Notes on Geology Quality for Building Materials at Edmondsham

Britain's 1st Shield Banner Seal 1190
Order of Richmount 1204

Britian's Exchequer 1129 Baron Orescuilz
Humphrey 1089 Editor Domesday Book
Justiciary as President of Exchequer 1100

Borough Mound – iron, gravel, clay and marl seams

Notes on Geology Quality for Building Materials at Edmondsham

Edmondsham's most valuable mineral was mined in the early 19th C. to create bricks, tiles and cement mortar and lime mortar to replace the local wood, wattle/dawb(dob) and thatch housing. It required all 3 areas of marl, admixture of sand, and gravel for structure. As well as brick works at Sutton Holms the two areas were:-

- Ed.Estate/Manor/Parish boundary – marl cement open cast mine at Bottom Copse that has yellow RB clay on top streaky/spotted (glauconite) black/green/yellow marl (both back of Ed.Hse.Park) with close park good RF sand "the sandpits" and gravel at the dolines (many) at the Ed/Cranborne Parish boundary (or the sand ridge all along the highest point to Ed.Common meaning Furze Common – clay bricks/tiles brick kiln at back of village with LC clay either side of "Keepers Lane" the treading pit to the east for the yellow seam in that valley, and Brick Close to SE of the Kiln above "duck flighting pond" which is RB clay. The hole that is the pond (by measurement of height differences) is explained mostly by the dam of ca 1830 but maybe a hole digging out alluvial clay.
- Marl noddles (see 1842 Ensham Map) were noted (& collected therefore) at Malder(ley) Field, was by fluvial action down to Murrel below Barnes Dry Meadow – this must be from 3 watery areas: where the River Ed goes between the irrigation (straight & thin) channel and large leat flow on the surface only (no evidence of digging).
- Cranborne Estate/Parish Boundary – the block between the Tregonwell bought (1795 freehold of CM) Castle Mound & Firs Copse above Ed Parish/ancient manor boundary to the "Marl-Pit field" (Ed Estate bought prior to 1842) was a single charcoal (oak coppice for char bits in lime mortar) and mining operation with track access and fields above Mill Lane – it was 5 sandpits (admixture) 2 gravel pits, 1 large marl pit of yellow RB silica it seems but maybe basal clay/glauconite too – the mining operation went up to but stopped at the Ancient Monument acreage where linear earth lines.

This 1795 to 1840 maybe mining style appears to entirely have missed the possibility (Frost – alluvial sand silica) of alluvial chalk/clay, alluvial chalk/silica sand and alluvial chalk/clay/sand white/brown/yellow seam (undisturbed) at 1.5 metres below contours 45M to 49M at Holwell (peat bog at lower Holwell; owned by Drax/ Fawcett as sub-Manor then Ed.Estate after 1901) and seam 1 metre below contours 44M to 46M at Murrel IDENTIFIABLE EXACTLY ON THE SURFACE *AS WET MEADOW REED* (the clay plug stops water sinking/flowing/ drying away) and corresponds very closely to the present SSSI boundary, which is the very best because the finest mix ready for Marl calcination. The situation superfluous (economics) after the industrial quantities of Alite "portland cement" produced from 1850. The economic pursuit of other marl pits west of the Cranborne Estate marl-pit at Castle Mound similarly redundant but very possible as the chalk still interfaces at a gentle decline the RB clay/silica/basal **glauconite** along Mill Lane to the east stopping at Mill Moor Common of Holwell.

Edmondsham's most important mineral (the 1086 manor captures nearly the whole seam and lower alluvial redeposit of same mineral at R.Ed and large part of R.Crane) (& Cranborne Estate Castle Mound & Holwell fields) can be summed up as follows, where all clays and micas have aluminium for quick setting marl (noddles even mix the best), slower setting has silica sand soil the best the finest in manual (see why for uneven marl-pit lime mortars below – low % sand or clay then lime mix, up to 40% of same to be marl cement mortar) mix, Edmondsham R.Ed best (was pond dug before 1901 but after 1855? as only a drain marked on the 1901 OS) as no manual mix needed in fine chalk and fine silicas; and some fine clay all mixed at MURREL washed chalk clay, that is to say (nb no interface of LC (thin layers anyway at this edge, yellow not grey) to Chalk here at Edmondsham):-

- Silica (sand) RB Marl (natural mix) "Frost" with iron oxide (spring water indicative) for under water hard applications, and streaked Marl from base layer of RB **leaching glauconite** (green to yellow on weathering to air) eg Marl Pits in copses around Castle Moot – the Burrow ie Borough Court (oak coppice seems to be the charcoal)...lime or marl cement
- Argillaceous (clay) RB Marl (natural mix) "Parker" with iron oxide (ditto)....lime or marl cement e.g. noddles from Malder(lye) field next to Malory wood (Nb this and Sutton were Ed. Manors)
- White Chalk Clay (alluvial mix) either RB or LC with < 6% iron oxide to give white china

- Finest Grain RB – sand & clay proportioned Finest Grained LC – sand & clay (alluvial mix) at the River Ed fluvial plugs at valley pinch points for slowest river at the point where 4 riverlets coalesce at MURREL
- Chalk Pits (soft chalk at west) – either chalk liming of poor farm soils or (man made mix) lime render or mortar, or marl cement (clay stucco or sand marl cement) with later admixture of pure sand.

The BGS Survey 314 omits (wrongly stating Pleistocene Head) the Quaternary Holocene "alluvium"(clay minerals and silt sand with basal gravel) at MURREL at the River Ed below Brick Close ie under Barnes Wet Mead and below Piles & Painters ie under the marsh. It has the alluvial clay for the River Crane at a wide seam at Holwell going down in a narrow band for the River Crane past Pinnocks Moor Bridge lakes.

Alumine is aluminium-silicate whereas Alumina is aluminium-oxide.

Nearly all clays contain aluminium needed for the **rapid setting marl cement belite crystal** but the silica sands do not (exception basal layer of RB as **glauconite**). Parker chose marine deposits of London Clay. *Frost chose the finest silica sand possible (by definition alluvial) in the Medway silt (confusingly general name clay)*. Edmondsham Mines appear to be pre 1842 on the Ensham Map. Yet see Appendix III where the London Clay "man made mix" was objected to as a) variable fineness b) sandy c) sulphur content. So tidal or river alluvium was chosen (running out ca 1910, so resorting to slurried LC original deposits) as the finest quality because of slow moving water sedimentation.....**here we have it at MURREL on the River Ed and at the sides of the River Crane (the fields at Holwell yet to be tested) that already has the mix of chalk powder so no need to be man made mix**. Frost chose Medway sand as the very finest powder grain silica sand. Washed sand produces (post glacial after 8000 BC here) the very finest silica for the lower temperature calcination....some clay mix for more rapid setting cement.

At Mill Moor Common (Edmondsham part is Doddemite House & Mill – NB tributaries mark the junctions of the Manor/Parish boundary AT THE RIVER CRANE points; Cranborne Borough part of Common to 8+acres; & Holwell (sub-manor to Cranborne Manor) lower mill part of common) the seam is SILICA MARL of white/grey to 10 cm; this needs investigating up to watercress/withy beds as still Quaternary alluvial marl (highest quality possible) and the different water content of 2 mini valleys (marked exactly by hedges) where two riverlets come down from Ed.Common & Sandridge Common for a different strata of alluvial marl to one side of "Round Copse". This in contrast to the argillaceous marl at MURREL marsh below Upper Farm.

At Edmondsham Common ie Furze Common/Road this steep hill is "textbook" in fitting with human landuse. The RTB above 75m contour are a reservoir of water in winter, seeping through the gravel to the start point of LC clay and sand creating the "winter spring line" at 75M, all around the hill. The water forced to the surface by the seam of clay. The "summer spring line" created all around the hill at 55M, the exact point the LC sand seam overlies the impermeable RB layer – ***this coinciding exactly with the feed into the ponds at Ensom Justyn Manor to the east and Payns Place Manor to the west.*** These ponds best in winter and often dry in summer, this fact precluding course fish or temporary pen for sea trout, EELs possible in medieval times as they like mud. Anecdotally we have "geese" next to "Goose Copse" post 1808 (moor before) and cock ie wild fowl to include woodcock at "Cuckalds Mead" proving domestic use for Northover "dwelling on the north bank" that sites Ens(c)om(b)e Manor creating the more likely fact these ponds were to attract birds for eating (not flighting pond moved by 1850 then <u>after</u> 4 ponds disbanded after 1808 at Payns Place) – all ponds being in direct close view of frontage of both manor houses....ergo not fish ponds although it was customary for pre 1500 houses of note to keep fish alive temporarily for the pot...the huge surface area of 4 + 3 ponds respectively too big for a fish holding pen.

We have two distinct compositions, used in somewhat distinct applications, but the "Frost" Edmondsham version of Marl from the interface and washed slip of Chalk to Reading Beds Clay that is a Silicate without any alumine (not basal layer seeping into chalk), ditto mixed with iron oxide/hydroxide chalybeate spring water with RB sands (quartz) in final mix is the predominant MARL MIX here "MALDER(ley)" as septaria; and "MURREL(leaze)" as post glacial washed slip:

- Hydraulic limes, with a higher lime content, consisting mainly of belite, but with a considerable amount of calcium hydroxide, prepared by light burning and slaking, and used in slow-setting water-resisting mortars
- "Roman" cements, with a lower lime content, consisting mainly of belite with small amounts of non-hydraulic silicates and reactive aluminates, prepared by harder burning and grinding, and used in rapid-setting water resisting mortars (high exothermic reaction).

At Edmondsham the west of R.Avon London Clay has been "washed out" of marine glauconite in original sediment and is firstly difficult to distinguish (west or east of R.Avon broadly), although seam is wide & washed slip in post-glacial valleys, because in two forms:-

- dark blue clay that is both sandy and carbonaceous (old plant material) with ***glauconite*** that is best for bricks – this also dark grey or black towards the Crendel and Roke Hill clay pits that is very plastic (not sandy) without ***glauconite*** that is best for pots or tiles.....the IRON PYRITES on weathering (exposure to air or bacteria) at the surface TURNS TO....
- brown or yellow clay with red stains (NOT to be confused with iron chalybeate springs of the Reading Beds seam) that is stiffer – this used for all kinds of pottery (eg seam at top of valley above Payns Place ie Keepers Lane).

At Edmondsham (noting the division of Dux Doda Manneriam into 3 manors (Beauboys/Eschelin and Justyn/Eschelin and Payns Place all in their own 3 valleys) by QET 1290, & RO gift of Worthe to Cistercians 1190 "Tithing" and retaining Chief Fee for another Worsyck Manor now Romford) the wealth and uniqueness of the diversity of geology is dominated by:

- Marl seam for natural cement, mined from at least Roman times (note villas and Briton dwellings at the head of streams) – the original seam from Malderley (field is leaga forest clearing) to Marl Pit in Bottom Copse to Marl-Pits on Mill Lane that is a Chalk/RB Clay mix, then post-glacial after 8000 BC neolithic and bronze age redeposited in River Ed valley at Murrel as washed noddles (all way to R Crane junction) and washed slip mix with (reverse layers in time deposit) Chalk Clay with black organic material with London Clay (grey or brown? I think all this washed away down R.Crane) then Chalk Clay with RB Clay (yellow brown with red iron streaks) – the largest at Murrel. In the final mortar mix I guess either RB sand (nicer golden yellow) or LC sand (greyer) could be used – there remains the question of the Marl Stucco face to Ed Hse ca 1830 (peak national production 1796 to 1840s before replacement by portland cement) that needs alumine marl for rapid setting to get stucco to stick YET the Marl here is Chalk/silicate RB clay giving the darker yellow/orange – how did it set quickly with aluminium clay of the LC/illite variety – the answer may be in the "slip blocks" perhaps cut from the Barnes Wet Meadow (ice rink created after removal by dam, and blocking up of mill leat to be vired over to irrigation channel with flood connecting channel made east of Dam (the outflow sluice not created until 1950s when deep cut created in this new channel). Was the Marl-Pit of Mill Lane just for field soil conditioning? This called Marling Pit (fields) ***clearly (abstracting dorset phonetic accents in 19th C.!) Malder(ley=leaze) Marling (Pit) Murrel (leaze), the latter IN FACT Barns Meadow not upper/dry field, had different aspects on different marl types/uses*** (nb 1838 2 other dolines/sink holes other side of road to the Dell so totalling 4 all on MARL SEAM LINE). Note HWBMonro has ascart into Cranborne Copse on west side of Marling Pit in/before 1838 Tithe Map together with some of the Marling Pit field enclosures – these straddle either side of pit indicating Edmondsham Manor[1] did have some mineral rights.
- Clays – 3 types:- 1) London Clay (grey deep layers) plus sand units (main group illite that is grey whereas pure glauconite is green/black exposed to air yellow, LC said to be bad for farming soil) has top surface layer yellow because of weathered pyrites and deeper layers grey 2) Reading Beds Clay (lowest layer glauconitic) plus sand units both darker yellow/brown and iron mix, and post ice age ie Quaternary alluvial clay at fluvial plugs: 3) chalk "finest powder" and (maybe washed with clay minerals, white when fired, < 6% iron) redeposited as alluvium 2) yellow/brown both as plugs at surface (so weathered) on valley floors; **Clay Slip (washed post**

1. Note Holwell Manor (5 knights service to St Michaels Cornwall for defence of Western State) has 5 hides – each "hi(g)id" enough 60/120 acres to support one family for one soldier where one hide is still marked on Tithe Map 1838 – this word in use before 7th Century – it goes right up to location of Roman Villa at the wells themselves as the permanent source of the River Crane (summer, winter source further up valley).

glacial) at Hyde Upper Holwell (fluvial plug) can be block cut and fired/calcined in the "Frost" way for large quantities of Marl Cement – large quantities and very valuable in area that is not SSSI.

- Mills – Rivers Ed and Crane (parts in Borough socage on mill moor at Holwell) where this warmer climate has the stacking of sheafs to dry (no barns of stone to store) and ricks for milling when needed (leaving only arch. evidence of mill itself) at Barnes (upper) Dry Mead (Barnes Wt Mead is the duck flighting pond area itself); Worsyck Lane escarpment (horizontal wheel) and pre 1066 horizontal wheel at Pinnocks Moor Cottage above bridge.

Natural "British/Frost" & NOT "Roman/Parker" Cement at Edmondsham (see Church mortar to test – it often said the Isle of Sheppey LC clay is best for Marl cement).

The Frost way using "silica" ie sand earth is in three methods:-

1) original sedimentary mix of yellow quartz finest sand dust as a marl eg "pale/streaky yellow marl" north part of Marl seam at Cranborne Copse Mill Lane

2) washed (so finest grain) alluvial mix at valleys floors where pooling at valley side pinches or plugs ie Hollwell R.Crane

3) man made mix – soft chalk and choice of RB sand earth (or extra clay), and choice of LC sand earth (or extra clay) milled and settling tanks then dried into blocks to be calcined removing carbonic acid (CO^2 water).

The proof Marl (soft) rock IS from the River Ed valley (not the "marlpit" in Cranborne Parish off Mill Lane) is three fold a) marl rock (3 great nodules found in mill race blow Duck Flighting Pond) washed down valley (post glacial) within watershed b) marl seam location itself mostly in River Ed valley c) mine locations and roman coin finds at those surfaces. After 1810 the bottle kiln has coke from carboniferous coal no longer char coal. Equal layers of coke/marl at middle entrance put in, and same quantity removed at bottom – but difficult because too long to cool to keep belite (dicalcium silicate) crystals that need rapid cooling (& ions). Iron oxide best for wet cement applications under water – that is the dark RB clay here. How long to cook "calcine" - 2 hours or 2 days (alite as portland cement crystals tricalcium silicate only above 1450 deg.)? All vitrified dust must be removed (all lime ditto). Bog Iron Ore (there is a lot of iron sandstone here in the RB seams) from crystallisation in chalybeate bogs forms after 100 years, this the same period for bog peat to form.

Following the aluminium (for rapid setting cement) trail through most (all 5) clay groups clay minerals, mica, and glauconite – phyllosilicate as layered aluminium silicate (iron rich illite has lots – of which grey illite is in LC, and glauconite is in the basal layer of RB):

argillaceous "clay" earth means alumine or alumino-silicates ie glauconitic clays – pure siliceous "sand" earth is the opposite containing no aluminium compounds but the necessary silicate for "dicalcium silicate" ie belite....Edmondsham is lucky in that RB clays (basal layer) has glauconite washed down into Hollywell with siliceous "sand" white marl in alluvial layers.

The nodules "noddles" of marl rock washed from the seam that runs in a straight line (plus smaller side seams) from Maldry Wood to "Duff Hill" to sink hole at west of "Allotments" to west of "Six Acres" to "Dell" & "Cockpit" at Ed.Hse to west of "Cock Row" over escarpment to Marlpit – below 50M contour for true source of R.Ed (not culvert to the Dell) at 2 lowest points and up to 60M for the valley sides – THE SEAM IS.....

43 to 60 metres contour where chalk ie marl seam not already weathered away,
maybe undulating to 7 metres and 40 metres wide with small side seams,
from line of Maldry wood to Ed Hse garden two marl mines to marl pit at Mill Lane within Cranborne Parish;

There is nice drop cut at Ed Hse garden where here OPEN CAST MINE – ONE BIG MINE WITH TWO TRACKS to mine in circular route surface and carry away Ore where the mined seam goes below water table in winter,

unexploited dig at sink hole in "Allotments" field (this valley side the natural shape for weathering in contrast to mined other side where the massive mine at Ed Hse Gardens that includes the bank cutting in front of summer house) to go SW and NW towards the Big "Open" Field by cutting into 50M contour. At the right geomorphological height just below 50M is the pit in Cowleaze field for Marl.

Chalk clay strata under marsh in field opposite rectory field and all of marsh downstream as ice wash chalk settling at pinch points (so pools for silt to drop) in valley of River Ed....changes to yellow clay with LC ice age wash layering in downstream of those white deposits. This CLAY PLUG distinguishable by surface indicators of marsh reed for clay is watertight – where RB or LC sand the water simply sinks in.

The Mine at Ed Hse Gardens is given away by the "too steep" for natural weathered valley contours where the cuttings by the path atop the banks a gradual decline and through the middle of the Mine (the location exactly as predicted by the seam contour at just 5-7 metres below 50M contour at straight line of Seam) where digging at depth stops as a different chalk seam is hit at a flat surface. *The track goes right through middle of mine (no road would choose this route under a free choice!) for down hill mining transport of Ore – each new circular cut – cut down hill for ease of carting the ore.* THIS MINE THEN IN USE SINCE AT LEAST ROMAN TIMES – the romans known to have used "roman" natural cement here in Britain.

There is no evidence of a bottle kiln in Edmondsham for either lime or marl – there is clear map evidence of a brick kiln north of village where a huge hole exists at the back of the later school house.(BGS sheet 314 Ringwood p.25 states "lime and marl" from many chalk pits in west of district in 19th C. used for fields deficient in calcium carbonate eg Palaeogene that includes RB and LC eg property right in 1842/1868 conveyance of Worth to Somerley Estate to use Edmondsham Chalk Pits – some of this to quick-lime for mortar – *this maybe "marl-pit" as clay content is low*, the small kiln within the Quarry itself with heat from coppices).

Two main Clays (some Pal.clays contain moderate levels of smectite causing "heave" and) are a sequence of SILICICLASTIC "silicate based" SAND & CLAY (RF iron oxide springs means it sets hard for water based applications) with Springs at the base of the Palaeogene cover indicating ancient settlement sites eg Chalybeate springs but springs also at run off through RTD eg Castle Mound to west (see p.15 BGS 314) with NO marine/ alumino-silicate iron rich illite on the LF for rapid early setting stucco....did basal layer of formerly known Reading Formation Basement Bed with glauconitic grains find it's way into post glacial wash at Murrel R.Ed valley clay plug??:

* Palaeogene – Eocene -Thames Group(of which below LC thin layer of Harwich Formation subsumed in the following descriptions and not differentiated at the outcrops here) – London Clay "LC" Formation with "S" sand – clay is sandy to silty brownish grey to grey with parts large laminate of clayey sand bodies. The East (Southampton) LC is marine (so alumine), silty clay with sand and glauconitic sand bodies – *the Bournemouth version here if tidal/fluvial beach barrier introducing greater sand bodies within the silty sandy clay*. Area 314 is intermediate in this – the less continuous sand units west of R.Avon cannot be correlated with this Bournemouth area of Whitecliff and Nursling sand that is glauconitic (marine-alumine) in east, ***but the implication is LC at Edmondsham is not with scattered glauconitic grains of the alumine/marine type so the Frost type British Marl Cement***. The uppermost 60M of LC is intercalcated sand and carbonaceous clay with fine to very fine grained sand units up to 15M. Woodlands ie Sutton side has are lignitic sands and ferruginous or calcareous sandstone resting on RB clay and on top of this stone is the basal pebble bed of London Clay.
* Palaeogene – Paleocene – Lambeth Group-Reading Beds "RB" Formation with sand/gravel – clay silty and sandy with pebbles overlying fine to medium grained yellowish brown and red stained clayey sand ***glauconitic in part only***. (Solution-collapse hollows (dolines) with swallow holes atypical at interface with chalk). ***Basal bed*** of "RF" is typically greenish grey and greyish green ***glauconitic clayey sand*** (3M thick at Fordingbridge) with interface to chalk *a line of oyster shells* for a few miles indicating short marine incursion from the south. ***Overlying strata is red, yellow, dark brown and purple mottled clay with clean sand units not then glauconitic***. Colours are attributed to soil formation on low lying coastal plain (sic. basal bed) – the Clay commonly contains calcareous nodules (see pit at Cock Row), and lenticular sand bodies and cross bedded channel fills composed of well rounded flint gravel as at the pit at Castle Mound SU 0606 1253.

RTD (typically upper layer gravely sandy clay 0.8M, lower layer 1/2M mixed sand/gravel and base layer of gravel) were major sources of sand (sand fraction predominantly quartz of a) medium or b) medium/coarse with fine) and gravel (91% angular or sub-angular, 7% quartz, 2% ironstone) – RB has good building sand.

Clay Render

1) soak overnight 2) mash to "thick lumpy gravy" 3) sieve bits, no stones – "greek yogurt" 4) 1:5 sand – stiff enough to hold shape 5) can be placed on top of wattle and dawb.

Earth Mortar

Half Clay: half dawb "dob" mix of mud/earth nb wattle and dawb ROOF IS POSSIBLE where Elm poles are roof rafters with cross battens of riven hazel or riven lime (sl) or sweet chestnut.

At Verwood initially people used Broadstone Clay "BC" to the south east. The layers are:-
* Branksome Sand "BrKS", on top
* Broadstone Clay "BC" and Parkstone Clay PkC ("white ball clay"), on top
* Parkstone Sand "PkS", on top
* Broadstone Sand "BstS".

Verwood Brickworks on London Clay at poorer end, situate on "Romford Manor" that is Worsyck Manor pre-1290, (distinct from "Owre" later known as "East Worth" after split post 1599 but before Brouncker purchase off Hooper 1787 – Romford Farm and Mill to Worwick Lane" already separate as St Marys Priory ie Boveridge ay 1086 also from "Owre Common" that covered St Stephens Castle and Wild Church Bottom to Ebbslake, that is to "Borough Ridge" ie the very large Boveridge of 1086 of St Mary's Priory (already Hooper by 1599 when they bought it – already Plecy/Shaftesbury had consolidated Romford Manor, later buying Sutton Holms mesne fees).

Gotham Brickworks should be on better London Clay (better because LC is said to be impenetrable and used for pond linings and waterproofing but shrinks on drying and unsafe to build on nb Ensom Manor House at Northover does not survive) – ditto Sutton (Holms) Brickworks that was on the London Clay/Sand seam on hillside for better ease of extraction.

Broadstone Clay "BC" eg at SU108077 was the Verwood Potteries east and south of Mount Ararat and Pistle Down (all religious names because of Bindon Abbey Cell of Cistercians using this Common Land) – note Le Esteford and Verwood Common strictly confined to present day Dewlands and NE to road not as far as Bakers Farm that was Eastworth Manor and Common arching over to Verwood, on allotment and then inclosure Shaftesbury of Romford obtained main brickworks south and north of Albion Hotel. This "BC" dark brown or dark grey – dicey (random) carbonaceous (making it dark) with no ***glauconite*** (mica?), making it good for bricks only. *Note the many cob or dob "dawb" houses here because clay so plentiful with also London Clay.*

The very rare white clay "bone china" or "pipe clay" that is purest at Parkstone is here as lentils of white Parkstone Clay exposed at surface in two areas eg SU114075 but in amongst "BC". It is sub-quality because of a) sandy content b) intercalcated with layers of loam of shale c) iron stained at times; but seems to have been used for white buff or orange tiles (eg Bournemouth Pavilion roof).

The rare "silver sands" are to be found towards Gotham read "Goatham" because goats & geese were NOT commonable animals for the pre 1066 Common that is now the "New Forest Common" at Wor (-the, -syck,-worbridge is Harbridge) Ward (or watch), and gravel pits atop Pistle Down.
The process of making bricks requires a) decalcification (treading clay?) this not a problem presumably with pure RB or LC seams because no chalk content that would not fire as brick but marl chips! ie not possible at Murrel seam – but Brick Close up the hill is a pure RB seam and white clay LC west of keepers lane b) weathering before firing. Alderholt and Sandleheath would appear to be red bricks from Broadstone Clay.

<u>Glacial or post Ice Age chalky (100%) clay at Marleys Row and under Pond – where 9 – 40% RB clay with > 6% iron this is Frost Marl, then yellow brown with layer of LC Clay Marl – 3 washed slips.....</u>

This white clay plug (chalky and carboniferous so < 6% iron) fires white bricks. It is about 80 cm underground and watertight creating the marsh above. Where iron RB stream from Furze Common the clay becomes further downhill yellow and brown..BOTH STICKY SO GOOD TO FIRE. The Marley is really a misnomer because the white marl rock is washed down from the Marl seam from Castle Mound to Maldry wood in post glacial drift. The reverse is sub-quality Marl (only formation mix of crystals will cement make) as "chalky marl" that with water and broken lumps is WHITE COB ie witchert – whereas the calcified clay ie a man made chalk–clay mix (unfired) is a render or wall "daub" that is smooth (no sand as thought at Holwell cottages) – it must not be too dry (crack) not too wet (slime). Note at Cock Row the yellow/brown clay sits atop the chalk where not already marl deposits. This WHITE COB is made from varied lumps of NORMAL CHALK to give stability in mass tapered to top of wall (made as one piece) and mixed with chalk-clay slurry with binding agent eg chopped straw.(this identical mix for brown cob ie clay/straw/water where earth at least 20% pure clay).

Under the Duck Flighting Pond – for it was a clay mine (not same as clay foot treading pit just off Keepers Lane that is either RB clay lower and LC clay higher on hills) – the Pond is the hole from which this (white raw and when fired) chalk clay was dug – it then an afterthought to make into a duck pond. THE PROOF is in the sluice (not 1950's one at the side) at the top of the marsh – 3 way with lowest point natural river course in middle – 2 large channels either side (subsequently to mining as meadow flooding) THAT TAKE AWAY ALL WATER completely around mine to keep it dry while dug – two channels clear on 1842/55 Map of Ensham after marl mining industry 1796 to 1840. Note a 4 stone footing to a building exists in the main flow channel/leat. The natural river course as the lowest point clear on all maps keeping to the road side channel then veering to the other side to meet the natural river meander, the current pond then still the lowest points.

Firebrick as thermal mass oven or fireplace is 2:1 sand:clay where it must be course river sand (ie river terrace deposit sand at Castle Mound and Furze Common). Brick in different proportions. Insulation cob is clay (LC or RB) with straw and water for ovens or walls. By contrast to firebrick Firestone would seem to be natural cement from Marl.

The quality of London Clay in the region is best to the north at Crendel Cranborne Valley sides where the sign it is most "sticky" ie most "plastic". Verwood ca 1900 preferred this clay for pots so carried it from Crendel to Verwood via either Hungry Hill at Worth Mill lane or Batterly (=Bokerley ie Dod Cer Leaga) Drove.

Uses in the Past and Present

River Terrace Deposits "RTD" at the tops of Castle Mound and Furze Common are river rounded pebbles, yet used as road metal. At Furze Common there are 2 pits. It is mixed with small layers of sand. It is mined by digging in at same horizontal plane ie the edge of the deposit so that the heavy pebble falls onto the extraction implement, and carried downhill thereafter! I remember as a child with Dad doing the paths at Ed Hse. It is not good for roads because not angular so slips under the weight of wheels.

There is Broadstone Sand "BS" to depths of 5M or 15M that is medium grained around Sutton Hill Farm in a crescent. The LC seam of sand on the Sutton Common is fine grained of a different era.

London Clay next to a coppice could be either "deer coppice of the Chase" not a legal inclosure or coppice for firing clay. Mill Coppice so called as it has 3 clay ponds/pens (LC clay) to save fish for a period of time and Upper Farm as Payn's Place had until 1830 4 large lakes (RB clay) in the valley there as eel or coarse fish ponds.

In the past all building material would have been within 15 miles walk of the site. There are yellow sandstone blocks (many moved to Ed House gardens) at Hungry Hill Gotham and Verwood Heath meaning Boveridge Heath as part of ancient Cranborne Curia pre 1066 to the Summer Leys at the Avon Ringwood and the "Har"bridge across the Avon to the Kings Forest as Allod to Fordingbridge, as the wild edge to the Borough Socage of Cranborne – the Beorg or Beorh meaning "highest" at both the Folkmoot and Ridge around the Moot then down to the River Avon at Alderholt to Fordingbridge meaning Charford.

Uniquely *the variety of the seams of London Clay on top of Reading Beds on top of Lower Chalk that is cut through by the River Crane all with layers of sand (vis Sandridge and Sandys Hill to east and south) give the greatest mix of building materials imaginable.* For example the top layer of Reading Bed Clay (below sand.gravel above gravel, but extra sand layer at Ed.Park "sandpits") interfaces the chalk at the Marlpit just off the Mill Lane near Castle Mound. The need is for atomic weight 65% Chalk and 35% clay as a light grey/brown colour (the excess chalk can wash out years later without binders) in the marl rock or seams as layers. Is Marlpits here flaser marl *(ripples in bidirectional current water formation) or pure seam (indicated by concrete pipe tunnel existence)?*

Marley field "MALDERLEY" & Row/Copse is Maldry Wood = Marldy=Marly field "MURRELLEAZE" & Row/Copse – & other Marlpits – NATURAL CEMENT

The Marl is very accurately identifiable in the gently sloping strata (NW to SE) they are:-

- Old Marl Pit (OS 1892) south of Mill Lane byway at just above 200 feet contour ~ 203 feet, but the seam itself in the big pit down to 175 feet (old mining shaft of concrete pipe still there).
- Pit below Mutton Hole accessed to Ed Hse Pk at exactly 200 feet (soft rock on surface), so again below to 185 feet – the best marl colour I have found. Very good gold brown clay seam just on top of chalk here – the pit for both then Clay and Marl.
- Maldry in the wood (not marked with pits on map) at 195 feet to 200 feet. The Marl here quite chalky, but the same gold brown clay seam to be found into the fields.

The explanation of ordered strata not as in the Geological Survey it is Chalk (at 217 to 225 feet OS 1901 marked as chalk pit and Geo Sur 2018) but clay on top (to give rise to marl) and then higher sand hence "sandy close field" THIS the same strata *sloping down to the Sand pits in Ed Pk at 200 feet at ca 230 feet plus in Sandy Close field* – good yellow sand.

WHAT ARE THE 3 OR 4 LARGE PITS PLUS MAPPED PIT ON Ed. Parish boundary JUST SOUTH OF BOUNDARY AT 200 TO 208 FEET in Bottom Copse (Park) – these are exactly the right inclined strata TO BE MARL – **RB Clay here yellow brown silicate without aluminium compounds (other ions and rapid cooling to preserve crystals of Belite for dicalcium silicate)**? Maps (of 1900 have the working pits only on maps at that year) just above Hut field (now Elves & Fairies Nursery) do not mark the SIX or so chalk sink holes THAT HAVE SOME MARL in chalk on surface ~ Mutton Hole is deeper into the chalk seam itself (by acidity the folklore that ducks were put in stream and came out at underground river in Ed House garden). Clearly these are the acid water running off the Reading Beds hitting the Chalk. There is a yellow/brown clay seam just above the chalk noticeable around Mutton Hole, and working pit to south.

Frost British Cement only needed at starting temperature 690^0 to 820^0 with best at 1000^0 (Parker 2 parts water 5 parts cement of 7). 2/3 chalk and 1/3 clay gives the brown appearance...except that London Clay grey appearance.

The "noddles" of mixed and veined "soft and crumbly rock" that are the mix of chalk and clay come in two varieties a) with extra sand or b) with extra silt. Both contain silica quartz that is "clinkered" at medium temperature (900^0. to 1100^0c) **to make dicalcium silicate that is cement**. (This is not clink from burning portland limestone to make portland cement but IS the same materials; it being possible for magnesium silicate for fire protected roof panels) – WHY NOT NATURAL CEMENT like magnesium silicate to make NOT JUST STUCCO BUT ALSO FIRESTONE PASTE as well as very hard tiles. The Maldry Wood (nb Pert Copse alongside mentioned in 17th C disputes as "chalkstone" not to be confused with "clunch[2]") just south west of Sandys Hill (London Clay formation) is Reading Beds with Head on Chalk so the perfect mix for the inter-mix and compression of clay and chalk "the marl stone". THE CLINK must be cooled rapidly if not to loose Belite crystal structure that lets in water

2. What is "chalkstone"? Harder than the friable chalk clunch is "melbourn rock" that is in near locations as the bottom layer of "middle chalk" interfacing with the lower chalk region (that then goes under Readings Beds at Ed.), this less hard than limestone – it looks like white rock in houses in north AONB.

for < 15 minute drying time. This is complete contradistinction to the "lime cycle" to return to limestone as here just calcium, hydrogen and oxygen compounds ie no silicon (glass quartz or flintstone in chalk is dead animals).

To make the calcium carbonate mix with clay that maybe makes the best Firestone for hearths – artificial cement by the same process is made from adding "brick powder" that is baked clay and sand, to chalk and then baked to make the same "natural" cement. These colours then made to make "stucco" marl – the 1830's grey of the front of Ed Hse may have been made however from the pit at Cowleaze that is "Marl Reading Beds – silt (head)".

The three locations on the ridge "Gipsy Pit" and near "pit" with the "old Chalk Pit" at the crossroads are on the same contour (so same seam YET no clay content) that would appear to be lime mortar kilns. But Lime Mortar or white wash because it sticks to most surfaces. Here sticking to wood to make it look like stone seems possible but not recommended by Parker 1795. The reason for "copse" meaning coppicing for fire charcoal to create quick lime powder of calcium oxide by burning chalk in a "lime kiln".
When mixed with silicate it makes the natural hydraulic (ie under water) Parker "roman cement" that sets underwater, and lasts 1,000 years. Or then lime mortar needs to dry (after thermic reaction) with carbon dioxide to form limestone mortar.

This leaves (assuming Gipsy Pit and near pit are not Reading Beds marl as not on the same contour as Castle Mound "sandy close" pit THAT IS READING BEDS) the seam of sand from the Reading Beds that traverses Ed Park sandpits to Sandy Close to Marl Pits Field; but not the sand of "Sandridge" around Keepers Cottage that geologists have overlying the RB as strata of the London Clay sand, TO CREATE TWO MARL PITS on chalk either side of Castle Hill wood (the water lying on the surface in that wood confirming RB clay top layer). Together with the Pit in Cowleaze that has silt (the cow pond and below it the water flows over ground to a fissure coterminous with this pit) that appears to be Marl stone with silt. These 2 Cement golden/rouge light brown + sand, So:

- Marlstone (off white crumbly rock of chalk & clay) with sand quartz (silica) baked then ground is hydraulic natural cement with dicalcium silicate or Marl (ditto) with silt (some silica)
- Marl made by churning chalk (Lr strata only) with brick dust (baked clay&sand) "the pozzolan" to be ground to make hydraulic cement because dicalcium silicate created. This almost impossible to do hence marlstone only real possibility.
- At it's hardest mix without aggregate it is a very hard stone recreation (added water 2 parts, 5 parts powder see Parker Patent 1795).
- Can this be done with London Clay? Note Goose Moor and Goose Moor Meadow are because goats and geese are NOT commonable animals here or New Forest.

The River Ed actually cuts into the Chalky Clay seam at the site of Payns Court Mill (so called duck pond) where the straight leat channel alongside the flighting pond has chalk "marl" lumps & seam at bottom, mill race has seam of chalky clay (white bricks) on side at approx. 43M contour – then clearly on maps "Marley Row below Marly? (it has sandstone) Field at the other "pinch point" on the other side of the valley (this pinch point of two the very reason for the siting of the mill cutting into the hillside to get the drop 46 to 43 metres for the water energy head) – the confirmation it is good clay content by the naming of "brick field" just below 28 Edmondsham on the other side of the valley..this higher clay would appear to be the yellow/brown variety from the Reading Beds at Furze Common.

SAND

Sand could be mixed with resin for a strong yellow render. The RTD at Castle Mound are in fact 4 sand pits around one very large gravel pit (see TTMS printout).

The very largest site of the best, ie most fertile alluvium, is the Holwell fields just below the spring/well line of the chalk watertable hitting the Reading Beds (itself normally an impermeable layer/barrier to water to create many chalybeate springs out of that seam) at the permanent Head of the River Crane below the watercress beds (used pre 1900 as a withy bed). The River Crane gravel is not completely rounded as it is a different source/

era as the Reading Beds in contradistinction from the different RTD "estuarine river terrace deposits" on the hill tops. This sand and gravel with alkaline water traversing it, is favoured by Sea Trout to spawn in, so particular sections of the Crane, but pre 1978 also the River Ed favoured (ie salmo trutta) for the same geology that mirrors the River Crane valley. At the pinch of the valley sides slowing the river down at Mill Moor Common the backing up of alluvium creating the perfect Peat (must be under water to kill worms) environment just above mill land at the Ed. Parish/Manor boundary with West Worth Liberty/Manor boundary.

It is not known how good or bad the Reading Bed top layer of thin clay is for firing. Reading Beds sand (where sparsely found) does make building sand. The Reading Bed seam identifiable by the escarpment or ridges above swallow holes in the chalk or terraces above the cutting by the River Crane, with some head in shallow valleys (it washed away in sharp valleys).

THERE ARE ALL GENERAL SANDS HERE TO USE.

The most interesting possibility (nb the plots or lotting of conveyances from 1841 seem to include all manorial rights, BUT do not include roads, road verges, road sides and some common patches eg Gotham Common & Worth Little Common) is the white clay "ball clay" that makes pipes – exposed at St Stephens Castle and Daggons? and one other spot to the East that could be used (where are Romford Manor rights as the Head Fee of Richard Orescuilz pre 1290 recorded in 1225 relating to 30 acres in 1190 that extends to Owre Common in post 1826 maps) for plugging gaps between wood log cabin or barn structures, so drying to keep out the wind. This white ceramic clay (also makes tiles) is white after firing because it is made (all varied proportions of same ditto white firestone) of Kaolin(ite), Quartz (silicate) and Micaceous clay (by contrast bentonite for waterproofing under pressure is completely different being smectite formed in marine conditions that is volcanic ash (similar to Fuller's Earth) – presumably if mixed with clay and fired makes the true Roman Concrete of 2000 years ago which uniquely lasts better under water than portland cement).

The best London Clay should be on the same contour line heights opposite Crendel and Roke Hill ie Joels at Keepers field and Rhymes Coppice or Mill Coppice in Edmondsham Parish as well as the (not so good) large seam in Birches ie Sutton Justyn with large sand deposits there too, that appears never to have been explored (sic. only at Sutton Holms brickworks). This can be used for Cob Walls, with hazel coppice support, or just large blocks, as in the past ca 1902.

Note the native Reed for Thatch (good for ridge) at Mill Moor Common Holwell; and there the Alders that make hot burning char (Elm good for embers) for 800 – 1100 degree C baking of Marl and differently Iron Ore.

Wood cement marl product – sawdust, marl cement, and clay .....25 yearsFF "**Woodcrete**". All (7) Clays are different structures of SAME ATOMS 1 Silicon (Si4+) and 4 Oxygen (O) for the tetradedron combined with 1 Aluminium (Al3+) with 6 hydroxels (OH) as the octahedron. The brown colour of all soils is from different forms of iron oxide. Iron oxide and Aluminium Oxide are together called "sesquioxides". Earthenware clay has upwards of 3% Calcium Oxide and Magnesium Oxide but less than 25% Aluminium Oxide. Stoneware has less tan 6% CaO and MgO but greater than 25% AlO. Alumina (AlO) is favoured to be in marl. No longer called Roman Cement but "Prompt Natural Cement" with distinctive brown admixtures (sand, pebble, see Rose of Jericho nr Dorchester) at GBP300 per ton.

Wood preservative (underground or splash point) Boiled (so hard setting) **Linseed Oil** mixed to paint with **fine charcoal** powder (inert forever, binding agent resistant to fire?; nb linseed oil paints). Or charcoal powder mixed with Birch Bark (outer layer only) TAR for better preservation.

"**Ramned Earth**"..is NOT concrete...with colours, **this is ideal for Edmondsham as great variety of sand, clay and chalk and rounded gravel, while no stone**. This is a step up from Chalk Cob used in the shared shelter of "borrowed resources" houses at "Covenbury" for beorgan(shelter) at the Assembly with wheat long straw from the "convenient barn" for Albretesberge open air Assembly.

The Eden Project wall has kaolin "china porcelain clay" mixed with the red devon overburden(but any earth with soil/clay see ATC chalk bricks) – at Murrel Edmondsham there is alluvial argillaceous marl "chalk clay" while at Upper Holwell there is alluvial siliceous marl (at Hesters Orchard the chalk clay is very carbonaceous) but the key ingredient would appear to be the "smallest binding agent"/humidity to be as dry as possible and removal of all air pockets to create great SURFACE TENSION in compression with the full spectrum of sized particles – small gravel to sand to silt to clay to the finest that is chalk. **Clay and concrete conflict in the chemical reaction of the latter, the former is a cure to create ADOBE, the two should be entirely separate, but some worldwide authorities mix the two. Ramned earth Chalk is a modern success because so fine, yet slow to dry and attracts water.** The chalk pits around Albretesberge are at a contour height for the correct "dryness" to ram chalk (cob) walls ca 1500BC.

Done in layers tampered down at outside edges first in a wooden frame "formwork" (sill staves(cleft radials) groove, verticals held at top by collar, wedges, that can be reused or left as wall structure if nice panelling ***to create thermal barrier and rain barrier of air gaps***); the mix has the binding agent 1) chalk 2) lime for a "mortar" and mixed while slightly damp – 2 days to 2 years to dry (~volume) with 30% to 50% reduced volume after MIXED DRY (lump test crumbly at fall 1.5M). Method rod, road "thumper" or hydraulic compression with all range of size particles, not much clay as also attracts water!

Mixes: – Adobe 7:3 sand silt/clay(compression strength 10% of brick) OR cement 7:3:1 sand silt binding agent ie **cement – marl** or portland (commercial – compression 40% of brick will take certain non-reactive clay added to silt)

OR TTMS version 7:2:2 – sand (RB or LC, dry, maybe small gravel) + silt (found with RB or LC sand, dried) + alluvial argillaceous marl (wet unfired!) from *Murrel Payns Court* because latter is clay and chalk already mixed (nb other type clays above Murrel Marl seam alternatively the overburden seam in Murrel valley that has clay mix below soil). If marl fired correctly ie cooled rapidly to form cement this cure will be 40% strength of brick. This a nice mixture between Cob chalk (ramned or not) wall and Marl stucco (marl cement plus admixture of sand only). Minimum 30 cm thick, but to get strength up to brick (nb mostly single storey so half needed) just create thicker wall or structure of a curved wall. Weather protection easy with (on outside) boiled linseed oil plus fine charcoal powder mix (earth or wood).

Dorset Devon cob is a type of ramned earth wall with mixture of all chalk sizes and binding of clay slip with lattice of straw and maybe small gravel (if not ramned hard). **Ancient Britons (3000 BC to 1500BC – proof at Durrington Wall houses) copied into Bronze Age right up to 600AD for round houses (in fact rectangle op cit, Assembly is round with wooden posts and roof plus sod or thatch and smoke ridge at low oval angle ?30 degrees at Must Farm Cambridge Bronze Age settlement) at roof level to create no wind edge on thatch, then same style with same Ridge pattern for smoke at both ends till present day.** DW house – as in Covenbury "convenient borrow" shared in borough precinct at contour height where rain sinks through chalk to water table – has dug out a) bigger room b) do not have to move chalk far to create wall – rectangle and door is evidence of timber framework for ramming. Clay slip is from just under organic soil – at Castle Mound clay layer of RB is above chalk already, ubiquitous at up to 8cm. Chalk pits all around edge of Covenbury and Lynchet (vegetable) fields.....because Britons did not carry construction materials far.

Greensand(stone) *green because* ***glauconite*** *within it* is in the seam only on the north west of the Chalk (eg Shaftesbury) with no sarsen (random stone erratics from ice flow) stones it seems on the chalk. Greensand only used in churches as ashlar from 14th C.. The Celebration and fervour of the First Crusade win because Church building exploded after 1100 is the reason for the building of the united parish (redrawn from Pimperne Deanery as Western State) East Hemsworth (wor to Shapwick) and Witchhampton and Edmondsham – two chapels of chalk, flint and it seems the local vernacular Heath(sand)stone (strong enough for saddle quern in Bronze Age) that is iron-brown was used (see chancel end at Ed.Church and pillars to north aisle and 1100 in north wall of aisle) – there is some fused pebble RTD?slabs in Ed.Garden. There is a Heathstone at the track end up from the Duck Flighting Pond (ley line to Le Horstone?). The "Worstone" of Verwood Bagshot sandstone from Rempstone Corfe Purbeck! that gives the name to Harbridge, Worthe, Worsyck "ward or watch" properties. It needs to be

checked which stone is a "standing stone" on the two tumuli near St Giles Park opposite hedge on ley line away from road. It does NOT seem henge stone (eg Knowlton probable) or tumuli standing stones were used in 11th C.to be ashlar cut as Christian Churches, more especially no greensand dragged from the Seam to the west until church towers first appeared (chapel to church status) in the 15th and 16th Centuries for banding with brown heathstone.

Ensom Manor Fish (flight?to attract birds) Ponds are 3 dams – all ramned clay earth and do not deteriorate with rain – they are local LC seams of clay and sand – above at 45M impermeable RB clay seam that gives way to escarpment that is the river erosion zone – this drop the head at Lower Holwell Mills. Is the Dartmoor 1500 BC house of circle stone roof supports and internal planks (raised bed of stone and fireplace) unique to local materials for stone ground does not allow wood posts in holes to support roof eave! – Dorset and Wiltshire "squareness" is the planks for ramming chalk with straight then of ridge for smoke exhalation at open ends. Door always downwind, so ridge across to draw out smoke (nb not conical teepee) with posts in chalk to support edge of roof in straw and ridge of reed.

Payns Place and Ensom Manor (that follows classic pattern Down or Heath, Winter Spring Line, Arable, Summer Spring Line, Meadow then Moor then River) both have their 3 or 4 Fish Ponds starting at the permanent Summer Spring Line at 55 metres contour.

Innovations today are a) harder hydraulic ram b) binding agent cement stronger and keeps off rain c) sealant (or sodium silicate) linseed oil + charcoal (wood or adobe) d) power point from portable water wheel Siphon (G) Wave with Venturi(TTMS invention). Although chalk cob (not compressed) is good as chalk breathes water and damp better with no need for sealant in or out. ***TTMS "single storey" design*** a) portable water wheel power (river attachment) for Mixer Bucket revolution to create the admixture b) wood walls (pannel i/s and staves o/s) are 1) rain barrier with air gap and breathable wood surface (both cladding & inner) as the middle sheath ***used twice first for ramming operation then wall build out of same FORMWORK*** and 2) thermal layer other side of diagonal sheath to be wood surround and ramned earth (extra chalk less clay BECAUSE INDOORS) between and 3) stone footings from beach pebbles....see old French ramned earth manuals for Formwork.

Some Conclusions

Powdered Greensand(stone) as part of marl cement? – never been tried before to give flash set and 24 hour set (n/w 3 month lime slacked cement set non-hydraulic CO^2 carbonate creation still debated) as roman cement.

Simplest most effective and easiest to produce – GOLD MARL Cement that was the intent for Ed Hse Front, and could be used to **proof shallow roof** (instead of clay/wicker in Bronze Age) for sheep turf/sod; no point to powdered heathstone except colour:

1) pure Quick Lime reacted by water with pozzolana of LC (Thames Group) sand seam that is golden brown (with hopefully some glauconite for a flash set) at say east side of Payns Place Valley with small pebble admixture for the true "**roman cement**" silicic acid reaction for CSH – one of 7 types of calcium silicate hydrate – medium to hard – use sea water for quartz acid already!
2) Chalk with green "green marl" brown/black seam after exposure to air for a flash set (2 places for Al-S-H 5-15 mins set: 1) green marl[3] itself and glauconitic (sic.green) at base of RF beds) for Quick Lime reacted by water with RB golden sand (– equal sized pits at Marlpits and east sand pits of Castle barrow freehold boundary for quantities mixed nb sand also at back of Park) for "**lime cement**" – GOLD MARL Cement where extra sand is admixture for **mortar**.

3. See Smart Cranborne Chase 1841 pps 89/90 – banks of marine sand and stuck pebbles (RF formation) at Boveridge, Burwood and Castle Hill & Other marking line of beach – adjacent to limits of Chalk is a bed of oyster shells exposed at several places in a line of some miles – AND IN SOME SPOTS WHERE GREEN MARL OVERLIES THE CHALK are the shells imbedded to several inches in the marl; and not at coarse earthen-ware pottery at Crendall and Daggons from blue clay – strong and plastic

Appendix I – Frost British Cement Patent

"Sandy Soil" (could it use either RB clayey sand or LF clayey sand not the following alumine glauconite (green/black streaks weathering to yellow) basal bed RF (at Edmondsham) nor London Clay "illite" (iron rich illite is glauconitic) with alumine compounds (not? at Edmondsham because not? marine west of R.Avon) or alumina compound? Nb pure alluvial chalk and quartz mix already in layer at Mill Moor Borough Common ideal for Frost!:

It was now generally known that the raw material for rapid-setting ie flash set and/or hydraulic cements should be an argillaceous ie Alumino silicate (LC-kaolin/Kimmeridge) "***glauconitic***" limestone, whether natural or artificial. In France, a material similar to Roman Cement was prepared in 1796 by burning and grinding certain beach pebbles in the vicinity of Boulogne. These were septaria from the Kimmeridge Clay.

A.D. 1822 No. 4679

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JAMES FROST, of Finchley, in the County of Middlesex, Builder, send greeting.

WHEREAS His most Excellent Majesty George the Fourth, by His Letters Patent under the Great Seal of the United Kingdom of Great Britain and Ireland, bearing date at Westminster, the Eleventh day of June now last past, did give and grant unto me, the said James Frost, my exors, adfriors, and assigns, His special licence, full power, sole privilege and authority, that I, the said James Frost, my exors, adrnors, and assigns, during the term of years therein expressed, should and lawfully might make, use, exercise, and vend, within England and Wales, and the Town of Berwick-upon-Tweed, my Invention of "A NEW CEMENT OR ARTIFICIAL STONE"; in which said Letters Patent there is contained a proviso, obliging me, the said James Frost, under my hand and seal, to cause a particular description of the nature of my said Invention, and in what manner the same is to be performed, to be inrolled in His Majesty's High Court of Chancery within two calendar months next and immediately after the date of the said in part recited Letters Patent, as in and by the said Letters Patent, relation being thereunto had, may more fully and at large appear.

NOW KNOW YE, that I, the said James Frost, do, by this present writing under my hand and seal, and intended to be inrolled in the said Court of Chancery, pursuant and in obedience to the condition contained in the said Letters Patent as aforesaid, certify and declare, that for the purposes of my said invention I select such limestones or marls or magnesian limestones or marls as are entirely or nearly free from any admixture of alumine ("aluminium silicate") or argillaceous ("clay or mica") earth, and contain from nine to forty per cent. of siliceous ("sand") earth, or silica, or combinations of silica and oxide of iron, the silica being in excess and in a finely-divided state, and break such selected materials into small pieces, which are then calcined in a kiln, in the manner calcareous substances usually are, until all carbonic acid be expelled, and until it be found on trial of a small portion of such calcined materials that it will not, when cool, slack or fall when wetted with water. The calcined material is to be ground to a fine powder by any machinery fit for reducing dry substances to that state, and the powder is the material for making the cement or artificial stone, and must be kept in dry packages for use. When used it is to be mixed with water and tempered to the consistency of common mortar; it should be mixed in small quantities, and applied instantly to its intended purpose, as it will set in a few minutes to resist the impression of the finger, and gradually harden to a stony body. For many purposes a quantity of clean siliceous sand may be advantageously incorporated with it when it is tempered for use. The cement will be lighter or darker in colour as there is a lesser or greater quantity of oxide of iron in the selected materials; the lighter colour will be found best adapted to dry, and the darker colour to wet situations.

I declare that my Invention is for making a cement or artificial stone from siliceous limestones or marls in the manner herein-before described, and that I shall call it by the name of British cement.

In witness whereof, I, the said James Frost, have hereunto set my hand and seal, the Tenth day of August, in the year of our Lord One thousand eight hundred and twenty-two.

JAMES (L.S.) FROST.
Signed, sealed, and delivered by the within-named James Frost, in the presence of
W. LYTHGOE, C. MORSE, Clerks to J. Lythgoe, of Essex Street, Strand, Solr.

AND BE IT REMEMBERED, that on the Tenth day of August, in the year of our Lord 1822, the aforesaid James Frost came before our said Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose. Inrolled the Tenth day of August, in the year of our Lord One thousand eight hundred and twenty-two.

James Frost's "British Cement"

James Frost was a major manufacturer (in fact, probably at one time the biggest) of Roman Cement and was the chief government contractor in that role. Francis suggests that his relationship with the government protected him from prosecution as he made Roman cement while Parker's patent was still active. From before 1810, he was experimenting with artificial compositions, although he didn't obtain a patent for his "British cement" before 1822 see Patent. He set up to make it at Swanscombe in 1825. The patent makes no mention of slurrying as a method of producing a rawmix. Frost seems to have obtained much of his inspiration from Vicat, whose works he had visited, perhaps between 1822 and 1825. His method was the classical wet process that was subsequently used with little change in the cement industry for nearly two centuries. Soft Thamesside Chalk was mixed with Medway alluvial clay and water in a washmill such as was already common for preparation of clay slip in the ceramics industry. The resulting thin slurry was placed in a "slurry back": a large shallow reservoir in which it was allowed to dry out, partly by draining through the porous base, and partly by decanting the water that rose to the top. Once it had reached the "leathery" consistency familiar to ceramicists, it was sliced out in convenient sized chunks and dried on "drying flats": surfaces of brick or iron heated from below by a coal furnace. Once dried to adequately hard lumps, these were loaded into a lime kiln in alternate layers with coke fuel and burned. This cement remained in production alongside Roman Cement until around 1850. In general, it remained regarded as a cheap but inferior alternative to Roman cement. Frost departed in 1832, selling the plant to Francis and White.

Parker's second patent:-
A.D. 1796 No. 2120

TO ALL TO WHOM THESE PRESENTS SHALL COME, JAMES PARKER, of Northfleet, in the County of Kent, Gentleman, sends greeting.

WHEREAS the King's most Excellent Majesty, by His Letters Patent under the Great Seal of Great Britain, bearing date the Twenty-eighth day of June, in the thirty-sixth year of His reign, gave and granted unto me, the said James Parker, my executors, administrators, and assigns, His special licence, full power, sole privilege and authority, that I, the said James Parker, my executors, administrators, and assigns, and every of them, by myself and themselves, or by my or their deputy or deputies, servants, or such others as I, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term of fourteen years therein expressed, should and lawfully might make, use, exercise, and vend my new Invention within that part of Great Britain called England, Wales, and Town of Berwick-upon-Tweed, of "A CERTAIN CEMENT OR TERRAS TO BE USED IN AQUATIC AND OTHER BUILDINGS AND STUCCO WORK", in such manner as I, my executors, administrators, or assigns, should seem meet; and in which said Letters Patent is contained a proviso, that if I, the said James Parker, should not particularly describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, by an instrument in writing under my hand and seal, and cause the same to be inrolled in His Majesty's High Court of Chancery within one calendar month next and immediately after the date of the said Letters Patent, that then the said Letters Patent, and all liberties and advantages whatsoever thereby granted, should utterly cease, determine, and become void, anything therein contained to the contrary thereof in any wise notwithstanding.

NOW KNOW YE, that I, the said James Parker, in pursuance of and compliance with the said proviso in the said recited Letters Patent contained, do, by this present instrument, declare that the principle and nature of my said Invention, and the manner in which the same is to be performed, is described and ascertained as follows (that is to say):–

The principle and nature of the said Invention consists in reducing to powder certain stones or argillaceous productions, called noddles of clay, and using that powder with water, so as to form a morter (sic) or cement stronger and harder than any morter or cement now prepared by artificial means. I do not know of any precise generical term for these noddles of clay; but I mean by them, certain stones of clay, or concretions of clay, containing veins of calcareous matter, having frequently, but not always, water in the center, the cavity of which is covered with small chrystals of the above calcareous matter, and the noddles agreeing very nearly in colour with the colour of the bed of clay in or near which they are found. These noddles, on being burnt with a heat stronger than that used for burning lime, generally assume a brown appearance, and are a little softened, and when so burnt and softened become warm (but do not slack) by having water thrown upon them and being reduced to powder after burning, and being mixed with water just sufficient to make into a paste, become indurated in water in the space of an hour, or thereabouts. Any argillaceous stone, then, corresponding with this description, whether known by the name of noddles of clay, or any other name, is the sort and kind only that I mean to appropriate to my own use in the fermentation of my cement.

The manner in which I prepare and compose this cement is as follows (viz.):
The stones of clay or noddles of clay are first broken into small fragments, then burnt in a kiln or furnace (as lime is commonly burnt) with a heat nearly sufficient to vitrify them, then reduced to a powder by any mechanical or other operation, and the powder so obtained is the basis of the cement.

To compose the cement in the best and most advantageous manner, I take two measures of water and five measures of the powder thus described ; then I add the powder to the water, or the water to the powder, taking care to stir and beat them during the whole time of intermixture; the cement is then made, and will set or will become indurated in ten or twenty minutes after the operation has ceased, either in or out of water.

But although I have described what I consider as the best proportions for the composition of the cement, it is expressly to be understood that these and all other proportions are to be included within the meaning and purpose of this Specification, but that no other proportion will produce so strong a cement in so short a time as those I have here pointed out; and, also, that I occasionally burn, and grind, and mix the powder before described with lime and other stones, clay, sand, or calcined earths, in such proportions as may be necessary and useful for the purpose that the cement is intended to be applied to, always observing, the less water is used the better, and the sooner the mortar or cement is used after being made, the stronger and the more durable it will be.

In witness whereof, I, the said James Parker, have hereunto set my hand and seal, this Twenty-seventh day of July, in the year of our Lord One thousand seven hundred and ninety-six.

JAS [L.S.] PARKER.
Signed, sealed, and delivered by the within-named James Parker, in the presence of
JNo DYNELEY, of Gray's Inn.
THOs LOGGEN, Basinghall Street.

Inrolled the same Twenty-seventh day of July, in the year above written.

Appendix II – Burning the nodules

Parker's manufacturing method consisted of burning the broken nodules at around 1000°C. The nodules were broken to about 40-80 mm. Although this was in part to aid rapid calcination, the main reason for breaking the nodules was to reduce the amount of neat calcite present. When broken, the nodules naturally break along the veins, which contain brittle calcite, allowing most of the contents of the veins to break away as dust, and leaving reasonably pure chunks of the uniform matrix. Thus the production of free lime in the product was reduced.

Parker used a bottle kiln rather than an open lime kiln. It is stated that the kiln was operated continuously, with equal volumes of coal and broken nodules added at the top and calcined material withdrawn at the bottom, with a residence time of 2-3 days. Coke was used as fuel when it became available in 1812. The energy consumption was probably in the range 12-15 MJ/kg. When cool, the calcined material was hand-crushed, then milled with flat stones, the product often being sieved prior to packing in casks. Parker situated his production plant at Northfleet because of the availability of a tidal mill and windmill for grinding. Packing was done quickly because of the extreme moisture-sensitivity of the powder, contact with damp air causing a considerable reduction in strength.

One ton of cement stone was said to yield about 21 bushels of cement. If the loss-on-ignition in the above analysis applies, then this implies a bulk density of 75.4 lb per bushel - a typical value for a lightly-burned cement. Hard burning was avoided because it led to longer setting time due to progressive conversion of calcium aluminates into unreactive gehlenite ($Ca_2Al_2SiO_7$).

Appendix III – why not London Clay around 1880?

When the main raw material is a limestone containing more than this amount of calcium carbonate, the composition must be adjusted by addition of a low-carbonate component, contributing SiO_2 [silica], Al_2O_3 [alumina] and Fe_2O_3 [iron oxide] to the mixture. The aluminosilicate-bearing minerals used are referred to as **Argillaceous (clay-like) Components**.

In some instances, cement manufacturers have had access to "argillaceous limestones" that have carbonate contents close to the target level - the most commonly used in Britain being the Chalk Marl and the Blue Lias. In these cases, rawmix control consisted of blending higher-carbonate and lower-carbonate layers to obtain the exact target chemistry. However, in general, nature is not that kind. The main raw material may be somewhat too low in carbonate, in which case a high-carbonate "sweetener" must be obtained to correct the mix. But in the majority of cases, the main limestone raw material is relatively pure, and must be blended with a clay or shale that is low in calcium carbonate. The nature of this "secondary material" chosen changed with the historical evolution of the industry.

The clays and shales used are discussed here in increasing order of geological age.

Alluvium

Alluvium is mud carried by and deposited by rivers, typically during the last few thousand years. Alluvial clay was the first to be used in Portland cement in the Thames valley (and although the source of clay used by Joseph Aspdin in Yorkshire is unknown, it was most probably also alluvium). Early cement manufacturers ascribed almost magical qualities to the alluvium of the Medway estuary, and even distant plants (e.g. Shoreham) used it, obtaining supplies by coastal barge. The key quality of the clay, not identified until much later, ***was the content of fine silica, in addition to clay minerals***, and the existence of highly-prized areas of the estuary in which large particles were absent due to the slow river currents and tidal flows transporting the sediment.

The popularity of the Medway alluvium resulted in a large specialised industry supplying clay to cement plants, by a method not generally employed elsewhere: clay was hand-dug from the foreshore of the very wide and meandering estuary, and conveyed by barges that arrived at high tide, beached as the tide fell, were filled at low tide, and floated off as the tide rose again. This industry considerably changed the estuary, removing most of the salt-marsh that had previously delineated the river's course. The product of this extraction method was naturally very wet (>40% as dug), and had a high content of salt, organics (up to 5%) and pyrite. Salinity in most of the worked area of the estuary was around 2.7-2.9%, so a clay with 45% as-dug water content (i.e. 81.8% dry basis) contained around 2.3% sodium chloride. Neither the moisture nor the salt were a problem for the early industry, preparing high moisture content (>60%) slurries, removing most of the water (plus dissolved salt) by decantation, and burning in a static kiln that evaporated all salts.

Later manufacturers, looking for materials closer to hand, soon found that many other alluvial clays were suitable, beginning with the clays of the Thames estuary. In many locations there were salt marshes yielding good clay, and furthermore, these were above water level at all but the highest spring tides, and so could be quarried by conventional means. The largest such deposits were at Cliffe, which for a while supplied many of the Thames plants. Clay was dug from the flooded workings by means of a floating dredger equipped with an on-board washmill that slurried the clay as it was dug, and pumped it by flexible pipeline to a tank on the shore, from which it was despatched to the plants in liquid form by custom-designed tankers.

Similar arrangements developed on the banks of the Humber, supplying the plants in that area, either with dug clay or with slurry.

Use of alluvium was problematic when rotary kilns began to be used, because of chloride cycles, and became fatal when electrostatic precipitators were installed, the chloride making the dust difficult to precipitate. All the south-eastern plants ended up using older bedrock clays.

London Clay is a sediment laid down during the Ypresian stage of the Lower Eocene, around 48-55 million years ago. The clay was laid down in tropical conditions, in a reducing environment, resulting in a blue colour due to the presence of pyrite. The clay oxidises on weathering, turning the colour yellow due to conversion of pyrite to hydrated iron oxides.

London Clay was familiar to early cement manufacturers because it was the matrix containing the original "Parker" septaria used in making Roman Cement. It is not a curious fact that the many plants that started by making Roman Cement, and graduated to making Portland cement, **chose to use alluvium** - often brought long distances - **as their secondary raw material, although London Clay was close at hand**. (Possible exceptions are Rainham and Upnor.) The use of London Clay began when the industry started to spread from its original home in the Thames and Medway estuaries. The first seems to have been Harefield (1880).

The initial objections to the use of London Clay (apart from mere superstition) were the fact that its fineness is variable, so that it often becomes big sandy, and its sulfur content, which was largely retained in the clinker in batch kilns. The sand content required either fine screening of the slurry, or in more recent times, the use of re-grind ball mills.

The availability of the classic tidal alluvium started to be restricted during the twentieth century, and during the 1920s, as part of their expansion programme, most of the large Thames-side plants opened London Clay quarries, slurrying the clay at the quarry, and pumping it to the plant's main washplant for incorporation in the raw mix. This technique reached its zenith with the provision of the 3.5 million tonne a year Northfleet plant with clay from Ockendon (Essex), involving an 11 km pipeline under the Thames. This quarry dug, at peak, over 1.5 million tonnes of clay a year. The sulfur content of the clay continued to be a significant problem, and effectively prevented the wet process Northfleet plant from achieving slurry moisture contents below 38%.

With the extinction of the industry in the south-east, London Clay is no longer used in cement manufacture.

Clockwise from top left:
Marl
Murrell
Crystal Water Well
Male Energy line Cross and Female Magnetic Quadropole
Magnetisable iron and water

Spherical cap plasma store and magnetic trough

Published by Baron Tregonwell-Monro-Smith ©2019

Britain's 1st Shield Banner Seal 1190
Order of Richmount 1204

Briton's Exchequer 1129 Baron Orescuilz
Humphrey 1089 Editor Domesday Book
Justiciary as President of Exchequer 1100