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GOVERNMENT GEOLOGIST

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REPORT ON DEPOSITS OF CLAY AT GEORGE'S
BAY AND ELSEWHERE.

Government Geologist's Office,
Lannceston, 1st March, 1904.

Sir,

In accordance with instructions, I visited St. Helens on the 2nd February to inspect the clay deposits reported to exist there, with a view to their suitability for the pottery industry.

For the clay industry, whenever it is established, three main descriptions of clay will be utilised.

1. *The kaolinic or silico-felspathic clay* proper to granite districts, and which is suited for the manufacture of china, granite ware, and fine pottery generally. This may occur in two ways, viz., as a residue resulting from the breaking-down and decomposition of granite *in situ*, and would then be found either as the filling, between dyke walls, or as softened and disintegrated granite rock; or this residue may be transported by water and deposited as sediment in the form of clay-beds on the floors of rivers, lagoons, or estuaries. In the great residual bodies, flakes of mica are apt to be abundant, and have to be eliminated by washing; grains and stones of quartz also occur, but these are often turned to good account in mixing. The sedimentary beds can very easily contain various objectionable ingredients, but on the other hand, it is this class of deposit which furnishes examples of the purest clay (when it is pure, it is very pure). Other things being equal, the great desideratum in clay for the finer class of product is that the colour should be white after the burning process. This is the description of clay which is quarried in the granite country of Devon and Cornwall, and carried to Staffordshire to be used in the manufacture of fine pottery. It has mostly to be washed, being fed into troughs with knife-machines, in which it is stirred and broken up, then passed in laundries to settling tanks, whence it is pumped into filter-presses and squeezed into cakes, which are finally air or steam dried. This washing process considerably reduces the quantity of clay, the proportion of clay obtained to the quantity quarried varying from 1—3 to 1—8.

The quartz washed out in this process is ground and used by the manufacturers for mixing and glazing. The clays for this class of pottery will in Tasmania be found in the tin-granite areas, for there the agencies connected with the deposition of tin have led to the alteration of the granite, and seem to have promoted its disintegration more extensively than is seen to be the case with the hard, non-mineralised granite of other districts. The ancient leads which are a feature of these granites were favourable channels for the deposition of beds of the felspathic clay. Hence, on *a priori* grounds, the North-Eastern tinfields, and the Heemskirk district on the West Coast, may be expected to yield these clays; and, as a matter of fact, such is the case.

2. The next class of clay for pottery work is the *fireclay of the coal measures*. It is silicious in nature, but not always refractory; indeed, the heat-resisting properties of the various kinds have a rather wide range. This clay is used for making firebricks and coarse pottery. Under the head of coarse pottery such articles as the following would be included:—Enamel stoneware (Bristol ware), jamjars and yellow ware generally, ink-bottles, ginger-beer bottles, chemical jars, sinks, lavatory furniture, drainpipes, glazed bricks, wall tiles, architectural terracotta blocks, &c.

There is generally a good deal of difference between clays from different districts, and this makes certain clays especially suitable for certain ware; hence it is often the practice to blend clays from different localities. In making firebricks, sand is usually used in various proportions. In considering the suitability of such clays for pottery purposes, several things have to be taken into account, apart from their purely chemical constitution. The iron coloration must be noted. If this is intense, the colour after firing is likely to be intense also. The proportion of sand will increase its refractoriness, but may make it less plastic. Carbonaceous matter in a clay free from iron will tend to colour the product, and make it more absorptive of moisture, which leads to subsequent cracking during the drying and burning processes. The physical tests applied to clays are:—determination of plasticity, as shown by the tensile strength of blocks dried in the sun; the amount of shrinkage during the process of drying; ditto in vitrifying; the temperature at which fusion occurs, also at which the clay begins to vitrify; the strength of the product and its colour; the amount of water necessary to make a plastic paste; the

impurities which have to be washed out; the fluxing impurities, &c.

But nearly all the properties possessed by these clays exert some influence during its treatment. It is consequently next to impossible to diagnose their value for working purposes without careful trials. There is also the further art of blending different clays for specific purposes.

These clays exist in Tasmania in association with our coal seams; generally, however, not more than from 2 to 5 feet in thickness, and varying a good deal in their physical properties. They are often at a good height above sea level, or the plains at the foot of the ranges, and sometimes in rather unfavourable situations for economic working. But those beds which exist at mines which are already being worked are obviously accessible without difficulty.

Nearly every coal mine has its clay seam of more or less thickness. The thickest which I recollect is the underclay at the Sandfly, which has been bored into 19 feet. The clay in the double seam at the Dalmayne is $4\frac{1}{2}$ feet, and there are others. These clays with us are usually semi-refractory.

3. A third class of clay for manufactures is found in the Permian and Tertiary strata, in which beds of clay are worked for the manufacture of common bricks, tiles, drain-pipes, encaustic tiles, earthenware, terracotta work, whitening, &c.

This clay exists in Tasmania, occasionally in the lower and upper Palaeozoic strata, but largely wherever Tertiary deposits occur. The clays of the Launceston Tertiary basin are well-known examples. They embrace every variety in quality, from brick earth to pipeclay, and are spread over a wide area. These sediments fill an old lacustrine basin of great depth, and it would be interesting, and undoubtedly useful, to examine the various occurrences of workable clay throughout this extensive field. The glacial clays of the West Coast, too, merit attention.

GEORGE'S BAY, ST. HELENS.

This is a sheet of water forming the land-locked estuary of the George River, averaging about one mile wide, and extending in a north-easterly direction from St. Helens to the Heads for a distance of six miles, flanked by low wooded hills. At the Heads the outlet contracts to a width of a few hundred yards. Outside is the familiar feature—a bar—covered by 10 or 12 feet of water, though it is a little

shallower just inside. I was told that recently the s.s. "*Warrentinna*," drawing 8 feet 6 inches, came in at dead low water. At the southern end of the bay, and on the eastern shore, there is deep water, 20 feet in depth only a few yards from the shore. There is a weekly steam service at this port, the "*Warrentinna*" touching one week from Hobart, the next from Launceston. A small oil launch has just been put on the bay for the use of visitors.

The George River flows into the bay just north of the township, but there is evidence, familiar enough to residents, to the effect that in Tertiary times it came into the present township from the south-west. The river then did not flow out to sea between the present Heads, which are rockbound, and Mr. Henry Grant, of St. Helens, who has made a special study of the local geology, has come to the conclusion that it headed from St. Helens eastwards across the Bay to Diana's Basin. There seems to me little doubt but that the old estuary did occupy the area now comprised by the hills of drift and gravel which form the eastern shore of the present bay. These all consist of quartz wash and grit overlying beds of finely levigated felspathic clay. There is no sign of granite bedrock in these hills anywhere between the rocky rim which fringes the coast-line, and the granite shore which borders the south of the bay at the Recreation Ground, Anchor smelters, Hon. E. Lytton's estate, and Beauty Bay. This latter is the southern rimrock of the ancient river or estuary.

The large body of wash enclosed in this granite basin might very well be expected to carry tin ore, and, as a matter of fact, an abortive attempt to recover ore by dredging was made by the Rose Tin Mining Company a few years ago. The dredging on the shore, however, penetrated, as it seems to me, the clay floor which is below the horizon of the wash; and, moreover, a good deal of prospecting was done in the wash itself without revealing the existence of ore in anything like payable proportions. The little tin which is stated to be found is always extremely fine, and the probability is that the wash contains only a little of this, which has been transported a long distance, and distributed sparsely over a wide area.

A.—Clay on the shore of George's Bay.

It is along this eastern shore of the bay that a stratum of light drab felspathic clay is to be seen at about high-water level, and exposed a few feet above it.

Landing at the hut north of the Bluff, on Richard Willis' purchased 98 acres, a seam of this clay begins to be visible in the bank at 10 or 12 chains south of the hut, showing for a thickness of 6 feet above high-water mark. It is clean, soft, without grit, and rubs down to a soft paste. The continuation is interrupted by some irregular beds of wash at the Bluff, but at the south end of the latter it comes in again, and continues southward for a quarter of a mile. South of the Bluff, Mr. Lansdell put down a small shaft 17 feet, all in pure clay. Further south, I saw a borehole on the shore, which Mr. Hodgman tells me he sank 32 feet 6 inches in pure clay of a uniform drab colour, and not bottomed. This depth would be about 30 feet below high-water level. Another bore, 10 chains further south, was sunk 31 feet 6 inches in good clay, and not bottomed. Sixteen chains south of this a bore, the first of all, was put down 9 feet in this clay, and 2 feet in a clay with red iron-stained grit, composed of granules of quartz. It may be that here the bedrock of decomposed granite is being approached. It seems clear that the clay is a horizontal bed, and does not rise with the hill, for bores and holes have been sunk higher up on the hillside, passing through wash and quartz-drift down to the clay bottom. This stretch of clay, south of the Bluff for about a quarter of a mile, is the best part of the deposit as far as has been shown by the borings, and appears to be of considerable thickness. How far it extends eastward under the wash of the hill will have to be ascertained by boring. Its persistence along the shore indicates its continuance into the hill, where it will enter private property, charted in the name of Rd. Willis. Going along the shore in the opposite direction, *i.e.*, northwards from the hut, the clay can be traced, and has been proved by bores; but it is not so thick or pure as at the south end. Three bores have been sunk on the bank in this part of the deposit. The first I did not see; the second was put down $19\frac{1}{2}$ feet from the surface. Fourteen feet of this were in pure clay, the remainder was sandy, and sand was struck at the bottom.

Further north, No. 3 bore was put down 21 feet, of which 13 feet were pure clay, the remainder being slightly sandy. At the bottom sea-water was found. In this direction the clay sinks out of sight below the wash, which is sometimes a felspathic sand passing down into purer clay. Past the "Chimneys," eastwards towards Moriarty Lagoon, the hill has been prospected by numerous holes, by Salmon and

Budgeon, and then by the Rose Tin Mining Company about three years ago. No tin was met with, and the holes appear to be in wash, with impure quartz-bearing clay now and then. The bed of clay from the south in all probability extends northwards below this area, and this occupies an enormous extent of ground. The clay is much more irregular here, and anyone establishing a quarry would do well to start operations at the Bluff end of the shore, where the clay is uniform, free from quartz granules, and contains very little mica. The light-grey colour betokens the absence of ferruginous impurities, and crude tests show the product to be white after burning. It is dense and tenaceous, and the air shrinkage would, I imagine, be constant. It would appear to be quite suitable for high-class pottery, and could be utilised for more than one grade or variety of stoneware. The first thing to be done is to prove its extension and thickness below the overlying drift of the hill. Its working would have been easier if more of it had existed above water level. It can, however, be excavated without much difficulty by means of inclined working planes, but the workings below the overburden of drift will have to be well secured.

Situate on the immediate shore of a deep-water channel, the position as regards shipping facilities is excellent, whether the clay only is shipped, or the manufacture of pottery on the spot is undertaken. If it is proved by boring to extend a quarter of a mile into the hill, and to have an average thickness of 30 feet, then the tonnage would amount in a quarter of a square mile to 3,646,205 tons gross.

If it were decided to make on the spot, steam-driven plant would be necessary, for which coal would have to be imported, or wood taken from the surrounding country. Or if works were established at some other centre, on clay beds of lower grade for coarser products, it would probably pay to quarry the fine clay here and ship it to the place of manufacture, as is done in England. In America, the Missouri kaolin is carried several hundred miles from the quarries to the potteries, and has to bear a transport charge of over 20s. per ton. Its value at the potteries is from 30s. to 40s. per ton.

The English china clay is not only carried from Devon to Staffordshire, but is exported to foreign countries. Most of the clay used in Italy for porcelain, &c., is sent there from England and France. The English production amounts to about half a million tons per annum.

The total exports of all sorts of clay from the United Kingdom reach over 400,000 tons, of a declared value of about 22s. per ton. In this quantity the United States figure for over 130,000 tons. It is evident, therefore, that clay can be moved about for the purposes of manufacture, and this circumstance gives a chance to some of our inland deposits. Whichever plan manufacturers, for their own reasons, may see fit to adopt, this clay deposit merits their careful attention. Works at St. Helens would enjoy all the advantages of an unrivalled position at the very edge of deep water, a favourable climate for continuous work all the year round, and a port available for cheap shipment to any seaboard town, either in this or any other State in the Commonwealth.

B.—Clay on Ferntree Creek, near St. Helens.

The tin drifts near St. Helens enclose beds of felspathic clay highly suitable for the manufacture of the finer pottery. A light-coloured plastic clay underlies the wash which is being treated at most of the tin mines. Naturally, this clay floor (locally called marine bottom, or false bottom) has not been removed by those working the overlying drift, but enough of it has been exposed here and there to show that its thickness is considerable. A bed of this clay exists at the lower Royal Ruby Mine. The floods, at the time of my visit to St. Helens, prevented me from crossing the ford and examining the deposit, but Mr. Patterson brought me samples of this clay, which he says extend right through the three sections charted in the names of Patterson and Cruse, and is stated as known to be over 5 chains wide. I saw a specimen of it roughly treated and moulded in a blacksmith's forge. It seemed hard and dense, and had a good colour. This is situate a little over three miles from the Bay, but it would not take much to run it down to the jetty, and the cost would not be prohibitive if the quality can be established as superior, about which I believe there is very little doubt.

C.—Pioneer Mine at Bradshaw's Creek.

Similar beds of clay occur in the tin drifts of the Pioneer Mine between Moorina and Gladstone. This wash also fills the channel of an ancient lead, now crossed at right angles to its course by the modern Ringarooma River. The clays

are sluiced away in working for tin. Thus Mr. C. Ryan, the Manager, tells me that the thickest seam, which was about 16 feet thick, and covered about half an acre, has disappeared in this way. According to the bores put down in the solid ground ahead of the present workings, there are several patches up to 5 feet in thickness. Some of the Pioneer clay is very good (snow white and free from grit), but the bulk is slightly gritty.

D.—Clay at Dulverton.

Mr. Ockerby, Launceston, has called my attention to a bed of clay overlying the coal seam at the Dulverton Colliery. This is from 2 to 6 feet thick, and is traceable at the outcrop for a considerable distance. It belongs to the fireclay series, and appears to be refractory, for it has been used at Mount Lyell, and it has been used in furnaces at Salisbury's foundry for two years at a stretch. I have seen a fragment of stoneware made from it at one of the Launceston pottery works. The situation of the bed is three miles to the Dulverton Station, whither the coal is transported on the Company's tram, and which is distant only 13 miles from the shipping port—Devonport.

E.—Clay at the Sandfly.

The No. 3 seam at the Sandfly Coal Mine rests upon a bed of white clay, which has been pierced by a boring-rod to a depth of 19 feet; and though its heat-resisting properties, as determined in the Government laboratories, are only moderate, it is possible that it could be utilised in a variety of ways. Once the mine tramway to the coast is established, the clay could be worked as a by-product.

F.—Clay at Mount Nicholas, Thompson's Marshes, &c.

Beds of more or less refractory clay occur at the coal mines on these ranges, but nothing has been done with them so far, the mine-owners devoting their attention to the extraction of coal.

G.—Clay at West Arm, Tamar River.

Mr. D. Dally informs me that he knows of two beds of clay on the West Arm, presumably in the Permo-Carboniferous system. These range from 2 to 5 feet in thickness,

and in colour from dirty white to black. In the country west of the Tasmania, some unctuous clay, somewhat resembling "Fuller's Earth," occurs; its thickness is believed to be considerable—between 15 and 30 feet.

H.—Clay at the Lower Piper.

Many years ago some clay was tested in Launceston from the Lower Piper, where a large quantity is said to exist, but nothing further appears to have been done with it.

I.—Clay at Mount Saddleback.

Mr. A. Evershed, Secretary to the Marine Board, Launceston, has given me samples of a white unctuous clay from the vicinity of Mr. Talbot's property near Mount Saddleback, which looks as if use could be found for it in some department of the pottery industry. It is said to occur in a bed 5 to 6 feet thick. I am not acquainted with its geological occurrence, and am consequently unable to form an opinion of its probable value. It has the disadvantage of being rather far inland.

J.—Clay at the Den.

On the Den Hill, near Lefroy (Captain Anderson's property) the Silurian slates and sandstones have decomposed into a body of clay, mostly reddish, forming the approach to the dry tunnel on the north-east side of the hill. This is a good silicious clay, and might be serviceable for terracotta manufacture. Its analysis, in the Government laboratories, showed its composition to be silica 77 per cent., alumina, oxide of iron, &c., 18.8 per cent., moisture and combined water 4.2 per cent.

Numerous other deposits of clay occur in various parts of the island, but though many of the localities are known to me in a general way, I am not acquainted with the occurrences, nor have I samples of them. The present report must, therefore, be regarded as a preliminary one, dealing with the subject as far as practicable within the limits of time available.

Two samples of the clay from George's Bay District were forwarded to the Government Analyst (Mr. Ward), who reports thereon as follows:—"These analyses would be long and tedious, and would serve no useful purpose, as compared with practical tests by a potter under ordinary working conditions. Small crucibles made with each clay are forwarded herewith; the discolouration of the bottoms is due to oxide of lead, firing having been carried out in an assay muffle. The clays are practically infusible."

I have the honour to be,
Sir,

Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. A. PRETYMAN, Esq.,
Acting Secretary for Mines, Hobart.

On the Dan Hill near Launceston (Captain Anderson's property) the Silurian shales and sandstones have been deposited into a body of clay mostly reddish, forming the approach to the bay tunnel on the north-east side of the hill. This is a good silicious clay, and is very serviceable for terra-cotta manufacture. Its analysis in the Government laboratory showed its composition to be silica 77 per cent, alumina, oxide of iron &c. 1.8 per cent, moisture and combined water 1.2 per cent.

Numerous other deposits of clay occur in various parts of the island but though many of the localities are known to me in a general way I am not acquainted with the occurrences nor have I samples of them. The present report must therefore be regarded as a preliminary one dealing with the subject, inasmuch as a preliminary limit of time is available within the

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