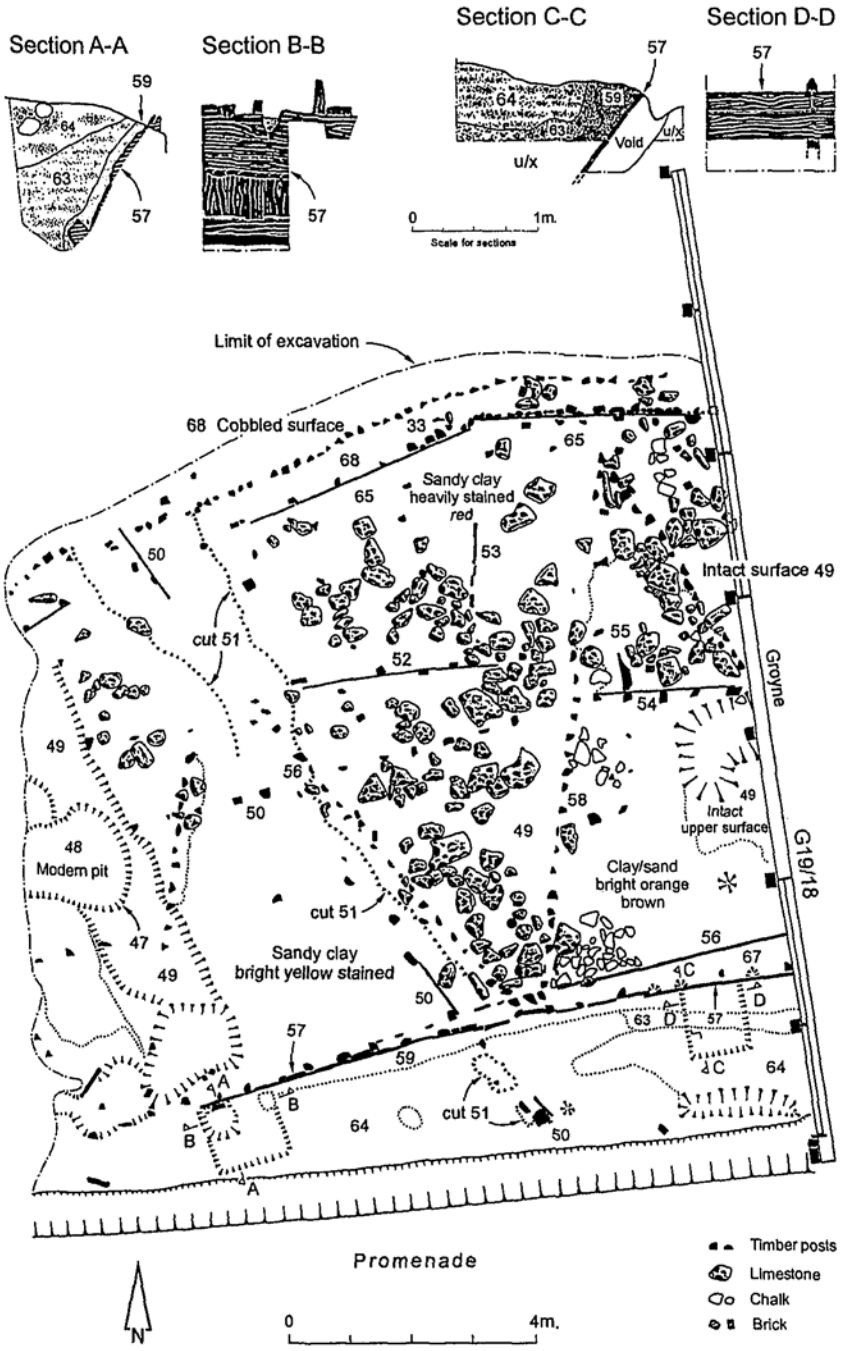


Fig. 3 Tankerton copperas works: plan of excavations in Area 3.

[33, 34, 33/65], contemporaneity being assumed on the basis that the northern apices of the triangles abutted or were abutted by the copperas bed. The triangular structures are shown on a chart dated 1725 (Plate I), providing a *terminus ante quem* for both the copperas bed(s) and the triangular structures. The latter were interpreted as the truncated supports for jetties, wharfing or similar, built to maintain a working area in the face of marine incursion by raising the floor level.

Overlying the above-described remains were many large mudstones from the Thanet Beds which outcrop on the Isle of Thanet, some 10km to the east. These were probably associated with work commissioned by Sarah Parker, owner of two Whitstable copperas works, a survey of which (predating 1775) states:

> By the Sea-side, eight large jetties and five small ditto, with long Wharfing and a great quantity of Stones fitted in, with land-ties and ironwork to all the same. Long land-piles, land-ties and planking to keep the upper ground secure; the whole having been done within these few years at a great expense.[39]

Maps of the early nineteenth century show only fish weirs and groynes to occupy the Tankerton foreshore, indicating that ultimately Sarah Parker's attempts 'to keep the upper ground secure' could not prevail against the forces of nature.

The southern copperas industry was one of the first heavily-capitalised, large-scale inorganic chemical industry to be established in England. As such, it played a very significant role in the English economy from the late sixteenth to the mid-eighteenth century. It also provided a catalyst for the development of the modern chemical industry, and in this respect, can be seen to have played a major role in the industrialisation of the British economy. Previously, such a role for copperas, and the importance of Kent in its exploitation, has been neither acknowledged nor well-understood. It is hoped that the above will provide a more balanced view.

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