THE EXCAVATION OF A RED HILL AT PELDON, ESSEX, WITH NOTES ON SOME OTHER SITES

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INTRODUCTION

MAN has had need of salt since the time of the early farming settlements; not only for himself, his cattle and the preservation of meat and fish but also for the curing of skins and for barter and trade. Solar evaporation of sea-water was feasible in Mediterranean-type climates, but on the Atlantic and North Sea coasts it was necessary first to evaporate sea-water in open tanks until strong brine was obtained which was subsequently crystallized over gentle heat.

The Essex coast was ideally suited for the production of salt by this method and the remains of many sites exist to this day; characterized by the reddened earth, they are known locally as Red Hills. The first recorded investigation of these ancient workings was in 1906 when the Red Hills Exploration Committee was set up under the chairmanship of Mr. I. Chalkley Gould and Mr. Francis W. Reader was appointed to direct the excavations.[1]

The characteristic artefacts used in this industry vary from site to site and the finds from excavation are more prolific than those found when field-walking. The accepted name for salt-making artefacts is briquetage[2] and details of those found on the site under discussion, with comparisons from other similar sites, will be reviewed here. It is recognized that the industry of salt-making covers a wide field, but this paper deals only with the Iron Age, Belgic, and Romano-British periods.

During the past fifteen years the red glow in exposed salting walls and the newly ploughed fields bordering the marshes has led to much field-walking and recording. In 1971 it became possible to mount a full-scale excavation in a small field near the road which leads to the Osea Island causeway in the River Blackwater (now known as the Osea Road Red Hill).[3] After two years' productive excavation here it was considered advisable to excavate another similar site at some distance from the first in order to check the finds and to compare the differences, if any. The site at Peldon was found[4] and the ensuing excavation is described in this paper.

LOCATION

The road west from the Peldon Rose Inn runs roughly parallel with the marsh. From the road the field, O/S 5778, slopes southwards to the marsh which is enclosed by a sea-wall erected some 300 years ago (fig. 1 and pl. xxv*a*). In the spring of 1973 red earth was noticed in the walls of the dyke on the landward side which closer examination proved to be part of a Red Hill. An attempt was made to excavate here but the shallow spread of red material proved to be unworkable. Accordingly the marsh on the seaward side was investigated and briquetage was found in the walls of two large tidal basins (pl. xxv*a*). Land sinkage has been

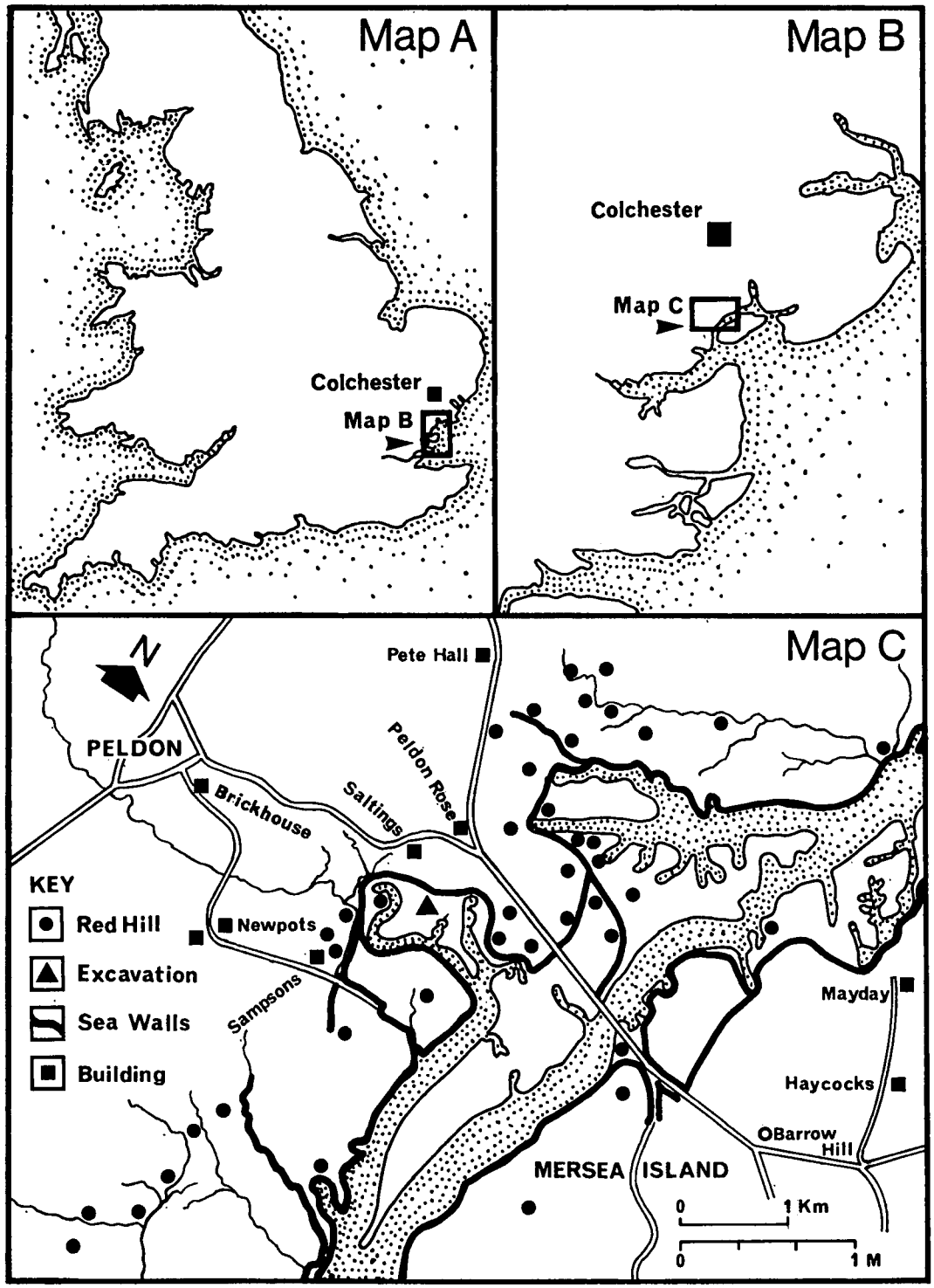


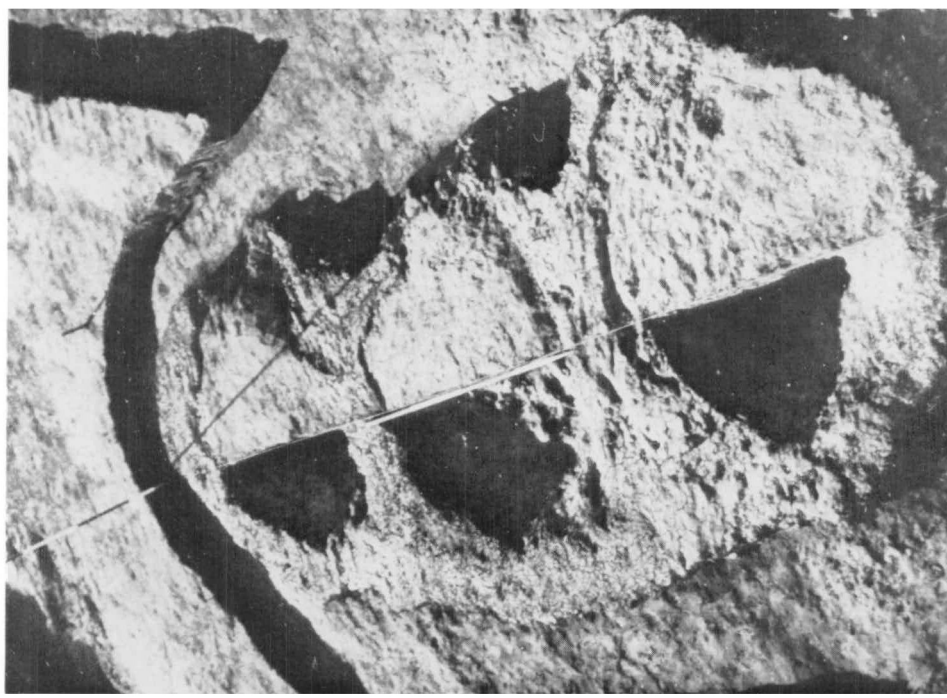
FIG. 1. Location maps to show position of Red Hill at Peldon and of others in area

Photograph: I. McMaster

a. Aerial view of Peldon Marsh (site at intersection of arrows)

Photograph: B. A. Bonner

b. Peldon Red Hill: evaporation tanks and hearth



considerable since Roman times[5] and these basins may be eroded creeks. Between these a small plateau afforded space for the excavation. The sea-wall is separated from the marsh by a creek and access was available by an old peatway leading across the site. A trench was marked out 2 m. wide and 13 m. in length, at O.D. 3·287 ft., N.G.R. TM 00551560 (fig. 2).[6]

Excavation

Having removed the cover of tough marsh plants, the top layer of alluvial mud came away easily from the red level 20 cm. below. Immediately, the problem of water seepage became apparent and channels were dug to the creek basins on either side which facilitated drainage of the site on the falling tide. The whole area was cleaned as far as conditions would allow and traces of clay structures were revealed which from experience at Osea Road could be identified as evaporation tanks. In order to expose the complete outline, the red infill surrounding them was removed and the original trench enlarged to the west and two conjoined tanks were confirmed. The wall connecting them was lower at the centre and could have been the remains of a sluice. An apparently meaningless jumble of clay to the south-west proved eventually to be a third tank; this too had an inlet from the central tank and an outlet, both of which could have been controlled by sluices. The tanks were sited as usual with the broadest aspect facing north-west and south-east to obtain the greatest effect from the prevailing winds, so important for maximum evaporation. The south-east wall was of massive construction and showed signs of reinforcement at some time; this would appear to have been the seaward side. The tanks were made of raw clay, firmly rammed down and the surface smoothed. They were placed immediately on top of the natural blue clay.

The position of the evaporation tanks having been established, the area round them was cleared of red waste. On the south this was of considerable depth and, except for a dense patch on the southern perimeter, there was little or no briquetage here or on the east. On the north, however, there was a platform of yellow clay extending from the edge of the tanks to the top of the northern slope. A strange saddle-shaped extrusion lay in the centre, obviously purpose-built, but it was not possible to determine its function. On each side of this perimeter two small clay-lined pits emerged, probably the 'heads' of gullies from which sea-water could have been obtained for topping-up the tanks. Beyond, a series of small terraces sloped down to the fleet, each tight-packed with briquetage interspersed with carbonized wood. It is possible that another set of evaporation tanks lies beneath the unexcavated area to the east.

Close to the central tank, on the west, there was a solid platform of red material containing many fire-bars, container rims and body sherds, carbonized wood, and lumps of green-glazed clay, the whole suggesting intensive crystallization; further investigation of this feature was postponed until the associated areas had been excavated.

Further to the west and south-west the outwards slope of massed briquetage continued and tests by auger in the tidal basins indicated the extent to which the red debris had spread. It was becoming increasingly clear that the central complex

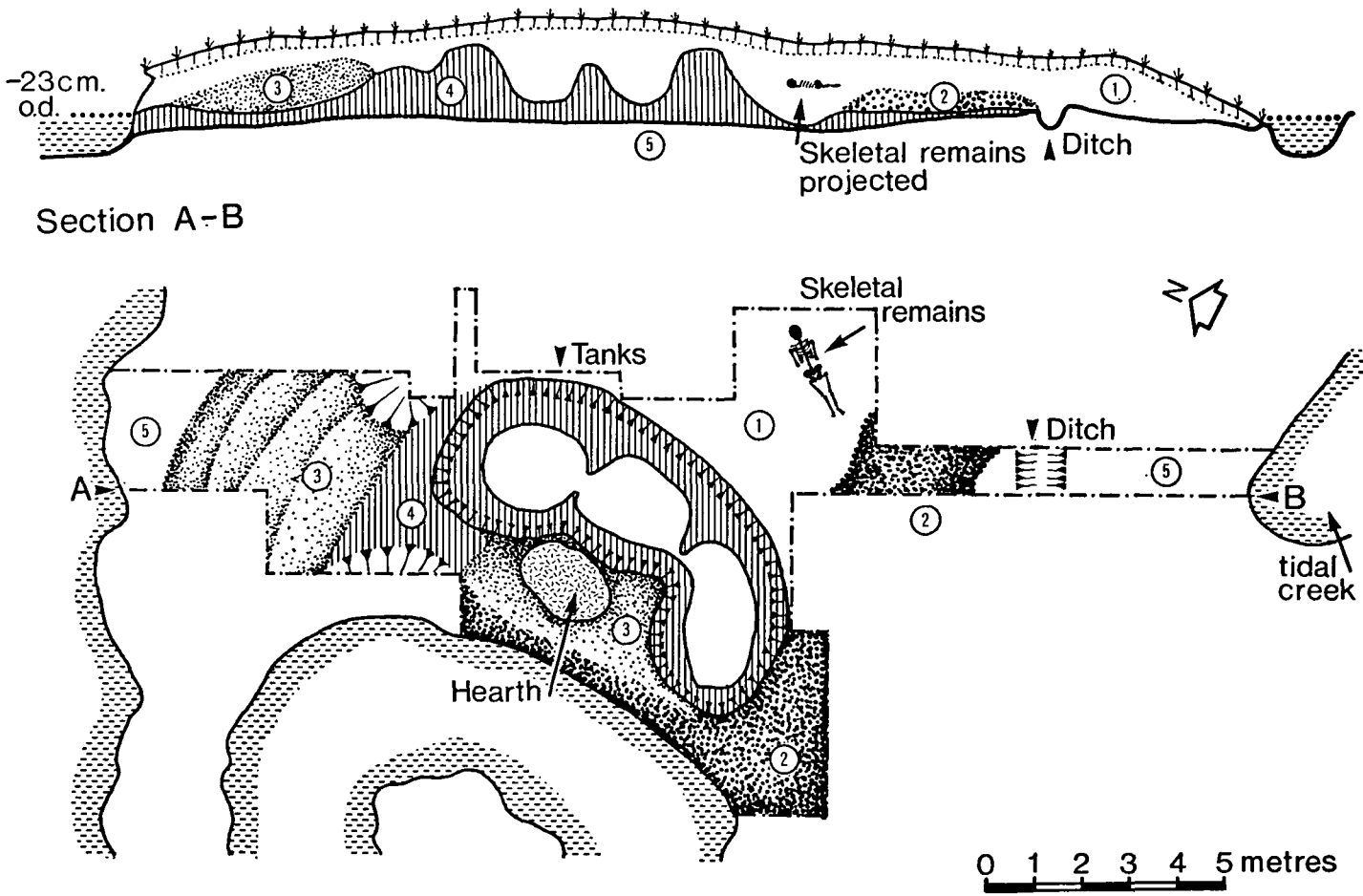


FIG. 2. Plan and section of Peldon Red Hill (layer key: 1, red infill; 2, briquetage; 3, briquetage and ash; 4, yellow clay; 5, blue clay)

of evaporation tanks and working floors was situated on a clay platform sloping down on all sides. An extension of the main trench on the south revealed clean blue clay descending to the tidal creek (fig. 2).

During the excavation to the south of the tanks the bones of two human feet were revealed protruding from the baulk on the east side. Accordingly, a rectangular box was dug at this point and what appeared to be an almost complete skeleton was found. In the new baulk now exposed, the outline of a ditch could be seen, the base of which was level with that at which the bones were lying. There was no sign of a grave and the silt had permeated through and under the bones. Expert assistance was enlisted[7] and the bones were lifted. The skull, which was in many pieces held together by mud, was carefully washed in the laboratory. It was then found that several small bones and vertebrae had become entangled with it, confirming the theory that the body had been dumped in the ditch and water running through it had washed the head on to the torso. Several small bones and teeth were recovered from where the bones had lain. Subsequently all the bones were taken to the Museum of Archaeology and Ethnology in Cambridge where they were processed by Mr. C. B. Denston whose report is to be found in Appendix I (pl. xxvi*b*).

The Western Hearth

Finally, the area of intensive working to the west of the central tank, mentioned above, was excavated. Almost immediately an important discovery was made. Elsewhere on the site hearth walls of hard-fired clay had been found, one surface of which was carefully smoothed and the other rougher, seeming to have come away from a softer surface. The rims were flat and hard and many bore the unmistakable indentations of fire-bars (fig. 10, 19). What was found here was quite different; it was a curving wall of solid red clay, the inner surface of which was fired hard. When the close-packed briquetage inside was removed, a continuation of the wall, at a lower level, was found on the east side. At the bottom was a hard green-glazed floor on top of which was a thick level of carbonized wood. Where the wall met the floor, the impressions left by the fingers exerting pressure to merge the two had also been preserved by firing (fig. 10, 20 and pl. xxv*b*). There was no wall remaining on the west but bands of white fused clay curved round to meet the opposite side.

It was clear that the wall had been reused several times as large pieces of earlier fired faces were found behind the final surface. Lumps of fused clay and fragments of fired floor had been incorporated in the structure, presumably to strengthen it. At one place two pieces of clay patching flaked off the inside of the hearth, the inner face smoothed and the outer quite flat where it had adhered to the wall (fig. 10, 21). After this find *in situ* several other similar patches were recognized. Finds at Osea Road of similar working floors and on the northern terraces of this site have established that when a hearth had been used for crystallization it was broken up and levelled and a new one constructed on top. Such is the practice in Africa today.[8]

When the surrounding walls had been removed and the uppermost floor cleared, Mr. A. J. Clark[9] carried out a magnetic survey. As can be seen from the plan (fig. 3) the northern end of this level was hard green fired clay and the central section soft red fired clay; samples were taken from both. Subsequently a large amount of carbonized wood from Level 5 was sent to Mr. Clark for radiocarbon dating. His reports appear as Appendix II.[10]

It was now possible to proceed with the excavation of the hearth. This was done level by level, a plan being made of each. The surrounding area was included on Level 7 only; obviously this was the first to be excavated but the last to be used. There were traces of more than one hearth on each level. The material used throughout was, of course, clay and the different degrees of firing were apparent only as differences of colour. The absence of datable material throughout emphasizes the importance of the scientific dating referred to above. The sea covered the site with every tide during excavation and, as the level became lower, more water remained. This had to be removed and the surface dried by sponges before work could be continued. A deeper drainage ditch to collect the constant seepage was dug on the west side of the hearth and periodical baling ensured a dry working area.

As stated above, Level 7 (fig. 3) was the highest level of the hearth remaining (depth 50 cm.) though there may well have been later hearths above this, eroded in antiquity and indicated by curving white lines at higher levels. The hard green floor merged with softer red clay near the wall at the south, the whole being covered with a thick layer of carbonized wood and ash. Imbedded in this was a slab of briquetage, a body sherd from a large container. Its smooth, eroded surface suggested that it had been used as additional hearth flooring.[11] From this it was inferred that large body sherds of similar appearance found on other parts of the site had been employed in a like manner. The plan of Level 7 (fig. 3) shows the alignment of the original hearth visible in the photograph (pl. xxv*b*), while a hard green floor, surrounded by red clay and ash within an enclosing strip of soft red clay, occupies most of the rest of this level. The narrow white strip enclosing the green floor is the uprising edge of a lower floor. Part of the latest hearth has been broken away showing yellow clay beneath this and the green floor.

Plans of the other six hearth levels are not included here. However, details of these are as follows:

Level 6 had another, lower, green floor on the north, a hard red floor on the south, and a soft red floor on the east. The edge of the lower white floor was still visible and a mixture of clay and ash appeared on the northern perimeter.

The white floor was partially uncovered on Level 5. It was markedly concave and the northern, cupped edge was roughly rectangular. At the south were two floors of hard red, one stippled with white, and, in the centre, a dense patch of carbonized wood was bounded by a strip of hard red on the north side, a white strip on the south, with yellow on the eastern edge. The carbonized wood seemed to consist of large-grained wood lying east and west and at the eastern end was the point of a fire-bar. Part of the green floor remained at the centre of the west side with soft red on the north-west, north, and north-east perimeters.

Level 4 was very confused with soft red, green, hard red, yellow, and two patches

PELDON RED HILL: 1976

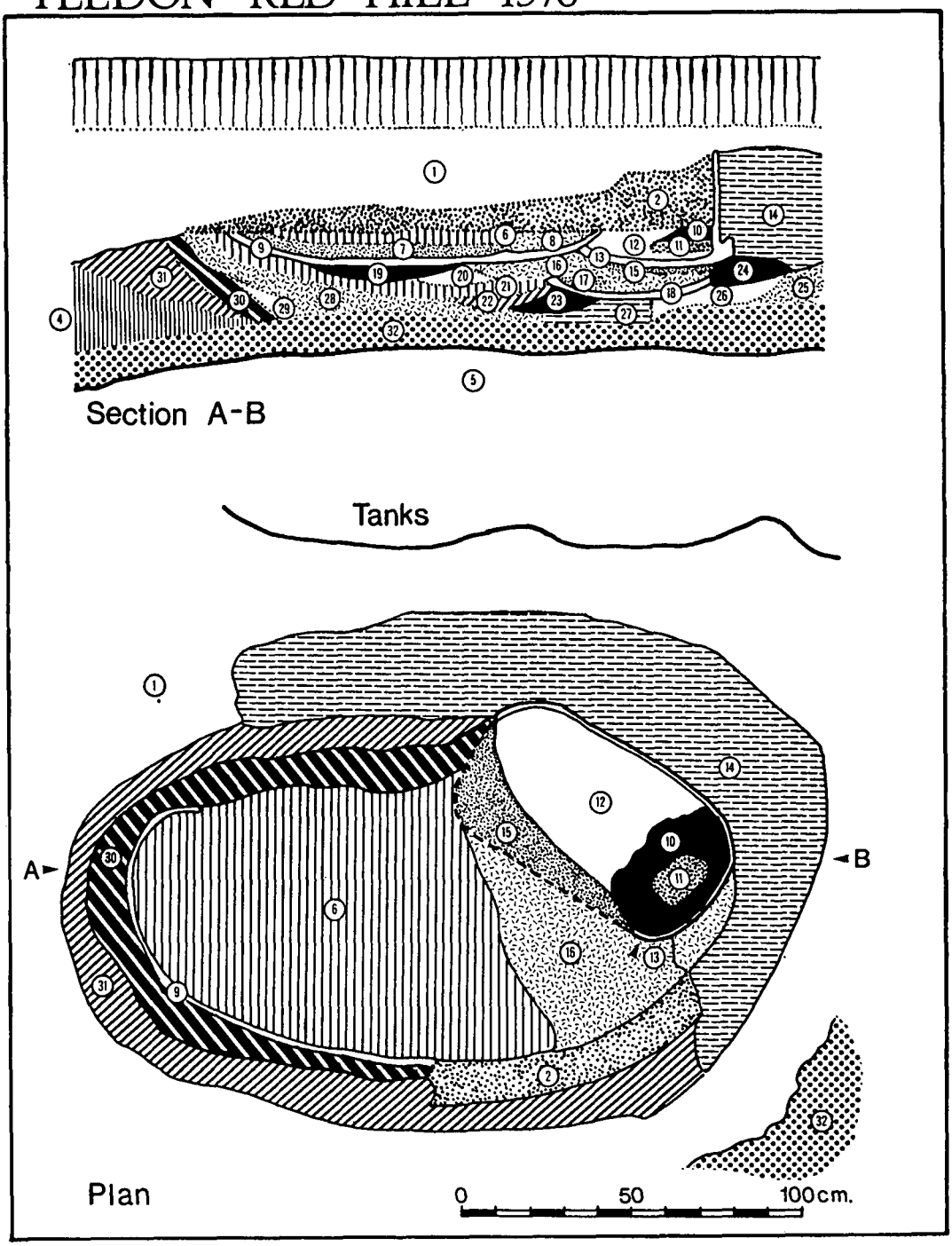


FIG. 3. Peldon Red Hill: plan and section of hearth (layer key: 1, red infill; 2, briquetage; 4, yellow clay; 5, blue clay; 6, 21, green fired clay; 7, 15, 17, yellow fired clay; 8, 12, 16, 25, 28, hard fired red clay; 9, 13, 18, white fired clay; 10, 19, 23, 24, charcoal; 11, briquetage and ash; 14, 27, red matrix; 20, 26, 29, red clay and ash; 22, 31, soft red clay; 30, hard fired red clay with white striae; 32, ash

of carbonized wood. The central patch seemed to be surrounded by rudimentary walls.

At Level 3 nearly the whole area was hard red with a patch of green and yellow in the centre and two patches of carbonized wood at the southern end.

A hard red level covered most of Level 2 with a large patch of soft red in the centre. There were two small patches, one yellow and one green, at the northern end.

The whole area of Level 1 was covered with granulated black ash, the northern end sloping downwards. In the centre lay a patch of hard red stippled with white. At the south-west corner there was a solid wall of hard red with a patch of hard red stippled with white on the outside. The layer of black granulated ash under the features described above extended over the whole area and varied in depth from 6 to 14 cm. In fact, it continued beyond the boundaries of the hearth area and it was not possible to define its ultimate limits. Immediately below it, at a depth of 90 cm., was the natural blue clay. This blue clay is the raw material from which everything on the site was made including the briquetage, the tanks, and the clay platform surrounding them, and is only blue when unexposed. When used in its unfired state it is brown on the outside and butter-coloured underneath.

In short, the hearth area consisted of various levels which were compacted into a thickness of 40 cm., excluding the 30 cm. of briquetage and red waste above. Traces of thirty-six floors were identified as follows:

Level 7—5 floors
" 6—4 "
" 5—6 "
" 4—8 "
" 3—5 "
" 2—4 "
" 1—4 "

The extensive layer of granulated ash might possibly have been the site of bonfire firing in the earlier stages. This is discussed below. The section of the hearth area was built up as the individual levels were revealed (fig. 3).

The End of the Excavation

The excavation at Peldon went on generally at weekends during the summer months of 1973–6 according to the state of the tide. During this time rescue surveys were made on some other Red Hill sites. One was at Little Wigborough on a field just inside the sea-wall ahead of levelling and another at Langenhoe marsh where the material was being used to repair the sea-wall. Visits were also made to Cooper's Beach, East Mersea, and to the site on the River Thames, between Leigh Beck and Deadman's Point, on Canvey Island, both of which are being eroded by the sea. The finds from these sites are discussed below.

The Finds

1. *Pottery*

Very little pottery was found. The finest and most complete vessel was a Belgic butt-beaker of Camulodunum types 115–18 of which just over half was

recovered from three separate find-spots in three different years (fig. 5). There are two separate double cordons at the shoulder and four separate burnished bands below. The pedestal base has a burnished band 2½ cm. wide and the over-all height is 25 cm. The material is black and hard with the characteristic 'soapy' feel and a marked tendency to flaking. A sherd of similar ware from the carination point of a large vessel was also found. In addition a number of sherds of early Iron Age and Belgic ware were recovered, none of which was closely identifiable.

In contrast, the pottery from Osea Road, excavated in 1971/2,[12] represented a much wider range, consisting of eighty-six stratified and forty-six unstratified sherds dating from Iron Age and Belgic to early Roman.

2. *Artefacts and briquetage*

(*a*) Evaporation tanks (figs. 2 and 4)

It has already been stated that these tanks were used for the evaporation of sea-water to brine which was subsequently subjected to gentle heat to obtain crystallization. For this purpose the tanks were sited so as to receive the full benefit of the prevailing wind. Although the heat of the sun helps, it seems a good drying wind is more important. During the excavation at Peldon, there was one exceptionally low neap tide when the sea was not able to flood the tanks and only 48 hours was needed to reduce the contents to a shallow residue of strong brine. Some of this was placed in a flat dish on an oil-fired boiler and salt crystals were produced within 36 hours. No doubt a brushwood fire would be much hotter and results obtained more quickly. There does not seem to be any reasonable explanation as to why the tanks should be in sets of three; but this was also the case at Osea Road[13] where two sets were found in the first year and three in the second. An overhead photograph (pl. XXVI*a*) of one set shows the tanks with the infill sectioned across the centre. The massive walkways between the tanks may be seen in the photograph with indentations on the working side to provide easy access for the operators.

A third example of evaporation tanks was discovered in the early 1960s when the Hill at Lauriston was summarily demolished by the local farmer and spread over his fields to improve fertility. Two sets of tanks, also triple, were revealed, but at that time it was not fully realized for what purpose they had been constructed. Reader excavated here in 1907 (his number 'X')[14] and, though he mentions a mass of bedded clay rising to the height of 3 ft., he does not seem to have found evaporation tanks here or in any of his other sites.

(*b*) Fire-bars (fig. 6)

There seems little doubt that the fire-bar is the common denominator on salt-making sites. It can take different forms, the most usual being an elongated rectangle having a wider section in the centre of the base to withstand stress. These are illustrated here (fig. 6) but are shown reversed to bring out variations in the centre base section.

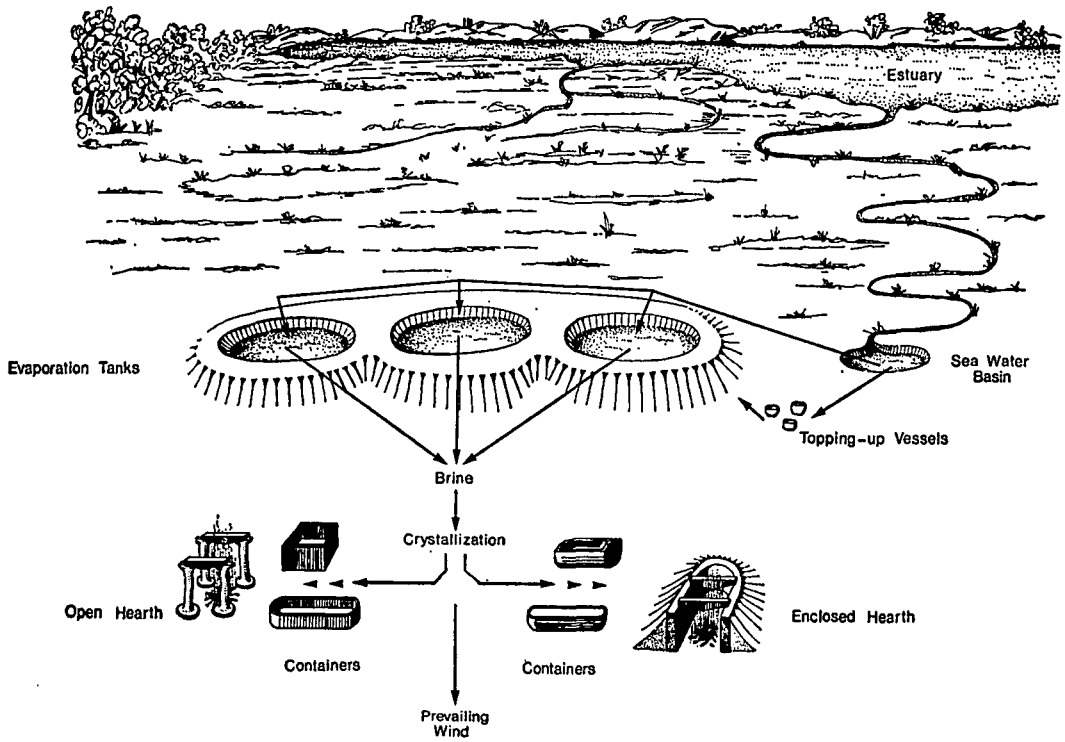


FIG. 4. A suggested sequence for the operation of a Red Hill

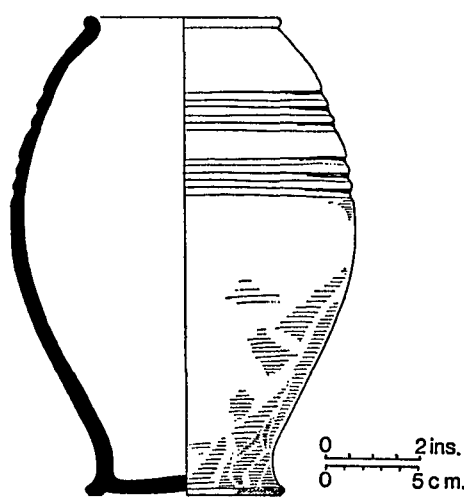


FIG. 5. Belgic butt-beaker from Peldon (scale ¼)

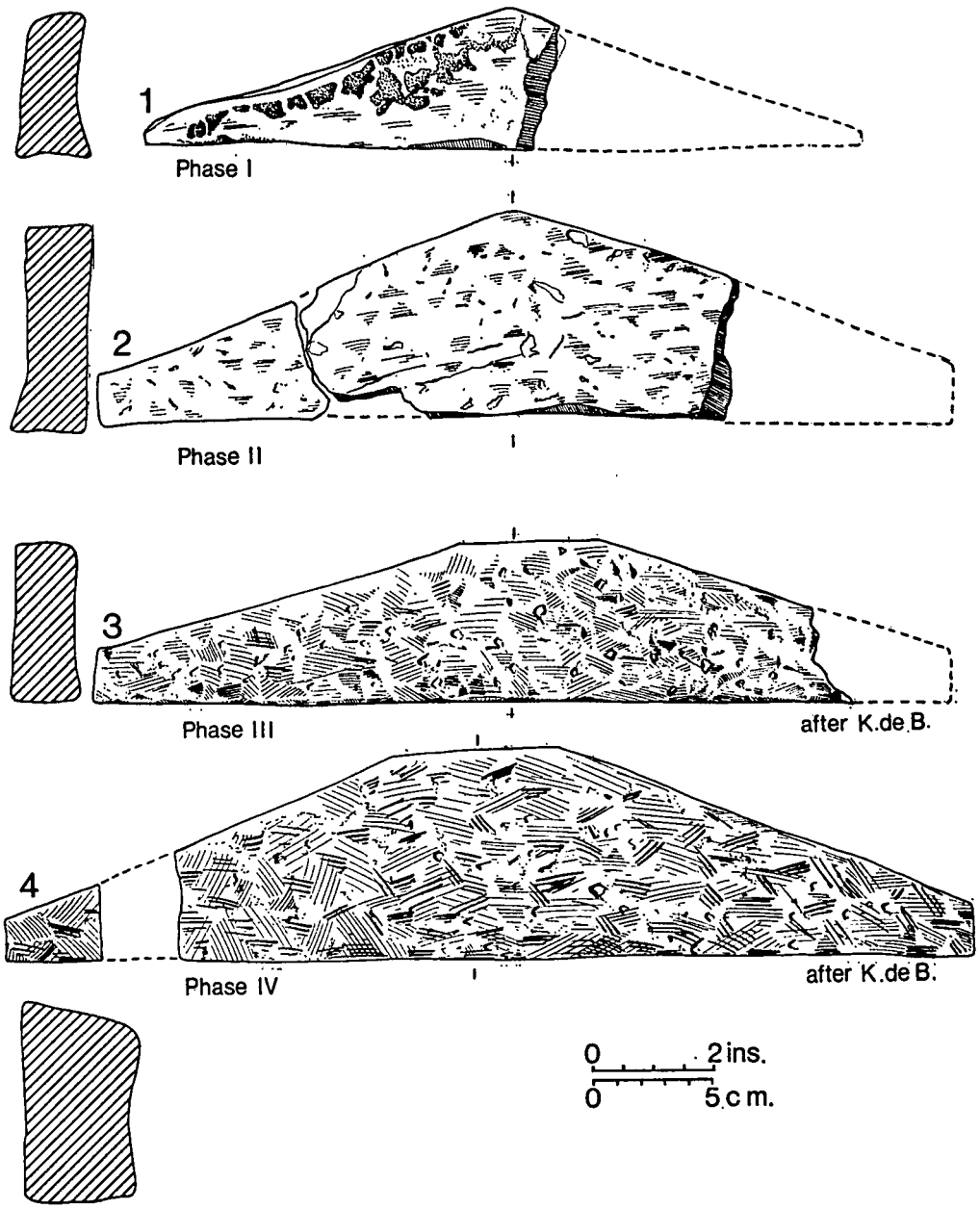


FIG. 6. Evolution of fire-bars (1, 2: Peldon Red Hill; 3, 4: Osea Road Red Hill)

A study of fire-bars found on the two sites excavated, Osea Road[15] and Peldon,[16] has been made in relation to subsequent discoveries and associated pottery. This points to the heavier, rougher bars with a flat section at the base and squared-off ends to be of a late date; while those with a pointed base section and pointed ends are the earliest types found so far. In short, the earlier types are more finely and the later more coarsely made.

From this four main phases emerge (fig. 6) with minor variations. A complete bar, in mint condition, has yet to be found; no doubt they were broken up with the rest of the hearth furniture at the completion of each firing as is the practice in Africa today. Usually the pointed ends are found, sometimes the middle section. At Peldon the figures are as follows:

Phase I (pointed end)	35
Phase II (squared end)	47
Middle sections	29

The width varies from 1·4 cm. to 3 cm. The early one illustrated (fig. 6, 1) is of particular interest as it was almost complete and was found in the centre of a patch of intense burning at the lowest level of the north end of the Peldon site. It had been subjected to great heat, being greenish in colour with several droplets of green salt glaze on one side. Just under half of a similarly burnt bar, phase II type, was found among the carbonized wood of the western hearth at Peldon, Level 5, and a small fragment of the same type was included in the make-up of the wall of this hearth. Reader found 650 fire-bars during his excavations of which 350 came from Lauriston.[17]

Other finds of fire-bars have been reported from: Cooper's Beach, East Mersea, Essex;[18] Home Farm, Peldon, Essex;[19] Further Lower Barn Field, Copt Hall, Wigborough, Essex;[20] Wick Farm, Burnham on Crouch, Essex;[21] Helpringham Fen, Lincolnshire;[22] Mucking Excavation, Stanford le Hope, Essex;[23] Orsett Cock cropmark site, Orsett, Essex;[24] Rushden, near Wellingborough, Northamptonshire.[25]

Fire-bars also occur as straight rectangular rods but these are usually found in Roman and medieval contexts with which we are not concerned here.

(*c*) Fire-bar slots

The use of fire-bars has been brought vividly to life by the recent discovery of various impressions and slots in hearth walls. It seems the use of hearth walls was found by some to be more efficient than pedestals for the support of fire-bars and, consequently, the placing of the brine containers over the fire. Pedestals are discussed below but, on Essex sites, they are the exception rather than the rule and would have meant an increase in labour to make and to fire them. A solid, continuous wall was more efficacious and the bars could be firmly bedded on it. The marks of fire-bars were first noticed at Peldon (fig. 10, 19) where they appeared on several pieces of hearth wall. In 1975, during a rescue survey on Sawdon's marsh,[26] a large piece of hearth wall was found at the bottom of a creek which had cut through a Red Hill; this contained a deep slot which exactly fitted the end of

a fire-bar (fig. 10, 23). This resulted in another study of Reader's report[27] and of the material in Colchester Castle Museum[28] where another example was found (fig. 10, 22).

(*d*) Pedestals (figs. 7, 8)

The pedestal is well known on many salt-making sites and, as has been described above, was probably used in two or three sets of pairs, with a fire-bar across the

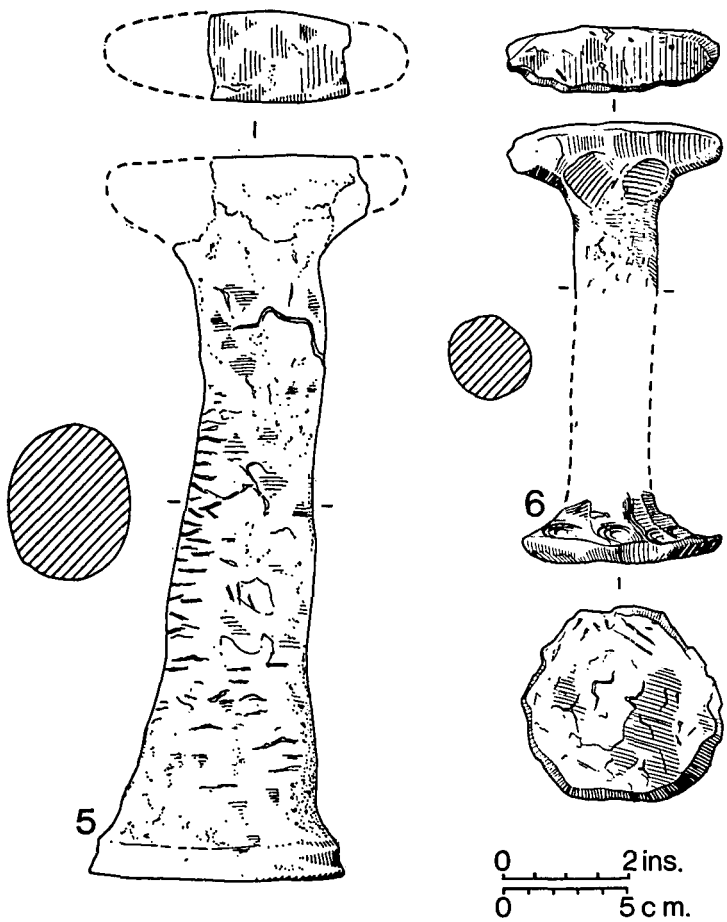


FIG. 7. Pedestals (5, Osea Road Red Hill; 6, Coopers Beach Red Hill)

top of each pair; marks on pedestal heads have been found to support this theory. Such a structure could easily carry the large rectangular type of brine container. A fire between the pedestals would provide the heat for crystallization. It has been stated above that fire-bars were used at Peldon in conjunction with hearth walls but, in fact, one single pedestal head was found at the furthest extent of the hill on the southern side; it measured 11 cm. in length and 4·5 cm. in width and can

compare with those illustrated (fig. 7). Although the site was cleared down to the natural blue clay no other example was found.

The large pedestal (fig. 7, 5) comes from the Osea Road Red Hill and the smaller one from Cooper's Beach, East Mersea (fig. 7, 6). Reader found pedestals only at Langenhoe I (2) and Lauriston (110)[29] but finds are reported from Hook, Hamble, and Burlesden.[30] Recently pedestals have been found in an Iron Age/Romano-British context at North Cave, a few miles west of Hull.[31] These have flat bases with a diameter of 7 cm. and one large example with a cupped top, diameter

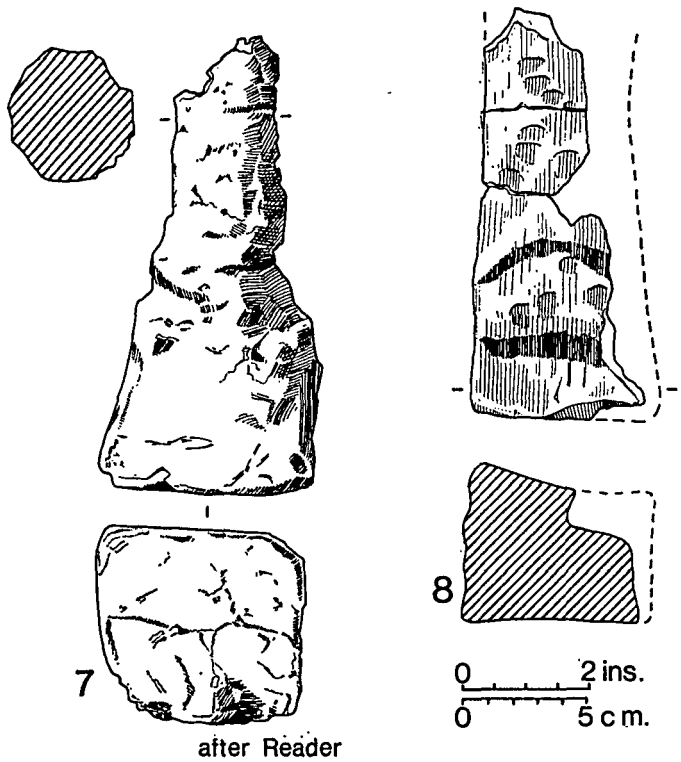


FIG. 8. Pedestals (7, Lauriston Red Hill; 8, Sawdon's Marsh Red Hill)

11 cm. In all cases the opposite end is missing. Some interesting examples have just been discovered on the Mucking excavation, Stanford le Hope, Essex. These have cupped heads similar to the Niger examples[32] but they have 'fish tail' bases presumably intended to be inserted in the ground, a theory supported by the fact that some have been packed with clay, perhaps to ensure a firmer seating.[33] In view of the geographical location it is perhaps not surprising that they are practically identical with those found in the Upchurch marshes, Kent, before 1830.[34,35] Another pedestal form has a splayed foot, rectangular in shape (fig. 8, 7 and 8). The latter was found on Sawdon's Marsh, Langenhoe[36] and the former, which came from Lauriston, is in the Colchester Castle Museum collection[37] (see also Reader).[38]

A fragment of the same pattern was found after ploughing on Home Farm, Peldon.[39] In none of these examples has the pedestal head been found but similar examples on the Continent have a smaller rectangular head.

(*e*) Wedges

Confusion has arisen because this term is sometimes applied to fire-bars or the ends of fire-bars; but if the accepted position for a fire-bar is across a pair of pedestals or to span the walls of a hearth, then it must be long enough to do this, i.e. 30–40 cm.

The wedges illustrated (fig. 9) are all roughly triangular in form and could be used in the manner shown in the central diagram. The one from the Peldon site (fig. 9, 9) has one corner broken off and the clay immediately adjacent to this break is bright red while the opposite end shows signs of having been exposed to heat. That from Leigh Beck, Canvey Island (fig. 9, 10),[40] is thicker, but this site has much Roman material and it is, perhaps, another example of the degeneration referred to above. The fan-shaped wedge from Sawdon's Marsh (fig. 9, 12)[41] is a variation in shape but, again, has one corner broken off. The fourth (fig. 9, 11) is from the Colchester Castle Museum[42] and was found by Reader at Langenhoe.[43]

(*f*) Pinch props

These strange little objects (fig. 9, 13–18) were found throughout the excavation at Peldon. In all, eleven were recovered and the only common factor was a flat base and one of more faces suggesting that they had been pushed up against another surface. They were the only artefacts to have no organic tempering in their make-up and were probably small lumps of raw clay which were used to level or prop up vessels or fire-bars on the working floors and were fired in the process. Attention is drawn to them only because, though small, they were obviously part of the working equipment and, as such, may be useful as a reference in the future. Two were found by Reader and are now in the Colchester Museum. Similar objects are used in Manga[44] today between the salt moulds on top of the pedestals.

(*g*) Short rods

The short rods (fig. 14) may have had a similar function to the pinch props, albeit on a different scale. Examples of these are also in the Colchester Castle Museum collection[45] and were found by Reader at Lauriston.[46] They are found today on the Lincolnshire saltern sites[47] in conjunction with hand-bricks which have not yet been found in Essex.

(*h*) Hearth walls

A characteristic feature of the Peldon site was the number of large heavy sherds, the rims of which appeared to have been cut or trimmed with a knife or cord. One face was smooth with vertical grooves and with a horizontal incised line just below the rim (fig. 10, 19), the other face was rough and unfinished, as if it had flaked off from a softer surface, as mentioned above. There were twenty-eight of these, two of which had an additional rim at right-angles, perhaps from the mouth or

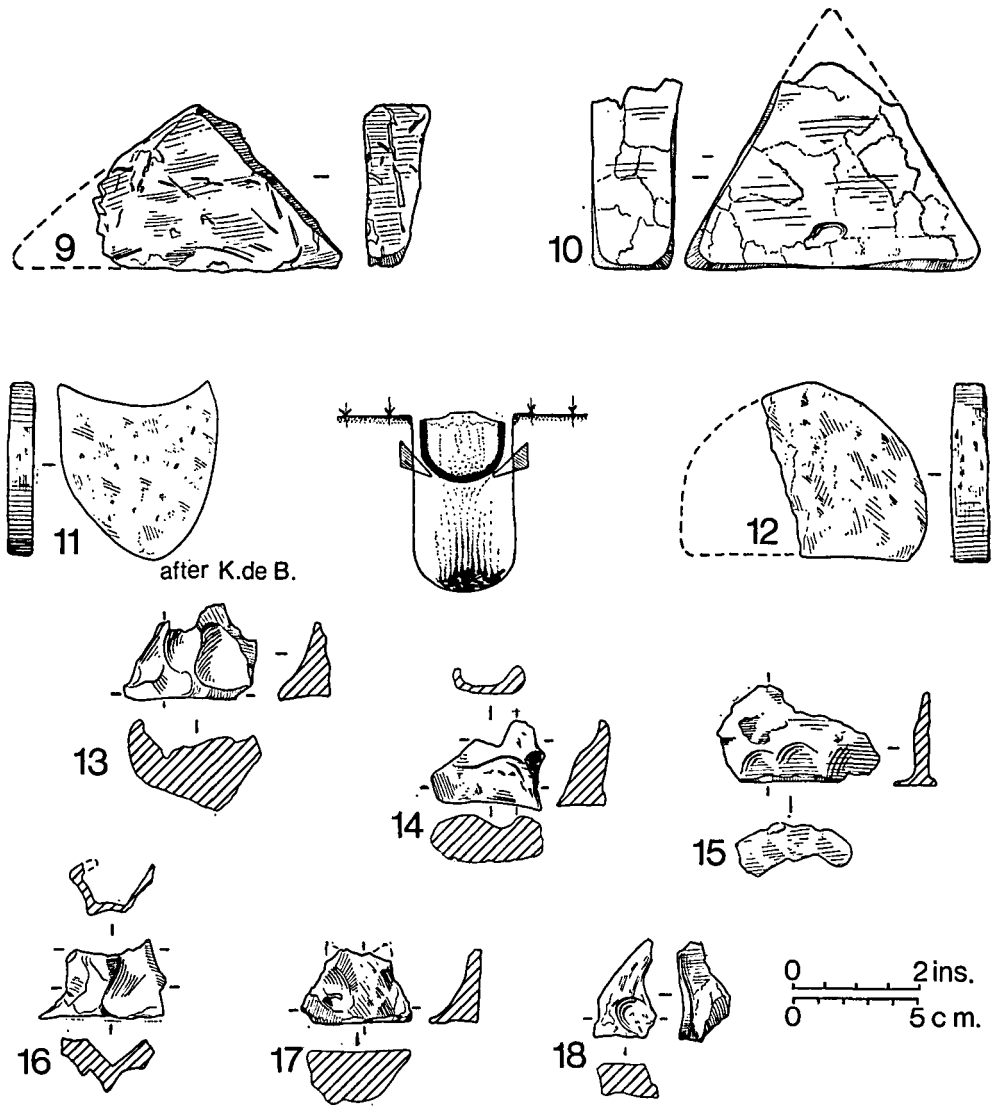


FIG. 9. 9–12: wedges (9, Peldon Red Hill; 10, Leige Beck Red Hill; 11, 12, Langenhoe Red Hill); 13–18: pinch-props (Peldon Red Hill)

stoking end of the hearth. Although none was found *in situ*, they are reasonably assumed to be parts of hearth walling, a view borne out by the impressions of fire-bars found on some of the rims. Similar sherds were found on Lower Barn Field, Copt Hall, Wigborough.[48]

(*i*) Crystallization vessels and salt moulds

It is difficult to be certain of the shape of these vessels in view of the practice of breaking up the hearth after each operation, as described above. At Peldon

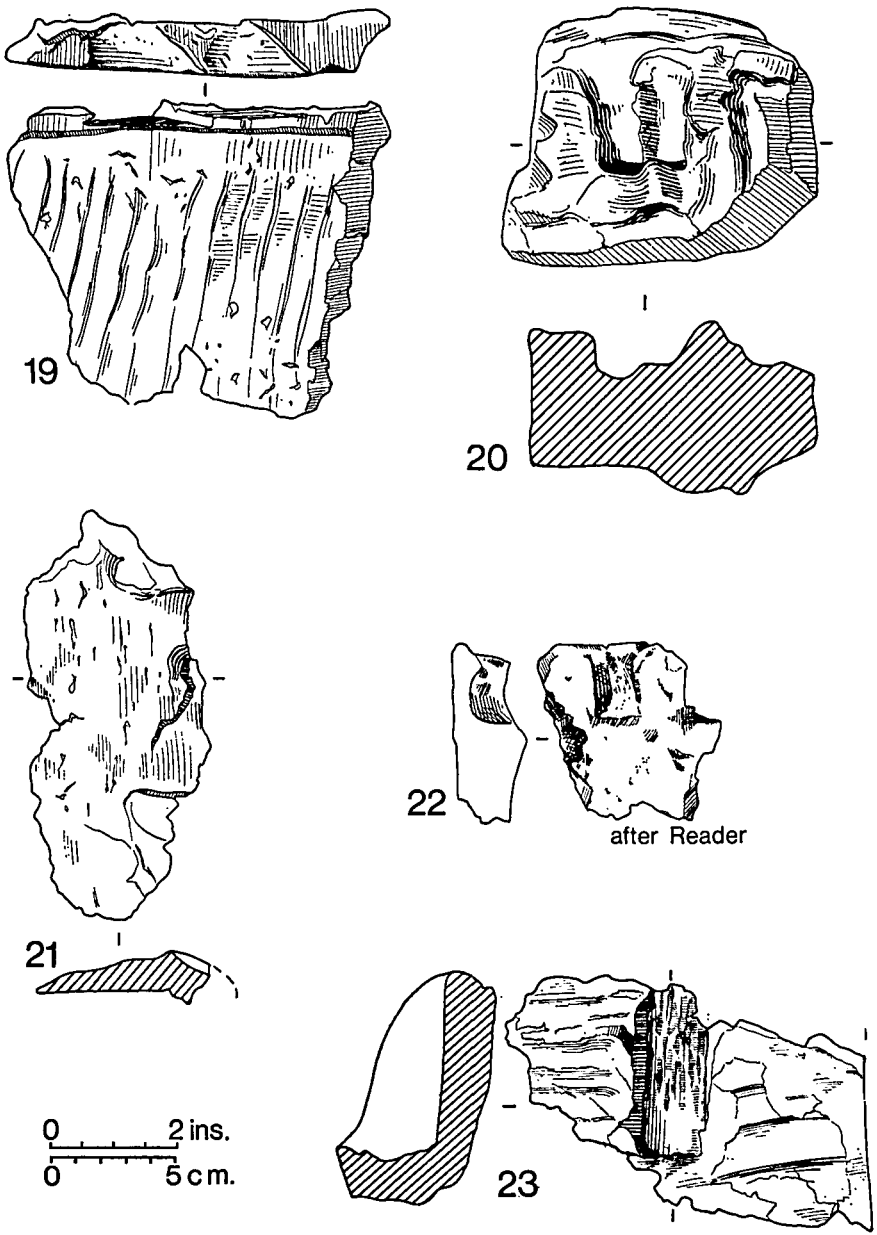


FIG. 10. Hearth fragments (19, hearth wall; 20, junction of wall and floor; 21, repair patch of clay from inner face; 22, 23, fire-bar slots)

there was evidence of two types, called respectively, from their similarity in shape, the 'pig trough' and the 'cream-pan'. The 'troughs' are of very heavy construction, with semicircular ends and a rounded centre portion, the base of which is thick and trimmed to make a flat base. Only five trough ends were found at Peldon and thirteen heavy bases; the best-known example comes from Cooper's Beach, East Mersea, the interior of which shows a clearly marked line presumably indicating the highest level reached by the contents (fig. 12),[49] though fragments have been found at Leigh Beck, Canvey Island.[50]

The 'cream-pan' shape is suggested by the variety of decorated rims found; these would give a diameter of at least 40 cm., about the size of the shallow pans used for setting cream. The decorations were highly individual (fig. 11, 24–6, 28) and one from Sawdon's marsh[51] had an inner flange, perhaps the seating for a lid (fig. 11, 27). There is another example from Peldon.

The different styles at Peldon were as follows:

Plain heavy rims	15
Plain narrow rims	33
Plain striated rims	2
Rims with cable decoration	11
Rims with stick or bone marks	12
Rims with small finger-tipping	5
Rims with large finger-tipping	2

Finger-tipped rims were also found on Further Barn field, Copt Hall, Wigborough.[52]

An interesting observation was made concerning two of the small finger-tipped rims at Peldon; the decoration seems to have been applied separately; one piece had come away completely from the body and another showed a crack running along just below the decoration; indeed, some of the plain rims looked as though a tipped strip had parted from them.

At Osea Road sherds of very large, heavy, rectangular vessels were found, one of which was 39 cm. in length, the ends of which were just beginning to curve, with signs of the base on one side. Many of these sherds showed more of the base and, in this case, it was often deeply furrowed. If, as is probable, the vessels were made and fired on the site using the bonfire method, these heavy containers would have been difficult to transport to the firing site even in the leather-hard state and it is reasonable to surmise that they were constructed and transported on a pallet made of sticks which would have burnt away during firing, leaving the grooves mentioned above (fig. 13). Many bases were found with these marks for which the term 'wattling' seems reasonable and more appropriate than Reader's word 'luting' used in reference to examples from Goldhanger.[53]

In Lincoln Museum there is a small rectangular vessel about 12/14 cm. square and 4/6 cm. in depth, said to be a salt mould.[54] From the same area came two strong round salt moulds, diameter 8 cm., height 5 cm. and diameter 10 cm., height 10 cm. respectively.[55] The Red Hill at Wick Farm, Burnham on Crouch, Essex, had yielded part of a shallow dish very similar to that in the museum at Nottingham University.[56,57]

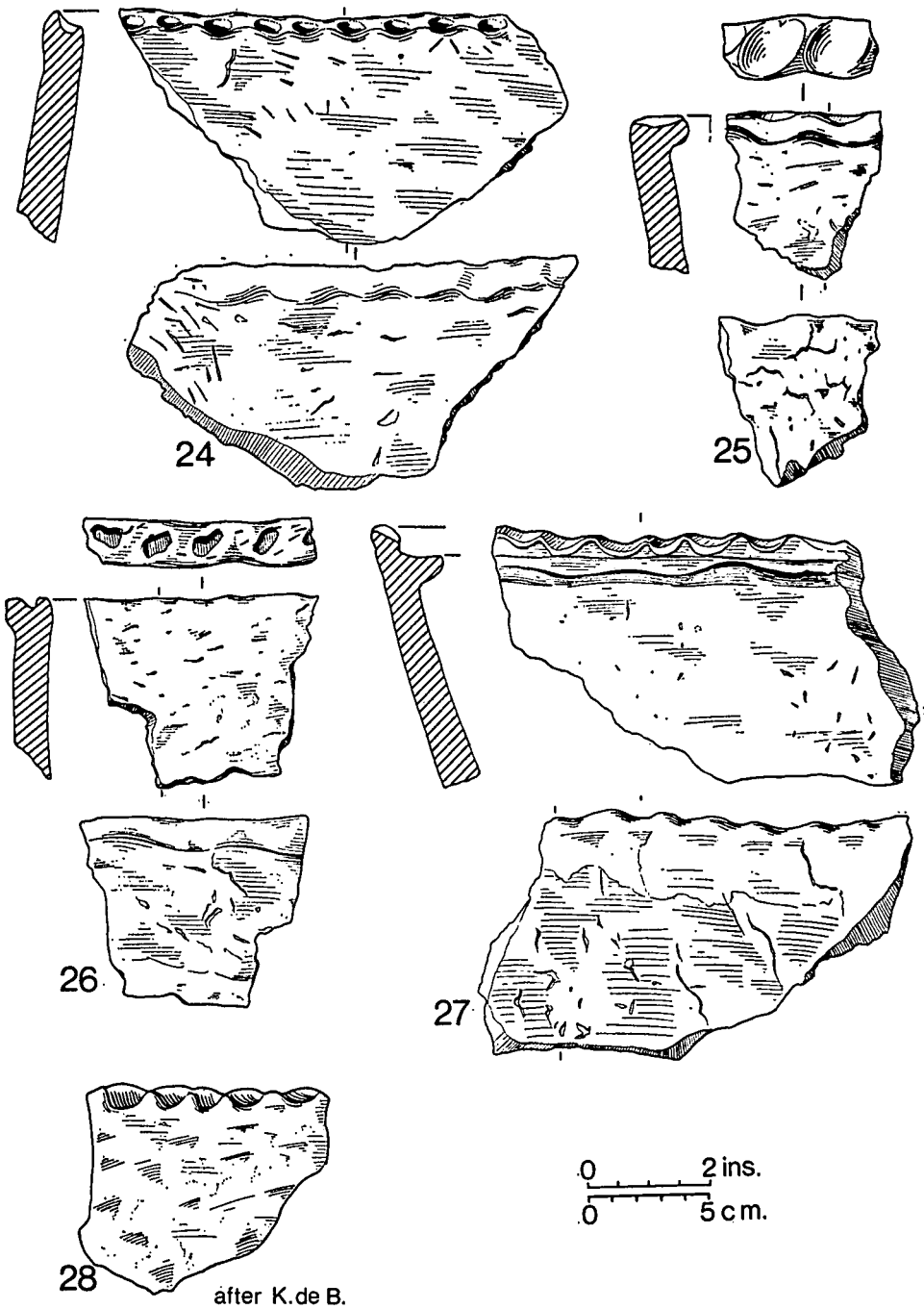


FIG. 11. Decorated rims of 'cream pan' crystallization vessels (24, 25, 26, 28, Peldon Red Hill; 27 Sawdon's Marsh Red Hill)

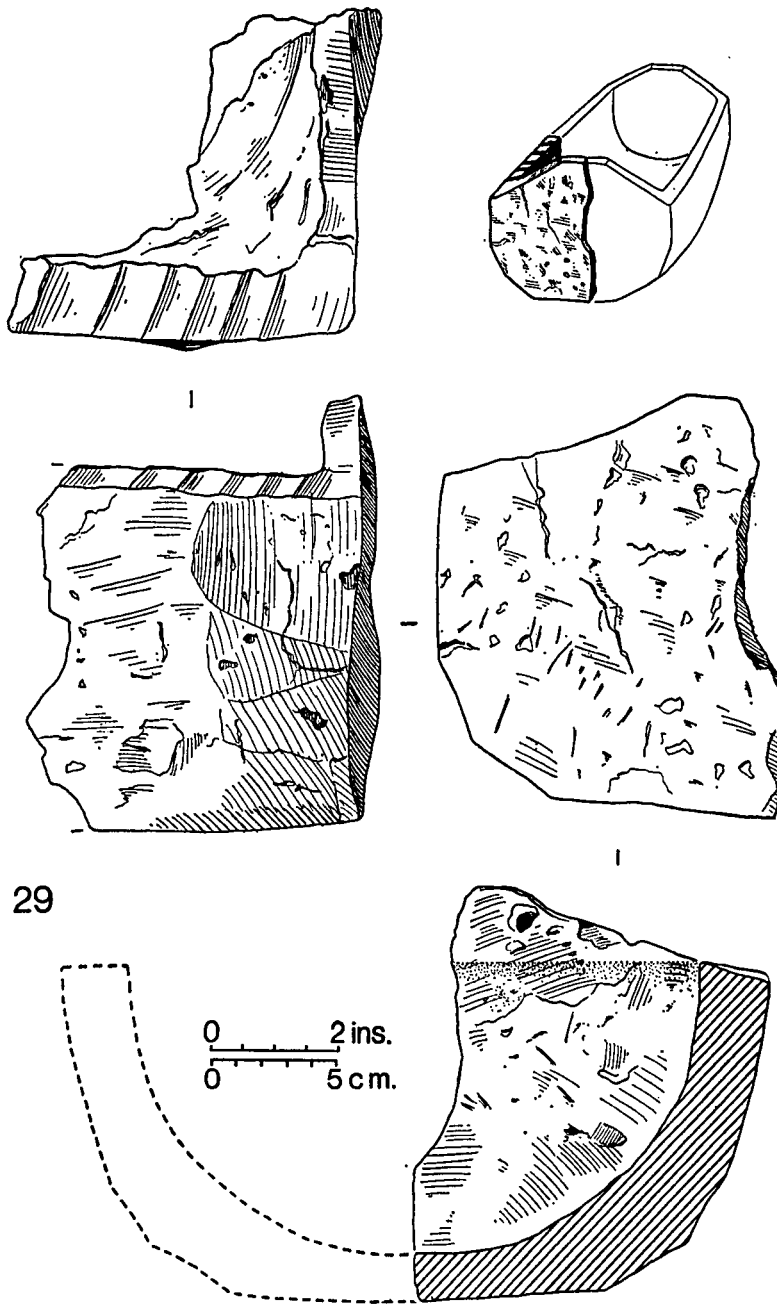


FIG. 12. 29, 'pig-trough' crystallization vessel from Cooper's Beach Red Hill

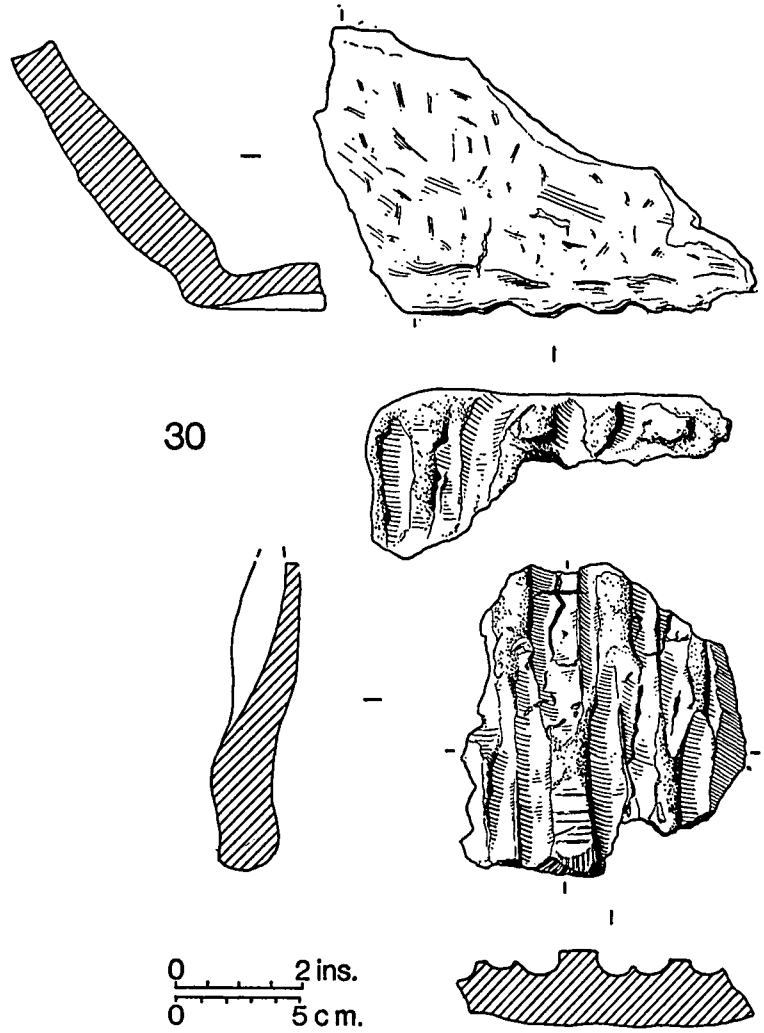


FIG. 13. 30, wattling on the base of a crystallization vessel

(*j*) Other objects of briquetage

An unusual object was found at a low level in the sand on the Leigh Beck site, Canvey Island, where the Hill is being eroded away by tidal action. It is made of briquetage material and appeared to be part of a large ring with four holes pierced through at regular intervals (fig. 14, 32). The over-all diameter would be 18 cm. and that of the inner circle 9 cm. If it was a hearth it is quite different from other Iron Age hearths or gratings[58] but it had obviously been designed for some specific purpose.

An object resembling a horned stand, also made of briquetage, is in the Colchester Castle Museum collection (Acc. No. 444). (fig. 14, 34).[59] It was found in

1935 in a sandpit about 200 yards from the River Crough, just south of Raymond's Farm, Canewdon, Essex. There is a hole through the centre, one arm is damaged, and the base looks as though it was broken off a flat plinth. Possibly it is some form of support.

The third object (fig. 14, 31) is a piece of reused rim from Peldon. It must have been an unfired fragment from an unusable vessel; a rounded groove, perhaps for a stake, and the flattened impression of a fire-bar have been fired into the broken edge. The original finger-tipping is intact. This is the second reused rim sherd found on the site and confirms the theory that the briquetage was made and fired on the site.

Familiarity with the site and the experience gained from the previous excavation made recognition of the finer details possible. Some economy of time and material must have been practised by the salters to make use of discarded material in succeeding operations. Hearth walls could be reinforced in this way and the raw clay was readily available for making repair patches and pinch props to increase the stability of the crystallization vessels. The use of old body sherds to strengthen hearth walls and as hearth plates was confirmed by the spillage of brine on their eroded surfaces and broken sides with the subsequent formation of the green salt glaze.

(*k*) Glaze and vitrification

This subject has caused some discussion. Certainly it has been found, particularly in the vicinity of hearths and working floors, at both Osea Road and Peldon as well as on briquetage found during field-walking. Vitrified clay, green in colour, was very noticeable on the hearth excavated in detail at Peldon; frequently there was a cupped edge marking the perimeter of the hearth, often with the marks of the fingers which had levelled it. At Osea Road circular patches of green fused clay with raised edges showed where pedestals had been settled into position. Large lumps of vitrified clay, rock hard with clear, glassy, green areas, have been found on both sites. Briquetage is often covered or splashed with green glaze, but this seems to happen fortuitously, probably when the hearth is broken up on the completion of one operation and a new one is built on top of the levelled briquetage debris.

Recently an analysis of some vitrified clay from the Peldon Red Hill has been carried out by Dr. Paul De Paepe at the University of Ghent. Beneath the green salt glaze he found a transitional layer consisting of needle-like crystals and, beneath that, sand. He stated that sand consists mainly of quartz, the melting-point of which is 2,000 °C. but the maximum temperature attained even in the kilns of the Roman period was only around 1,000 °C. A glaze could have been produced, however, by the sodium in the spilled brine (sodium chloride) since this would lower the melting-point of quartz to approximately 800 °C., the heat generated by an ordinary bonfire.[60]

The Construction of the Briquetage

It is an interesting fact that the basic equipment of the Essex Red Hills is consistent throughout: fire-bars, pedestals, hearths or working floors, and the vessels

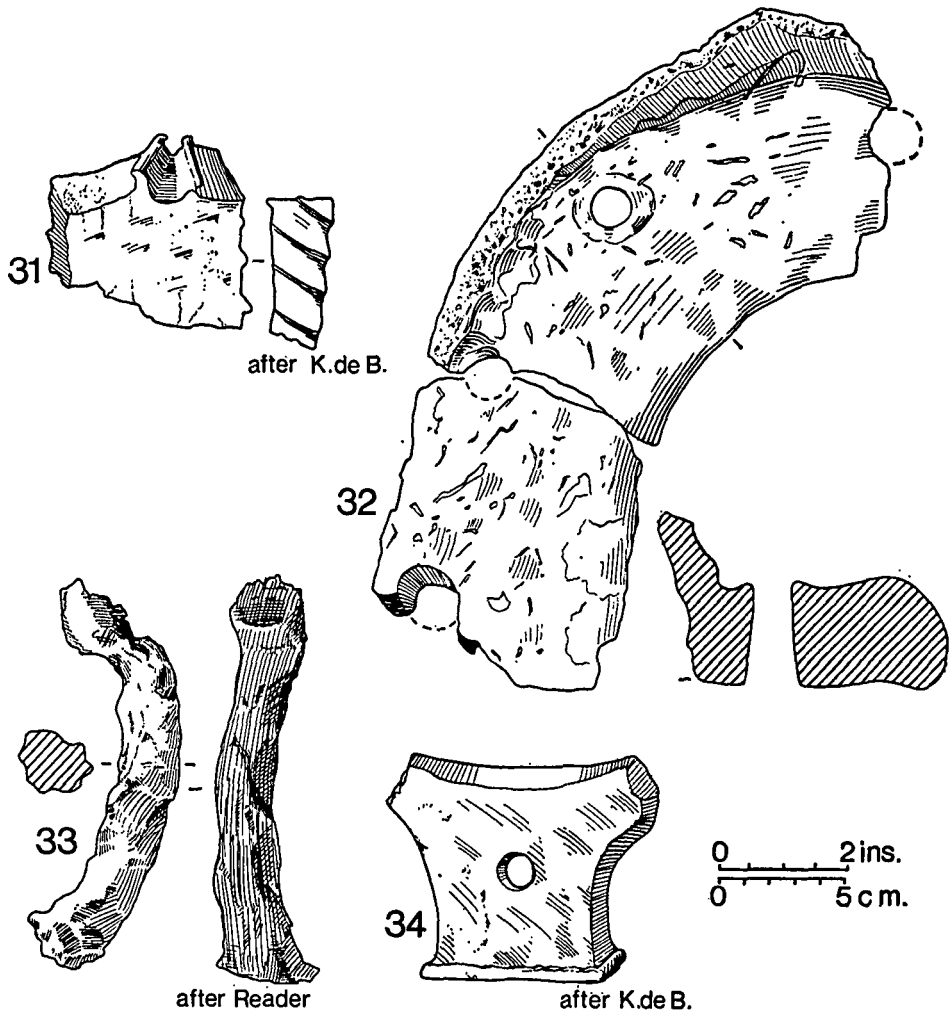


FIG. 14. Other briquetage from Essex sites: 31, reused rim sherd with impressions of fire-bar and stake; 32, fragment of hearth or grate from Leigh Beck Red Hill, Canvey Island; 33, short rods from Lauriston Red Hill; 34, object of briquetage from Canewdon

for crystallizing the brine, all made of the local alluvial clay, readily available on the site. For the fire-bars and pedestals there was a uniform pattern, varying only in size; the industrial use of the artefacts demanded the strength of good design and firm compacted clay. But the vessels used for crystallization allowed for some individual variations, almost, in the case of Peldon, of artistic licence.

No trace of any recognizable kind of kiln has yet been found on or near a Red Hill and it is therefore accepted that all the briquetage was fired on the site by the bonfire method. As the name implies, all the objects to be fired, presumably in their leather-hard state, were placed together on the ground and brushwood

piled around, among, and over them, possibly surrounded by a turf wall and perhaps with turf on top. The late Mr. Hull describes the finding of such a site during the excavation of Camulodunum in 1938.[61]

The use of an organic admixture to the clay artefacts of Red Hills is well known and was probably intended to ensure a greater elasticity in firing. Visual inspection of briquetage fabric suggests a constant presence of grain and grain parts which, it would seem, were added deliberately as opposed to accidental incorporation.

Research into the kind of grain used in the tempering of briquetage was carried out at the University of Nottingham in 1975.[62] Impressions were taken from several examples of briquetage of the imprints left by the tempering material after it was burned out in the firing of the clay. The results are given below and these, incidentally, also show the types of grain available at that time.

Ingoldmells, Lincolnshire. Impressions in trays, potsherds, supports, and baked clay.

Hordeum species (barley)—hulled—5 grains.
Triticum spelta Linneus (wheat)—spikelet forks—25.
Triticum dicoccum Schübl (emmer)—spikelets—2.
Triticum species (wheat)—7 grains.
Rachis (axis of inflorescence in grasses)—1 grain.
Avena species (oats)—6 grains.
Chess, *Bromus* species—13 fruits (wild grass cultivated in the early Iron Age)

Osea Road, Essex. Impressions in briquetage.

Triticum species (wheat)—spikelet parts—8.
Triticum spelta Linneus (wheat)—spikelet parts—many.
Hordeum species (barley)—hulled—many.
Avena species (oats)—many.

Leigh Beck, Canvey Island, Essex. Impressions in briquetage.

Triticum spelta (wheat)—many.
Hordeum species (barley)—many.

Burnham on Crouch, Essex. Impressions in briquetage.

Triticum species (wheat)—spikelet parts and grain.
Triticum spelta Linneus (wheat)—spikelet parts.
Hordeum species (barley)—spikelet parts.

Peldon, Essex. Impressions in briquetage.

Triticum spelta Linneus (wheat)—many spikelet parts and one impression of grain enclosed in a fork with an ascending internode.
Bromus species—one complete spikelet fork ('A' measurement 2·9 mm.)[63]

These samples are not completely burnt away, suggesting a lower firing temperature.

Tollesbury, Essex. (1977) Impressions in briquetage.

Triticum spelta Linneus (wheat)—2 complete spikelet parts ('A' measurements 2·4 mm. and 2·2 mm.)[64]
1 single grain enclosed in its spikelet part still having its ascending internode.

Avena species (oats)—2 grains; one length 7·3 mm. width 2·7 mm and one length 10·7 mm.
Bromus species—also present; one sample with a length of 5·8 mm.

Straw and chaff also present together with some grits showing small spots of salt glaze. All these samples were carbonized showing a higher firing temperature than those from Peldon.

The specimens from Burnham were difficult to identify as they were very worn, possibly by water, but they appear to be very much the same as other sites. It is of great interest that the same material was used for tempering not only in different parts of the country but also in the Iron Age, Roman, and medieval periods.

Conclusions

As soon as the Iron Age farmers became settled on the gravel plateaux above the marshes their need for salt was of paramount importance. The coast of Essex, with its creeks and estuaries lined with alluvial clay, was readily available for the salters to fulfill this need. With a higher land level[65] and a more clement climate than today, the making of salt could have gone on intermittently throughout the year, concurrently with farming.

Once the salting site was established the working of it could be carried on by the women, leaving the men free for farming and trading. Sweepings from the threshing floor would provide tempering for the briquetage and fuel for the marsh fires could be supplied by forest clearance. Many varieties of wood are given in a survey carried out on carbonized wood from Reader's sites;[66] these included oak, ash, elm, hawthorn, hazel, and willow; and traces of the earliest cultivated grasses have been found on many early Iron Age sites.[67]

In tropical countries salt is transported in cakes or blocks[68] but this does not seem feasible in an Atlantic climate. The bulky briquetage vessels were hardly suitable as travelling containers; baskets, leather bags, or wooden casks, which could be more readily carried, unfortunately leave no trace on archaeological sites such as those under discussion. For export, either direct or from the main trading centre at Camulodunum, reused amphorae could have been employed. The rim of an amphora (Dressel 1, Camulodunum 181) was found at Osea Road[69] though one with a wider neck would have been more practical.[70]

Recently upwards of twenty finds of briquetage have been reported from sites at some distance from the coast, though unfortunately these do not seem to consist of any recognizable type of artefact. Rivers would have provided links with the hinterland of Britain, though there must have been trackways for pack animals and carts. Some have been confirmed by research and aerial photography.

At the beginning of the century there were said to have been between 150 and 200 Red Hills along the Essex coast; but this was, no doubt, an incomplete figure.[71] The investigations described above have confirmed 186 but some areas still remain unexplored and many sites have been eroded by sea and the plough. For such an extensive industry, coastal and continental trade was, no doubt, the most favourable outlet for these salter-farmers who must also have been longshoremen.

ACKNOWLEDGEMENTS

My warm thanks go to Mrs. K. A. Evans who owns the field and who has been unfailing in her support and advice. My gratitude, too, to the late Mr. M. R. Hull, for his constant interest and assistance must be recorded. I should also like to thank Mr. G. M. R. Davies, Assistant Curator, for his valuable advice and for arranging for me to study the material in the Colchester Castle Museum, and Dr. P. L. Gouletquer of the University of Brest who widened my horizon and supplied many overseas comparisons and anomalies. My grateful thanks to Mr. F. H. Thompson for affording me the benefit of his expertise, to Mr. J. C. Thorn for his expert preparation of the illustrations and plans for publication, and to Mr. F. J. H. Gardiner for advice. I must also record my appreciation of the kindly interest and co-operation over many years of the following: Mrs. E. H. Rudkin, Mrs. Betty Kirkham, Mr. Alec Miles, and Mr. Jeffrey May.

APPENDIX I

THE HUMAN SKELETAL REMAINS FROM PELDON RED HILL, 1974

By C. B. DENSTON

The remains received for examination included those of the skull and postcranial bones and were in a very fragmentary condition, especially the skull which consisted of numerous fragments. Reconstruction of the bones was attempted and produced a calvarium-cranium minus facial portions, a mandible minus the left ramus and condyles, a complete femur, a complete tibia except for the medial malleolus, and the shaft of the opposite tibia. Other bones represented, but not complete, were of radius, ulna, fibula, clavicle, innominate, rib, and vertebrae; also bones of the foot.

The position of the skull in relation to the postcranial bones *in situ* in the earth suggested they were of the same individual, but the characteristic sexual features which are displayed in a skeleton are not uniform throughout this skeleton. The robustness of the postcranial remains, especially the femur, tibiae, and the innominate bone, and the sexual characteristics of the innominate bone, overwhelmingly suggest a rather rugged male individual. On the other hand, the cranium and mandible are of small proportions with no overwhelming evidence for male sex. The superciliary ridges and the supraorbital torus are not so well developed as is expected of a male skull, but, opposed to these features, the occipital condyles are large and the mandible flares out at the gonion at the base of the ramus, both being recognized as male characteristics.

The closure of the sutures of the cranium suggests that the individual was over thirty years, but under fifty years of age at the time of death. Ageing by sutures alone has now fallen into disfavour and by far the most valuable age indicators are the teeth. The dental attrition of the teeth, particularly the molars of this individual, indicates an age at death of between thirty and forty years, which corresponds with the age from the suture closure.

Two bones, the left femur and the left tibia, were complete enough to record the maximum lengths, and, using the formulae of Trotter and Gleser, the reconstructed stature of the individual came to approximately 5′ 7½″.

The form of the cranium is pentagonoid, more of a wedge-shape from the frontal to the parietal bones, the widest point being at the parietal eminences. A few arcs and chords were able to be taken on the cranium and from the maximum length and maximum breadth measurements a cephalic index of 77·7 mm.—mesocephalic—was calculated.

PATHOLOGY. (*a*) Dental. (*b*) General

(*a*) With the reconstruction of the mandible and loose teeth put back into their particular sockets, the mandible contains two molars, two premolars, one canine, and four incisors. The first left molar was lost *ante-mortem*, with the third left and first and third right molars lost *post-mortem*. Also lost *post-mortem* from the mandible were the two left premolars and the right canine, though portions of broken roots of the canine and the second premolar remain in the sockets for these two teeth. The appearance of the tooth socket for the first right molar is suggestive of an abscess being present, and resorption of the alveolar border is indicative of periodontal disease. The second right molar and the second right premolar also display various cavities in the distal neck area. None of the maxilla was among the fragments, but four teeth from the maxilla were present. These were first, second, and third molars, and all possibly were from the right side, the other tooth being the left central incisor. Close scrutiny of the teeth revealed some enamel hypoplasia. Teeth may often be seen with lines or ridges running horizontally across the enamel, a condition due to some short-time disease, or dietary deficiency. The growth of teeth is, however, influenced by a great number of hormonal and dietary factors, disturbances in any of which will produce hypoplasia; moreover, the degree of hypoplasia and the number of teeth involved varies considerably, depending on such factors as the number of teeth fully formed at the time when the hypoplasia-inducing factor is at work (these will not, of course, be affected) and how the causative factor is at work. This is the stage of hypoplasia visible to the eye. The lines of hypoplasia are not prominently imposed on the crowns of these teeth, so suggesting the health of this individual was not greatly impaired in childhood.

(*b*) The anterior border of the auricular area of the innominate bone displays evidence of osteoarthritis, possibly also involving the rim of the acetabulum, and the head of the femur in line with the rim of the acetabulum. Perhaps a slight degree of osteoarthritis had also affected the navicular bone of the right foot. The left tibia has a small localized raised area of periostitis on the medial surface of the shaft towards the mid area. This possibly was, or could have been, the result of a blow to the leg. Though in a less complete condition, the left calcaneum appears to be slightly smaller than the right one.

Single fragments of a sphenoid, parietal bone, and petrous portion of a temporal bone are duplicated portions, so suggesting the existence of a second individual.

APPENDIX II

PELDON: SCIENTIFIC DATING WORK ON THE HEARTH

By A. J. CLARK, F.S.A., Ancient Monuments Laboratory

MAGNETIC. Samples were taken, and their thermoremanent magnetic direction measured, using the methods developed by the Department of Geophysics and Planetary Physics, University of Newcastle upon Tyne, and the Ancient Monuments Laboratory (*Journal of Archaeological Science*, forthcoming). Fifteen samples were taken from the uppermost hard surface of the hearth —the last relining—by the disc method, and 5 from rather softer material about 12 cm. lower by the cylinder method. The samples were orientated by magnetic compass. In the laboratory, viscous magnetic components were removed with an alternating field of 20 oersteds; measurements were made on a Digico-Molyneux spinner magnetometer. No consistent directional difference could be distinguished between the two sets of samples, and all 20 were therefore combined to obtain the mean direction which was: Dec. $4{\cdot}1° \pm 2{\cdot}1°$ W; Inc. $69{\cdot}0° \pm 0{\cdot}8°$ (single standard error; normalized to Meriden). This fits well to the magnetic variation curve as it is

emerging, and may be tentatively placed in the date range of 10 B.C.–A.D. 40. Samples taken from the lowest level of the hearth, in an attempt to obtain the date of its first construction, were not sufficiently stable to be used.

RADIOCARBON. Examination of charcoal from a lower level of the hearth showed it to be of oak (*Quercus* sp.) from large timbers, with some bark also present. This is consistent with its interpretation as a pair of timber baulks. Three radiocarbon measurements (Harwell Ref. HAR 1832) produced a mean date of a.d. 20 ± 70. Applying the calibration curve of Ralph *et al.* (1973) gives a corrected date range of 60 B.C.–A.D. 130. However, recent work on Irish oak by Pearson *et al.* (1977) indicates that we should be justified in drawing a much smoother radiocarbon calibration than those derived from the earlier bistlecone pine measurements. Using a provisional smoothed curve, a span of 46 B.C.–A.D. 94 is suggested. Although the timbers were large, the presence of bark is evidence that the radiocarbon result represents a good approximation to the time of cutting down. Thus there is good agreement between the dating methods, and a date somewhere about the magnetic and radiocarbon medians of A.D. 15 and 24 would be fully consistent with the Belgic pot.

ACKNOWLEDGEMENTS. I am grateful to the following for their co-operation: M. Noel of the Department of Geophysics and Planetary Physics, University of Newcastle upon Tyne, for magnetic research and measurements; R. L. Otlet of the Carbon 14/Tritium Measurements Laboratory, AERE Harwell; and C. A. Keepax of the Ancient Monuments Laboratory, DOE, for the charcoal identification.

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SUMMARY

This description of the structure and function of the salt-making site at Peldon, together with comparable evidence from other sites, demonstrates a degree of specialization within Iron Age society with interesting consequences for any view of social structure. The possibility of trade in salt, over and above production for local needs, must also affect our view of the extent to which economic factors could over-ride the basically tribal organization of Britain at this time.

NOTES

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[2] de la Sauvagère, *Recherches sur le nature et l'étendue d'un ancien ouvrage de Romain appelé communement le briquetage de Marsal* (1740–70).

[3] K. W. de Brisay, 'Preliminary report of the exploration of the Red Hill at Osea Road, Maldon, Essex', *Colchester Arch. Gp. Bulletin*, xv (1973), 22–43, and 'A further report on the excavation of the Red Hill at Osea Road, Maldon, Essex', *ibid.* xvi (1974), 19–36.

[4] By kind permission of Mrs. K. A. Evans.

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[7] Dr. J. B. Penfold, Consultant Pathologist, Essex County Hospital.

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[9] A. J. Clark, Ancient Monuments Research Laboratory, Department of the Environment.

[10] The expert assistance rendered by Mr. Clark was invaluable. No funds were available and, without his help, such scientific research would not have been possible.

[11] Similar hearth floors have been found in the Upchurch marshes, Kent. Information kindly supplied by Mr. Alec Miles.

[12] K. W. de Brisay, *Colchester Arch. Gp. Bulletin*, xvi (1974), 30–1.

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[16] K. W. de Brisay, *ibid.* xvii (1975), 32.

[17] F. W. Reader, *op. cit.*, p. 195.

[18] Field-walking by the author, 1976.

[19] *Do.* 1975.

[20] *Do.*

[21] Information kindly supplied by Mrs. B. Perren 1975.

[22] Information kindly supplied by Mr. Brian Simmons at the 'Salt Weekend', 1974.

[23] Information kindly supplied by Mrs. M. U. Jones, 1973.

[24] W. Rodwell, 'The Orsett Cock cropmark site', *Trans. Essex Arch. Soc.* vi (1974), 13–39.

[25] Information kindly supplied by Mr. Peter Woods 1971.

[26] Field-walking by the author, 1975.

[27] F. W. Reader, *op. cit.*, fig. 16 (10).

[28] Permission to study material in the Colchester Castle Museum is gratefully acknowledged.

[29] F. W. Reader, *op. cit.*, p. 195.

[30] C. Fox, 'Salt works at Hook, Warsash', *Hants Field Club*, xiii (1935–7), 105–9.

[31] Information kindly supplied by Mr. J. B. Whitwell, 1975.

[32] P. L. Gouletquer, *op. cit.*, p. 50.

[33] Information kindly supplied by Mrs. M. U. Jones, 1976.

[34] Material presented to the Eastgate Museum House, Rochester, Kent by H. and J. Woodruff (1834–69).

[35] F. W. Reader, *op. cit.*, pp. 200–1, fig. 24.

[36] Field-walking by the author, 1975.

[37] Colchester Museum (n. 28).

[38] F. W. Reader, *op. cit.*, fig. 13 (5).

[39] Field-walking by the author, 1973.

[40] *Do.* 1971–5.

[41] *Do.* 1975.

[42] Colchester Museum (n. 28).

[43] F. W. Reader, *op. cit.*, fig. 18 (7).

[44] P. L. Gouletquer, *op. cit.*, p. 50.

[45] Colchester Museum (n. 28).

[46] F. W. Reader, *op. cit.*, fig. 15 (1 and 2).

[47] B. Kirkham, 'Salt making sites found in north-east Lincolnshire since 1960', in de Brisay and Evans (eds.), *op. cit.* (1975), pp. 41–2.

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[50] *Do.* 1971–5.

[51] *Do.* 1975.

[52] *Do.*

[53] F. W. Reader, 'Notes on briquetage found 1908–9', *Proc. Soc. Ant. London*, 2nd ser., xxiii (1910), fig. 11 (5 and 8).

[54] Found by the late Mr. J. Giles at Ingoldmells, Lincolnshire (1957) at mid-tide level in a mass of briquetage. Information kindly supplied by Mr. Andrew White, Lincoln Museum.

[55] Information kindly supplied by Mrs. E. H. Rudkin.

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[58] K. W. de Brisay, 'Fragment of a hearth or oven from Canvey Island, Essex', *Colchester Arch. Gp. Bulletin*, xix (1976), 5–6.

[59] Colchester Museum (n. 28).

[60] Information kindly supplied by M. Etienne Cools of Ostend.

[61] M. R. Hull, in 'Preliminary report on the exploration of a Red Hill at Osea Road, Maldon, Essex', *Colchester Arch. Gp. Bulletin*, xv (1973), 34–5.

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[64] *Ibid.*

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