

GSREPA

Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY REPORT

No. 4

On Cement Materials at
West Arm

BY

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Issued under the authority of
The Honourable J. E. OGDEN, Minister for Mines



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ILLUSTRATION.

GEOLOGICAL SKETCH MAP OF THE COUNTRY ON WEST ARM.

Cement Materials at West Arm.

I.—INTRODUCTION.

It has been necessary to examine certain beds of limestone situate on the West Arm of the River Tamar in connection with the needs of the Launceston Marine Board for the large works about to be undertaken for the improvement of the port. This arm debouches into the river just north of the township of Ilfracombe. The latter, in accordance with the practice of dual nomenclature in vogue in Tasmania, is better known as Beauty Point. Beauty Point, however, strictly speaking, is the little promontory where the jetty is situated; but the name is usually shared by the the cluster of cottages and villas nestling on the hillside, and away north and south of the jetty. The place deserves its name, and will always draw its quota of visitors in quest of quiet and beauty, for it is difficult to imagine a fairer scene than the view across the noble estuary of the Tamar where the changing panorama of the opposite shore delights the gaze, while to the north is the vista of the open sea between the distant Heads, shining in the sunlight like a sheet of burnished silver.

With the curtailment of mining operations at Beaconsfield, Ilfracombe will, perhaps, for a time, suffer a little in the volume of its maritime trade, but the surprising start which has been made in orcharding will have a beneficial effect on its future. Apple orchards are being planted everywhere on the hill range skirting the river, and on the flat lands all along the West Arm, and on both sides of it. The proposed new port in Bell Bay on the other side of the river will also assist Beauty Point. The little jetty here, with 40 feet of water, accommodates ocean steamers with ease, and will always secure its share of business.

II.—GEOLOGY.

Comparatively few geological systems or time periods are represented in the area under review. These are (1) Quaternary, (2) Tertiary, (3) Mesozoic, (4) Permo-Carboniferous.

(1)—QUATERNARY.

Sands and clays which apparently belong to the Recent period are scattered as a thin covering over the country on both sides of the Arm. They are evidently derived from the underlying sandstones and shales of the Permo-Carboniferous system, and are not always easily distinguished from the Tertiary sediments of the district. The country at Ilfracombe has possibly risen in Post-Tertiary times, for the high land towards the south end of the township is covered with a pebbly and sandy drift, which itself rests on clays which may be of either Pleistocene or Tertiary age.

(2) TERTIARY.

The clays below the basalt at Inspection Head must be Tertiary, and these clays and sands form the hill ridge of the Ilfracombe township. Large boulders of basalt are embedded in the soil everywhere along the east slope of this ridge, but the only really basaltic solid rock is that at Inspection Head. The immense boulders are the only remains of the lava sheet which once overspread the eastern part of the township area. The appearance of the occurrence is that of an ancient valley filling. The sub-basaltic clays are greasy and unstable and have occasioned serious landslips along the river side of the hill.

A bore for coal was put down 40 or 50 years ago by Mr. Zephaniah Williams to a depth of some 80 feet, and some lignitic or coaly material is said to have been met with. Whether it penetrated the underlying Permo-Carboniferous strata is doubtful.

(3)—MESOZOIC.

The usual diabase rock of the coal measures areas forms the Anchor Point promontory on the north side of the Arm, and continues north-westerly on the line of the Stockyard Hills to West Head. At one time it evidently extended to the present site of Ilfracombe, for some loose boulders of it are scattered on the beach at the north end of the township, and stones of it are met with again on the high land further south.

(4)—PERMO-CARBONIFEROUS.

The shores of the Arm show that the country north and south of the estuary is composed of strata of this system. Mudstones, mudstone conglomerate, shale and limestone, indicate the Lower Marine division. They have a general north-westerly strike, with a flat dip to the north-east. It is uncertain whether the yellow sandstone near the diabase contact on the north side of the Arm does not belong to a higher horizon in the system. It is highly micaceous and ferruginous, and there has been a little scraping for coal where the stone has a black stain. Some of the freestone from the north side of Turner's Creek was used to build the Port Lemprière blast furnace in 1876, and the furnace of the Ilfracombe Iron Co. in the early seventies.

South of Turner's Creek, going towards Soldier's Point, are beds of yellow and grey sandstone, with carbonaceous bands dipping about 7 degrees to the north-east. Dally's tunnel has been driven across these beds for a few feet at high water mark with a sandstone roof and floor. About 150 feet west is a small shaft on the bank sunk to nearly 20 feet with nothing showing. Near this spot at low tide an outcrop of stony coaly matter is visible, which would pass below the bands in the drive.

Mr. Dally also bored these strata to a depth of 75 feet at about a chain in from the shore, but without intersecting any seam of coal.

From the dip of the Lower Marine beds further west, and the indications (admittedly very slender) afforded by coal markings, and by the lithological aspect of the beds generally, it may be conjectured that the sandstones near the diabase contact and those near the Port Lemprière jetty, on the south side of the arm, are possibly on the horizon of the Mersey measures.

The writer has already expressed his opinion that a possibility exists of seams of coal occurring in them, although the few trials made have been abortive; that a few coaly markings met with are indecisive indications, and that the existence of payable seams is by no means certain. If it were desired to put the matter to the proof, the most favourable locality for boring would be at Point Lemprière (near Red Bill Point).

III.—LIMESTONE ON THE WEST ARM.

The Launceston Marine Board is prospecting some beds of limestone on the north side of the West Arm, half way between Boat's Crew Point and Soldier's Point*, and nearly three-quarters of a mile from the head of the Arm. The exact locality is on a vacant mineral section 2775-M, previously taken up for limestone.

The steep bank of the Arm at this spot consists of yellowish pebbly grit and clayey sandstone, belonging to the Lower Marine division of the Permo-Carboniferous system. These are therefore below the horizon of the lowest coal measures in Tasmania. Below this, and not higher than high tide level, are calcareous beds, the softened upper surface of which is exposed on the beach as the tide recedes. They are crowded with marine fossils (*Spirifera tasmanvensis* and various forms of the *Fenestellida*), which are characteristic of this system. The beds rest conformably on mudstone conglomerate of the same system.

Two bands of impure limestone appear to be separated from one another by about 30 feet. The outcrop measurement of the eastern belt along the foreshore is 46 feet, and as it seems to be underlying at an angle of about 20 degrees in a north-easterly direction, its true thickness would be about 15 feet. The western belt extends along the beach for 115 feet, and its true thickness would be about 40 feet.

The pitch of these beds is downwards towards the water's edge; consequently they rise N.W. into the bank, but as at the same time they have a north-easterly dip at right angles to their strike, any drive into the bank tends to pass over their upper surface, which remains at or just below high water level.

A small drive into the bank has in fact gone over the limestone into the overlying grits; and a second drive started a few feet south of the first one has met the same fate. Some ground has been excavated by a landslip near by, and an attempt is now being made to clear the walls of this and trace this extension of the limestone, with a view to driving into it if it rises above high water mark. A shaft put down somewhere in the landslip would certainly intersect the limestone, but the ground there is too unstable and the better method, failing success otherwise, would be to sink at the top of the bank, a matter only of 15 or 16 feet.

* Said to derive its name from its being the spot where the first soldier was buried in Tasmania.

There is no doubt that these beds are in a very inconvenient position for prospecting, and still more so for permanently working, lying as they do at and below the level of the water.

Samples taken from the beds on the beach were submitted to Mr. W. F. Ward, the Government Analyst, who reports as follows :—

	Per cent.
Lime, soluble in acid	20·0
Silica, &c., insoluble	53·4
Alumina and iron oxide	6·2
Moisture, &c., and carbonic acid ...	19·0
	98·6

Obviously, the analysis reveals the composition of a calcareous mudstone rather than of a limestone. The lime content is equivalent only to 35·7 per cent. carbonate of lime (CaCO_3) and the silica, much of it evidently uncombined with alumina, is in excess of the extreme limit for a natural cement rock. The proportion of lime is on the low side, even for natural cement rock, and certainly rules the stone out (in its present state) as a suitable material for making Portland cement.

Certain American argillaceous limestones used for making natural cement have as low as 34 per cent. carbonate of lime, but their silica percentage does not exceed 20 or at most 40. A highly siliceous limestone does not give a sound cement. The excessive silica in the West Arm beds may be ascribed to grains of sand and included pebbles.

The proportion of high calcium limestone which would have to be added in order to bring the lime percentage up to the proper grade precludes, in the writer's opinion, any probability of a payable proposition eventuating.

Naturally, proper samples cannot be taken so long as only weathered and saturated outcrops are available; but the likelihood of the deposit improving sufficiently as it gets under cover is very slight; and if only selected bands of the best quality rock are relied upon, the quantity of stone would be reduced enormously.

Until the whole formation has been penetrated, it is a little hazardous to venture an estimate of its volume. The Marine Board, however, has a reserve of 100 feet from the water; beyond this limit the land here is privately owned. Assuming the beds in question to continue to the inner boundary of the reserved strip, their dimensions would give about 500,000 cubic feet.

This in itself is not sufficient to maintain even a small plant for more than a year. Large cement works nowadays have a producing capacity of 2500 and 3000 barrels per diem, which makes for economy at every stage in the manufacture. A small plant, such as the Marine Board might conceivably erect, capable of producing 500 barrels a day (or 500 tons per week) requires about 500,000 cubic feet of limestone and 125,000 cubic feet of clay per annum.

It is generally considered that a cement factory ought to have at least 20 years' life, and accordingly it follows that it should have 10,000,000 cubic feet of limestone and 2,500,000 cubic feet of clay on its property.

If it is desired to start works of this capacity at this spot, an area of 8 acres will have to be acquired in order to keep up the output for 20 years.

An idea of the acreage of limestone required to supply a plant of a daily capacity of 500 barrels (500 tons per week) from beds of varying thickness for 20 years may be gained from the following table:—

Thickness.	Acre.
10 feet	23
20 "	12
30 "	8
40 "	6
50 "	4 $\frac{1}{2}$
60 "	4
70 "	3 $\frac{1}{4}$
80 "	3
90 "	2 $\frac{3}{4}$
100 "	2 $\frac{1}{4}$

In addition, an acreage equal to one-fourth of the above is required for supplies of clay or shale during the same period. Beds of pebble-free shale or mudstone crop out here and there on the north side of the Arm, notably at Boat Crew's Point. These outcrops would have to be prospected, for a suitable clay is just as necessary as a suitable limestone.

Summing up, the quantity of suitable limestone rock for producing Portland cement at this spot appears to be very limited. A supplementary supply of high grade limestone would have to be procured, and even then the reduction of the silica percentage to within the proper limits would be extremely problematical. In addition, the awkward position for quarrying, and the inconvenient site for the plant, would make for uneconomical and unprofitable working.

IV.—LIMESTONE ON YORK TOWN RIVULET.

At the head of the Arm is the York Town township reserve, where a few cottages still remain surrounded by old apple gardens. These are on the flat country on the south bank of the rivulet. The township site is that marked out by Lieutenant-Governor Paterson at the end of 1804 for what he called York Town. The rivulet was called by him Kent's Burn. In March, 1806, he moved to Launceston, and this sealed the fate of the inconveniently situated settlement at the head of the West Arm. On the north side of the rivulet a hill ridge called Mt. Albany by Paterson rises to a height commanding the flat land of the township with a steep face to the stream.

This ridge consists of Permo-Carboniferous shales and limestone. A small landslip has exposed a face of shale on the hill-side about fifty feet above the rivulet. This is on Pott's township block, but the beds evidently continue for an undetermined length along the ridge side. Horizontal beds of slightly calcareous shale have been exposed here for about 15 feet vertical. About 50 feet further west a boulder or two of grey limestone occurs loose in the soil of the hill. Information is to the effect that when the water is low, identical limestone is visible in the bed of the rivulet.

It is important that the hill face should be trenched down to creek level with a view of ascertaining what alternations of beds occur. At present all indications are concealed by a mantle of soil, and nothing much can be said till the bed rock is uncovered.

Two samplings of the landslip face show a rock only slightly calcareous, containing not more than 6 per cent. carbonate of lime. The bulk of the exposed face is a siliceous shale carrying over 75 per cent. silica.

1. Samples chipped from it were assayed by Mr. W. F. Ward, Government Analyst, with the following result:—

	Per cent.
Lime, soluble in acid	3.4
Silica, &c., insoluble	78.2
Alumina and iron oxide	8.4
Moisture, &c., carbonic acid	6.8
	<hr/>
	96.8
	<hr/>

2. A very siliceous grey quartzitic rock which crops out just at the base of the face was also analysed by the Government Analyst as follows :—

	Per cent.
Lime, soluble in acid	1·4
Silica, &c., insoluble	94·2
Alumina and iron oxide	3·2
Moisture, &c., carbonic acid	1·4
	100·2

3. Samples broken from the loose boulder of limestone on the hillside a little west of the landslip have been examined by the Government Analyst as follows :—

	Per cent.
Lime	37·6
Silica	23·0
Alumina	5·8
Iron protoxide	1·8
Magnesia	0·9
Moisture, &c., carbonic acid, loss on ignition	30·4
Not determined	0·5
	100·0

The lime content is equivalent to 67 per cent. carbonate of lime.

It can be readily seen that the rocks represented by samples Nos. 1 and 2 are useless for any cement purposes. Their lime content is trivial, and the silica percentage is prohibitive. They are, in fact, very siliceous clays with low alumina percentages. The landslip face, therefore, as it is at present, is not of any practical use for the object in view. But there is reason to believe that there are beds of higher grade rock somewhere on this side of the hill, for analysis No. 3 shows a limestone having the composition of natural cement rock. This too by itself is unsuitable for Portland cement manufacture without a fair admixture of pure limestone. If a pure limestone can be found on the property, or quite adjacent, it can be added to such a rock as this and a suitable mixture obtained. If limestone No. 3 is discovered in quantity in this hill to make it utilisable, a high grade limestone must also be found and made available in the immediate vicinity.

Provided that a suitable rock is discovered, this is the most appropriate position for works anywhere on the Arm. Working benches could be cut readily, and an aerial ropeway would convey the stone to works built on the flat land on the south side of the rivulet.

During the preparation of this report the Marine Board has carried out some prospecting work on the hill, consisting of long trenches, which have disclosed the average nature of the available rock quite effectively. Unfortunately these have not shown occurrences of any rock which could be called other than calcareous mudstone. The lime content is altogether insufficient for the desired purpose.

Samples of rock from the different trenches were taken and analysed in the Government Laboratories, Hobart, with the following results:—

The calcareous mudstone shale from Macdonald's west trench, 50 feet above the creek, yielded on assay 7 per cent. of carbonate of lime.

Samples taken from a long trench inside the east boundary of Macdonald's town lot on the hill above creek, proved to be simply fossiliferous mudstone, with much less lime content than the preceding; and the same applies to samples from the outcrop face at the landslip where a shot had been put in.

Samples of fossiliferous mudstone from the trench at the top of the hill on Macdonald's north boundary yielded no carbonate of lime; neither was any present in samples from the western long trench on Tippin's town lot.

V.—LIMESTONE AT THE BLUE STONE FORD.

This is situate on Anderson's Creek at about one mile from its mouth, on an extended prospecting claim, 320 acres, in the name of H. E. Evans. The claim is on the west side of the creek, and is separated from the southern boundary of York Town surveyed township by John Dally's 500 acres.

The limestone is visible in flat beds in the stream at the ford, but at this season of the year is not accessible on account of the volume of water in the creek. The adjacent hill to the west needs prospecting for the extension of these beds. There ought to be a considerable quantity of stone available.

Mr. H. J. Colbourn's analysis of the limestone was as follows:—

				Per cent.
Carbonate of lime	...	...	...	66·00
Insoluble matter	..	...	...	29·15
Oxide of iron and alumina	...	...	...	2·20
Moisture	...	...	...	2·43
Magnesia	..	...	...	0·22
				<hr/>
				100·00

This analysis shows the characters of a rock very suitable for the production of natural cement, sometimes called Roman or hydraulic cement. The iron and alumina percentage is perhaps a little on the low side, but natural cement rock has a very wide range of composition. The cement sets under water, it is cheaper than Portland cement, and is burned at a comparatively low temperature, not much higher than in burning common lime and in much the same type of kiln, though the rotary Portland cement kiln is sometimes used. The resulting clinker is crushed and ground, and gypsum has to be used as a retarder, as in the manufacture of Portland cement.

The manufacture is thus a simple matter, the kiln product being crushed in cone-crushers and ground under mill-stones. The raw material is generally far from being uniform in chemical composition, and the product is consequently of varying quality. A certain amount of control is possible in the burning process, but it seems to be practically accepted that the composition of the raw material is the determining factor, and if this cannot be regulated, the product must pass a test before it is marketed.

As Portland cement falls in value from year to year, natural cement finds it increasingly difficult to compete with the superior article.

According to the present assay of the Blue Stone Ford limestone, to bring its grade up to a suitable lime content for Portland cement, it should be mixed with a high grade limestone. The assay, however, is from samples taken from the creek bed, mostly under water, and cannot be relied upon as being representative of the deposit.

The rock might find an important application as a metallurgical flux, being free from metallic impurities.

VI.—CEMENT MATERIALS AND MANUFACTURE.

A pure limestone will, when burned in a kiln, yield the ordinary non-hydraulic lime. To obtain a hydraulic lime, *i.e.*, one which possesses the property of setting under water, a siliceous or otherwise impure limestone must be used. It must be composed of such proportions of silica, alumina and carbonate of lime that an excess remains after burning. This will cause a slow slacking action and a hydraulic lime is produced.

A natural hydraulic cement may be made from impure limestone (impurities—silica, alumina, iron). The kiln product will not slake in the lump form, but when ground fine and mixed with water, will set both in water and air. Such a cement sets rapidly, but does not possess the strength of Portland cement.

Portland cement is a manufactured article made by burning a mixture in which lime, silica, alumina, and oxide of iron are blended in definite proportions so as to form in burning a fused clinker, which will when powdered set under water. The limestone and clayey matter are mixed so that carbonate of lime shall be present in about three times the quantity of the silica, alumina, and iron oxide. If the limestone is too argillaceous, a small proportion of high-calcium limestone may be added to supply the correct ratio. If the proportions vary even only a few per cent., an inferior cement will be produced; consequently, whatever raw materials are used, the composition of all Portland cements remains approximately the same.

A natural limestone perfectly suitable for Portland cement making would carry 75 per cent. carbonate of lime and 20 per cent. of silica, alumina, and iron oxide. This could be burned without adding any clay, and would yield a good cement, but such an ideal rock is never met with. Hence, the necessity for additions. The result is that Portland cement differs from other cements in being a strictly artificial product. A remarkable thing is that it is such a thoroughly re-constructed substance that although composed of the constituents of sedimentary rocks, its mineralogical analogies in nature are with the rocks of the ultra-basic peridotite group.

Eckel gives the following analyses of United States Portland cement mixtures ready for burning:—

		1	2	3	4
SiO ₂	Silica	12·85	12·92	13·52	14·94
Al ₂ O ₃	Alumina	4·92	4·83	6·56	2·66
Fe ₂ O ₃	Iron oxide	1·21	1·77	—	1·10
CaCO ₃	Lime carbonate ...	76·36	75·53	75·13	75·59
MgCO ₃	Magnesium carbonate	2·13	4·34	4·32	4·64

Objectionable elements are magnesium carbonate when exceeds 5 per cent. in the total mix; sulphur when it exceeds one half per cent.; and free silica such as vein quartz or chert.

It will be seen from the above that clay or shale is as indispensable a substance on a Portland cement property as limestone. As a rule, 4 cwt. of limestone and 150 lbs. of clay are used to make one barrel (380 lbs.) of the cement. Attention has to be paid to the nature of the shale or clay. It should not contain less than 55 per cent. SiO_2 , and preferably 60 to 70 per cent.: and its alumina and oxide of iron together should not be more than half the silica content, and preferably only about one-third.

Some of the smallest works are built with a capacity of 500 barrels per day, but it is generally considered that for modern economical manufacture the plant should be capable of producing from 2000 to 3000 barrels per day, and that the raw materials on the property should be sufficient to last for 20 or 25 years in order to justify the erection of works. It may be of interest to sketch the operations connected with the manufacture: they resolve themselves into the following:—

(1) MINING THE RAW MATERIALS.

This should be done by quarrying wherever possible, and underground mining only resorted to when open cut working is impossible. Rock drills are employed, actuated by compressed air, steam, or electricity. Limestone quarries are usually worked in benches, and the material is broken up by blasting and sledging before loading. In clay pits both quarrying and loading are frequently done with the steam shovel. The broken stuff is then transported to the mill by horsepower, steam, self-acting inclines or aerial ropeway.

(2) PRELIMINARY DRYING.

Freshly quarried rock carries hygroscopic water and has to be dried prior to crushing, so as to prevent clogging in the subsequent fine grinding. The driers are usually of the rotary type (iron tubes, brick-lined) and fired with coal. They have a working capacity up to 10 tons per hour, and require about five horsepower each.

(3) FIRST CRUSHING.

The mixture of limestone and clay is first crushed coarsely (2' dia.) in either gyratory (Gates type) or in jaw crushers (Blake type). The former has a continuous action and a

greater capacity ; the latter type is less favoured. For cement works a crusher capable of passing 25 tons per hour requires 20 to 30 horsepower.

(4) INTERMEDIATE GRINDING.

The crushed mixture is next reduced to a 16-mesh size in either a Ball mill or a centrifugal grinder like the Huntingdon or Kent Mill. The Ball mill has a capacity of 5 tons per hour, and requires 30 horsepower ; the Kent mill treats between 5 and 6 tons per hour with 25 horsepower.

(5) FINE GRINDING.

The material is now ground to 100-mesh size, either in a tube pebble mill or a Griffin swinging roll mill. Both of these are efficient for grinding the stuff sufficiently fine for burning. The pebble mill is an iron tube carrying pebbles which fall and pulverise the mixture as the tube rotates. It will treat 10 tons per hour and consumes 70 horsepower, but more power than this is required for starting it. The swinging roll mill grinds upwards of two tons per hour and requires 25 horsepower.

(6) BURNING TO CLINKER.

The mixture is now to be burned in special kilns and at a high temperature (nearly 3000 degrees F.). The product is a partly fused mass, termed "clinker."

In advanced practice the rotary type of kiln is used. This is a steel tube from 60 to 100 feet long, or even longer, by 6 or 7 feet diameter, and lined with fire-brick. It is rotated by gearing and the mixture, fed in one end by a screw conveyor, travels through the cylinder by gravity. The cylinder is inclined about half inch to the foot. The fire is started with wood, and the heat is maintained by blowing in coal dust at the lower end of the tube. A kiln 60 feet long will yield 180 barrels per day. Theoretically each barrel of cement should require only 30 lbs. of coal as kiln fuel, but in practice this quantity is insufficient, and twice or four times the weight is a normal experience.

(7) GRINDING THE CLINKER.

The hot clinker which drops out of the kiln is carried by a conveyor to the heap, and cooled with water sprays. About 2 per cent. of gypsum is added as a retarder, which has the effect of preventing the cement from setting too quickly. It is then reduced in an intermediate grinding mill (a ball or

Kent mill). The final fine-grinding to 100 and 200 mesh size takes place in the tube, Griffin or other mills. The capacities of the mills named range from 10 to 20 barrels per hour.

FUEL REQUIREMENTS.

Firewood must be easily available and coal procurable at cheap transport rates. The East Coast coal will probably be found suitable for kilns, if used fine. The more finely ground the coal, the poorer is the quality which may be used. If coal is used for power purposes as well as for the kilns, about 2 cwt. of coal per barrel of cement must be arranged for. This, with a 500-barrel plant, would amount to about 16,000 tons of coal per annum.

POWER REQUIREMENTS AND COST.

The usual calculation is that $1\frac{1}{2}$ horsepower is required for the production of each barrel of cement. According to this a 500-barrel mill would require 750 horsepower; this is, however, an outside estimate, and probably might be reduced by one-fourth.

The only water available for works at York Town is that contained in York Town Rivulet and Anderson's Creek, the latter some distance away. The capacities of these creeks would need investigating, but it is pretty certain that the motive power for any mill would have to be steam.

Bleining estimates that in America a seven rotary kiln plant, with a capacity of 1200 barrels per day, can be put up for \$300,000 (£60,000).*

Meade's estimate of the cost of a mill with a 2000 barrels a day capacity is from \$600,000 to \$750,000 (£120,000 to £150,000).†

* The Manufacture of Hydraulic Cements, by A. V. Bleining, Geol. Survey, Ohio, 1904, p. 329.

† Portland Cement, by R. K. Meade, p. 161.

VII.—CONCLUSION.

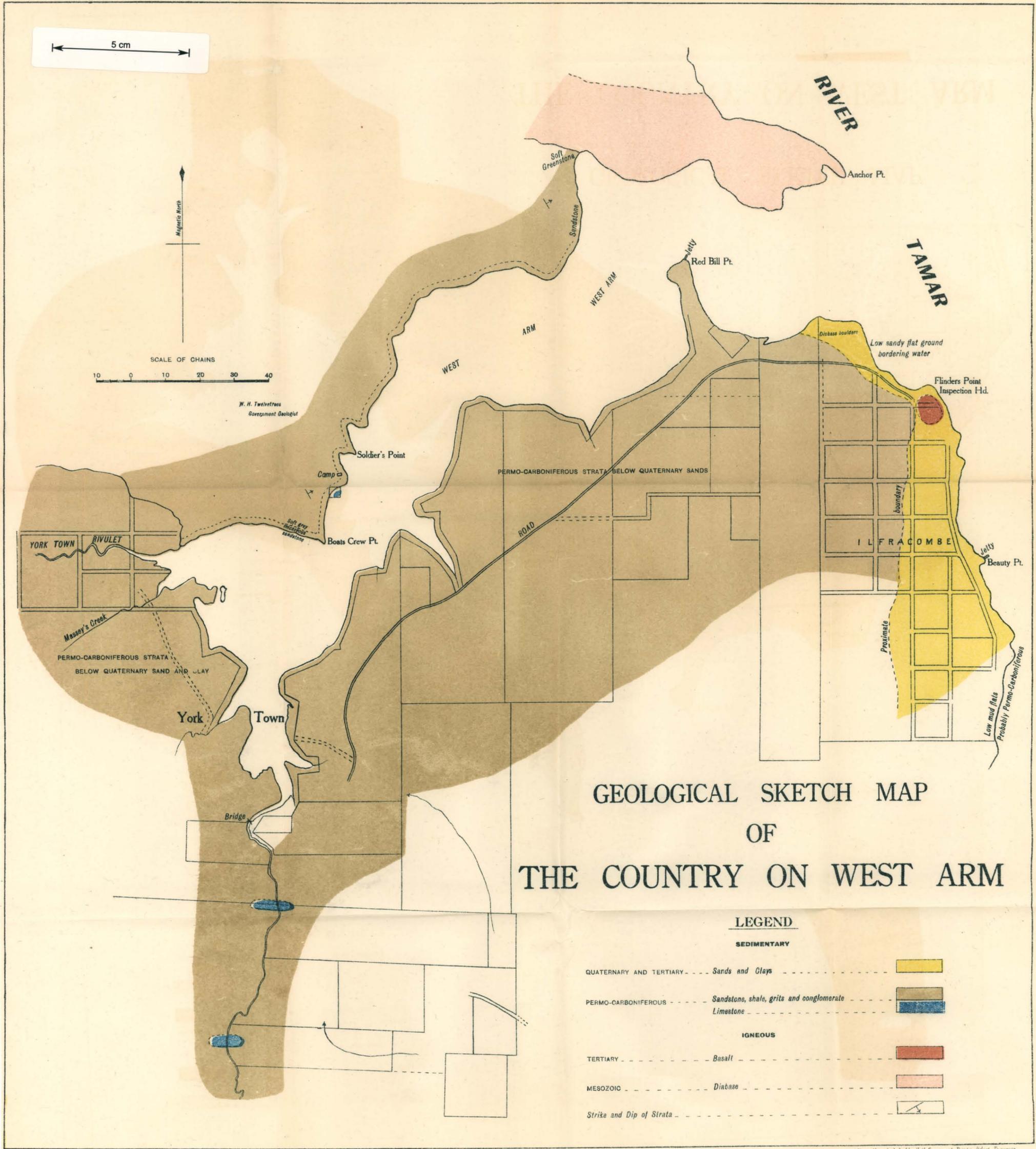
From the preceding remarks it will be gathered that the establishment of a Portland cement works is a question which demands the consideration of several factors. Unless these factors are favourable, there should be hesitation before commitment to the large outlay requisite for success. The suitability of the limestone and shale must first be ascertained by practical tests; the quantity available must be adequate to the capacity of the proposed works for at least 20 years; firewood and coal must be procurable cheaply; water for boilers must be at hand; a machinery site must be in a position for economic handling of the material; and finally there must be a cheap transport to market. It seems certain that the market price of the cement will for some years be downward rather than upward, and that new cement works will succeed only if the abovementioned factors exist in favourable combination. There are numerous localities in the island where deposits of raw material occur more or less suitable for the manufacture of Portland cement, but unless favourable working conditions coincide, intending manufacturers would do well to be cautious before sinking capital in the large works which are necessary for this enterprise.

But seeing that Tasmania is importing its entire consumption of this article, it is highly desirable to investigate the conditions surrounding each property which possesses the necessary material for its production. During the last 10 or 12 years the industry everywhere has undergone a wonderful expansion. The use of Portland cement by engineers and builders has developed a truly marvellous consumption, and this makes its manufacture by any country a question which should receive serious attention.

The limestone hitherto met with in the West Arm country is the argillaceous variety which is usually employed in the manufacture of natural cement. To make it of use for producing Portland cement, it must be mixed with the proper proportion of purer limestone. Prospecting operations are requisite with a view of discovering beds of better grade rock. The nearest visible supplies of pure limestone at present are at Beaconsfield and Winkleigh.

W. H. TWELVETREES,
Government Geologist.

Launceston, 25th August, 1914.



5 cm

Magnetic North

SCALE OF CHAINS
10 0 10 20 30 40

W. H. Twiss
Government Geologist

GEOLOGICAL SKETCH MAP OF THE COUNTRY ON WEST ARM

LEGEND

SEDIMENTARY	
QUATERNARY AND TERTIARY	Sands and Clays
PERMO-CARBONIFEROUS	Sandstone, shale, grits and conglomerate
	Limestone
IGNEOUS	
TERTIARY	Basalt
MESOZOIC	Diabase
Strike and Dip of Strata	